Troubling Design: A Design Program for Designing with Women's Health

MARIE LOUISE JUUL SØNDERGAARD, KTH Royal Institute of Technology

The euphemism “female trouble” (discreetly referring to women’s health experiences) suggests that trouble is linked to women and bodily transitions women can go through. However, trouble is not only a noun; it is also a verb with a strong feminist tradition. In this article, I present *troubling design*; a theoretically grounded and practice-oriented design program for designing with women’s health. *Troubling design* brings to matter how trouble is an implicit condition of designing ethical and responsible technologies for women’s health. By designing with trouble, *troubling design* encourages designers and researchers to develop knowledge embedded in criticality and questioning status quo, in order to expand their perspectives on designing with intimate and tabooed bodily experiences. Grounded in feminist theory and research-through-design, *troubling design* contributes with analytical and generative design knowledge articulated through design examples and three practices: staying with the wrong, curious visiting, and collective imagining.

CCS Concepts: • **Human-centered computing** → **Interaction design**;

Additional Keywords and Phrases: Feminist HCI, women’s health, feminist theory, troubling, research-through-design, design program

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1 INTRODUCTION

“I concluded that trouble is inevitable and the task, how best to make it, what best way to be in it.”

—Judith Butler (1990, p. vii)

“Our task is to make trouble, to stir up potent response to devastating events.”

—Donna Haraway (2016, p. 1)

“Feminist trouble is the trouble with women. When we refuse to be women in the heteropatriarchal sense as beings for men, we become trouble, we get into trouble.”

—Sara Ahmed (2017, p. 255)

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Author’s address: M. L. J. Søndergaard, Department of Media Technology and Interaction Design, KTH Royal Institute of Technology, Lindstedtsvägen 3, Stockholm, Sweden; email: mljso@kth.se.

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Digital technologies and smart materials are intimately shaping women's health experiences. "Femtech" (industry's term for the development of digital technologies for women's health) is estimated to reach a market potential of \$50 billion by 2025 [Frost and Sullivan 2018]. Still, basic reproductive rights are challenged globally by conservative political ideologies, and it has been argued that health care needs a feminist revolution [Block 2019]. In a world historically designed for and by men [Perez 2019], technologies continue to oppress and marginalize crucial bodily experiences of women. Examples include sex technologies leaking private information to the company owners [Hern 2017], voice interfaces entrenching harmful gender biases [UNESCO 2019] and failing to provide appropriate and quality sexual health advice [Rushe 2011; Wilson et al. 2017], and menstrual tracking apps reproducing the stigma that has historically surrounded menstruation in the menstrual hygiene industry [Homewood 2018b]. But technologies also have emancipatory potential supporting, e.g., the legalization of menstrual cups in Taiwan [Bardzell and Bardzell 2018], better breastfeeding practices globally [Balaam et al. 2015], self-discovery, and intimate care in women [Almeida et al. 2016], and easier and safer access to abortion pills [Women on Web 2019]. To better understand the oppressive and potentially emancipatory role of technologies for women's health, we must consciously and carefully engage with how technologies participate in global political issues related to gender equality, women's rights and access to sexual and reproductive health and education. Simultaneously, although many digital technologies for women's health are globally accessible and designed for and with women, we must also understand how technologies impact women differently on a local scale and how they challenge or reinforce the position and social construct of "women" differently across various contexts [Almeida et al. 2018]. The power and privilege of who has access to and control over information, education, and products related to women's health not only varies between genders, but also between races, classes, and national borders. How these intersectional inequalities are felt on women's bodies is deeply interwoven with women's health topics being tabooed and stigmatized in medical, political, and cultural contexts, consequently silencing women's experiences and producing feelings of embarrassment, shame, and disgust. As such, how women's bodies are shaped by technologies, and how designers and researchers seek to better understand this, is necessarily a situated *and* global, personal, *and* political question. A question that by being critically framed and responded to could help shape better and more just futures.

In this article, I contribute with a design program, *troubling design*, that articulates the research and design I have done on intimate technologies for sensitive and tabooed bodily experiences, especially focusing on menstrual and sex technologies. Carrying out research primarily in Denmark and in a Scandinavian context has provided me with an institutional, political, and cultural frame in which I could design and research intimate practices with open-minded, progressive, and feminist values. Women's health, sexual and reproductive rights, and women's bodies have previously been ignored in HCI and design research, perhaps due to cultural taboos or because technology is a field dominated by men [Almeida et al. 2016]. The interaction with intimate parts of the body can nevertheless be important and mundane aspects of women's lived experiences and can indulged with shame and stigma. These topics bring new methodological challenges and potentials for designers and researchers; most importantly expressed through a need to move beyond a problem-solving approach to also address the troubling aspects of intimate and politically charged areas. In carrying out research and design on menstrual and sexual health in a Scandinavian context, I often find it difficult to frame my research as something that deals with problems and solutions. Thinking of it in terms of wicked problems [Buchanan 1992] is not particularly useful either. Because what is the *problem* when you design sex technologies? What is a *solution* to menstruation? Or how do you *solve* the gender issues of voice assistants? These design challenges grapple with identities that should not be *fixed* and with women's health topics in which the body should not be framed as a

problem to be solved. Through a critical and feminist way of thinking and practicing design, I have instead engaged with the complexities, sociocultural attitudes, responsibilities, and the structural oppression involved in designing with these intimate situations and bodies; they cannot really be described as problems but are still troubling in many ways.

With *troubling design*, I contribute to methodological questions of what and how knowledge is produced through design research in women's health, how such knowledge shapes particular bodies and experiences, and how these experiences and designed technologies could indeed be different. I contribute to current strands in Human-Computer Interaction (HCI) and design research [Avle et al. 2017; Light et al. 2017; Lindström and Ståhl 2019; Rosner 2018], that examine our individual and collective approaches to responsible practices and ethical design methods, which can respond to contemporary issues and the role technology plays herein. On the particular topic of women's health, I contribute with a design program [Redström 2017] *troubling design*, in which I argue that the concept of *trouble* and the action of *troubling* provide rich ways for designers and researchers to engage with women's health. *Troubling design* is a design program for designing *with* the trouble of women's health; explicitly grappling with *trouble* as an implicit condition of designing with intimate and tabooed areas, while using the feminist action of *troubling* to design more ethical and responsible technologies for women's health. There are the following three main reasons for why trouble/troubling are fitting allies in women's health: (1) in socio-cultural contexts, the euphemism "female trouble" is used to refer to women's health experiences in a discreet way [Butler 1990; Roberts 2004], and it suggests that trouble is tightly linked to reproductive health and bodily transitions some women go through; (2) in feminist and queer theory, trouble is a feminist action (*troubling*) that disturbs fixed gender categories and norms [Butler 1990; Hall 1996; Filippo 2016], and more recently trouble has been further conceptualized as a feminist position of "staying with the trouble" [Haraway 2016]; (3) in HCI and design research, which are disciplines traditionally dedicated to solve or fix problems, the concept of trouble and the action of *troubling* become ways of reflecting on alternative design approaches that engage with uncertainties and complexities of lived experiences. *Troubling design* aims to de-stigmatize intimate health topics and challenge industrial and individualized problem-solving of bodies, so that women's bodily transitions are not treated as women's problems or indeed as problems to be solved. It proposes a trajectory through which designers and researchers can instead critically analyze and develop their design practice through speculation and activism. *Troubling design* is both a personal and a political project, and one that builds on my own research through design practice and years of literary traditions within gender theory and feminist technoscience. By contributing to recent theories in bringing gender theory [Almeida et al. 2018] and feminist technoscience [Jönsson et al. 2019; Liu et al. 2018] into conversations with design research, I hope this article will trouble the reader; it will stimulate questions and concerns but hopefully also suggest designerly ways forward. Consciously, I do not aim to provide a descriptive framework of *troubling* or universal guidelines for how trouble matters in design of women's health. Leaving the definition of trouble and *troubling* just open enough, I instead ask the reader to retune to their responsibility and agency in bringing meaning into how trouble could matter for them in their practice and context.

2 FROM SOLVING PROBLEMS TO DESIGNING WITH THE TROUBLE

2.1 Feminist Design Approaches to Women's Health

A growing number of works within HCI and interaction design are sharing a commitment to feminist practices within the topic of women's health. Common for these feminist practices is that they bring feminist values and theories into conversation with design research and practice, questioning what it means to design for and with people whose lives are affected, and the role

that technologies play herein. This includes how designers advocate for equality and justice through design [Costanza-Chock 2018; Hope et al. 2019], norm-criticism [Ehrnberger 2017], self-disclosure and reflection on positionality, bias and privilege [Bardzell 2010; Prado de O. Martins 2014; Søndergaard and Hansen 2017a], woman-centered design [Almeida et al. 2018], designing for marginalized and ignored areas of women's health [Balaam et al. 2017; Almeida et al. 2016], and attending to situated knowledges and pluralism [Suchman 2002; Bardzell 2010].

In the feminist HCI methodology, Shaowen Bardzell advocates for feminist interaction design building on qualities of pluralism, participation, self-disclosure, agency, embodiment, and ecology [Bardzell 2010]. She writes "The quality of pluralism refers to design artifacts that resist any single totalizing, or universal point of view" [Bardzell 2010, p. 1305]. Pluralism is closely linked to feminist trouble as it too resists fixed entities and binaries. Feminist HCI has had a great impact on the HCI field and inspired an increased attention to women's health experiences such as breastfeeding [Balaam et al. 2015; Hope et al. 2019], intimate care [Almeida et al. 2016], menstruation [Fox et al. 2018], menopause [Bardzell et al. 2019; Tutia et al. 2019], sexuality [Bardzell and Bardzell 2011], and given rise to attention to gender issues in technology use and design [Strengers et al. 2019; Søndergaard and Hansen 2018]. These topics may bring trouble in the ways that they require designers to research and develop technologies in tabooed and sensitive areas. By voicing and manifesting tabooed aspects of everyday life through designed artefacts and technologies, designers and researchers of women's health stir up the social rules of a taboo by resisting to silence certain behaviors or experiences. By troubling the boundaries of social norms, by voicing and manifesting tabooed areas of women's health, such designers and researchers will inevitably bring trouble, perhaps even bring one in trouble [Balaam and Hansen 2017], something that involves emotion work [Balaam et al. 2019].

Women's health is growing within the HCI and design community, and an increasing number of design projects intend to de-stigmatize women's health experiences through challenging the role technologies should play herein and proposing better possible futures. One example is the design fiction "Menstruation Machine" by Sputniko!, a wearable device that simulates a 5-day menstruation period with cramps and blood, hereby allowing people who do not menstruate to experience physiological changes during menstruation [Bardzell et al. 2015]. Another example is "Ambient Cycle" by Sarah Homewood; a lamp that visualizes a person's menstrual cycle through colored light displayed in the ceiling on a living room [Homewood 2018a]. These two examples are radically different than for example LoonCup, which is branded as the world's first smart menstrual cup; a cup that notifies the wearer when it is about to get full, so that the wearer can empty it before it would start leaking. Although LoonCup represents a traditional problem-solving approach to menstruation, where the problem of leakage gets solved by a monitoring technology, Ambient Cycle and Menstruation Machine respond respectively to the perception of menstruation as something private and its cultural relation to identity and gender. Another example of a women's health technology is "FeedFinder"; a smartphone application that localizes parents' experiences with breastfeeding in the public [Balaam et al. 2015]. This application reconfigures breastfeeding from a merely private action to a public one, leveraging sharing and community functionalities of geo-location technologies to support better experiences of breastfeeding in public. Working more directly with representations of women's bodies, "Labella" and the "eTextile Toolkit" [Almeida et al. 2016, 2019] are designed to facilitate body literacy of women's anatomy to increase empowerment and self-care in women. Lastly, designers are also starting to create objects and garments that more intimately integrate with women's bodies and its materiality. Examples include "Future Flora" that is designed to treat and prevent vaginal infection by harvesting and growing healthy bacteria from vaginal discharge [Tomasello 2016], as well as "Curious Cycles" that encourages people to touch their menstruating body and its bodily fluids [Campo Woytuk et al. 2020]. These examples, among

many others, explore how we can reimagine women's health through digital technology, and they are closely related to the feminist and speculative practices that I present in this article.

2.2 From Problem Solving to "Staying with the Trouble"

When working with intimate, tabooed, and marginalized topics, it is apparent that design is never neutral. Women's health topics are interconnected with politics of the body, thus requiring designers and researchers to take a responsible and ethical stance toward their intention and presumed goal for change. To integrate such reflections into their design and research practice, designers and researchers are required to reconsider and potentially reimagine their design methodologies. When engaging with bodily topics that are highly interwoven with social, cultural, and political understandings in society, designers must ask themselves if solution-oriented processes work? Can complex design issues related to women's health be framed as problems to be solved? Can they be approached through established methodologies rooted in values such as user-friendliness or efficiency, or do we need to trouble these and imagine new approaches? And, when is it appropriate to use technologies to respond to these complex issues? When following underlining threads of women's health into cultural myths, social taboos, patriarchal oppression (all aspects that have shaped medical care of women's bodies [Block 2019]), are our methodologies apt for challenging and responding to these aspects through the design of new technologies? I would argue that the complexity and sensitivity of women's health require us to reimagine which design approaches—beyond resolution-seeking methods—are more appropriate, and that this could be seen as an opportunity to reflect on broader design methodologies. One example of a design contribution questioning the role of design is Light et al.'s urgent call for design for existential crisis [Light et al. 2017], which implies a shift from designing for needs to a search for meaning. As argued by Light et al.: "this priority [of a search for meaning] is best not viewed as a one-time solvable problem: it is a continually updating, idiosyncratic process in interaction with the people around us, our broader ecology of fellow beings and the things we use and are immersed in" [Light et al. 2017, p. 4]. Even if global existential crisis points to "a raft of problems," Light et al. argue that we need to accept flux and prepare for the absence of a sense of direction (ibid). Women's health certainly points to "a raft of problems," yet if we approach these as one-time solvable problems, we risk to ignore the deep complexity of societal and contextual factors that shape women's health experiences. Critical and speculative approaches to design have a tradition of shifting from problem-solving to problem-finding, suggesting that technology design can be "solutionist" [Blythe et al. 2016]; merely coming up with solutions to problems that do not exist, or proposing technological fixes to complex social, cultural, and political challenges [Morozov 2014]. Some examples of Femtech can indeed be argued to be solutionist, such as aforementioned LoonCup [Søndergaard 2018]. Speculative design and design fiction provide an alternative approach that challenges a solutionist world view [Blythe et al. 2016]. Yet it has been argued that critical and speculative approaches to design have been blind to their own privileged position and mostly practiced by white, academic, middle-class designers from Northern Europe and the United States, and that this has impacted what, how, and for who design has been carried out [Prado de O. Martins 2014]. Critical and speculative design aims to question the status quo, but does it accomplish that? In articulating a feminist speculative design agenda, Prado de O. Martins [2014] argues that critical design has failed to acknowledge and address critical issues of social justice related to gender, race or class, in favor of narrow, privileged ideas of what "critical" could mean. Thus, although critical and anti-solutionist practices may offer ways of grappling with complexities of women's health, these approaches must also reflect on issues of gender, marginalization, and oppression as foregrounded by intersectional feminism. Parallel to the practices of critical design and design fiction, a number of other design practices are orienting themselves toward

Fig. 1. Design theory can operate in a design space between the particular (a product) and the universal (a paradigm). Design program is placed in the middle. Figure from [Redström 2017, p. 39, Figure 3.4].

alternative practices of design that reject problem-solving approaches in favor of pluralistic feminist accounts of design. This includes a number of design practices that build on feminist technoscience and Haraway’s “staying with the trouble” [Haraway 2016] in a multispecies perspective, including speculative design [Galloway 2018], participatory design [Lindström and Ståhl 2019], and speculative fabulations [Liu et al. 2018]. Within the field of women’s health there is a potential for thinking-with Haraway’s “staying with the trouble” to inquire how our design methodologies could change from dominant problem-solving approaches to designing with trouble. With this motivation for the troubling design program, I ally with feminist and decolonial critiques of solutionist and critical design practices, and contribute to feminist practices of design [Light et al. 2017; Prado de O. Martins 2014; Rosner 2018] in women’s health. Design research has been missing feminist perspectives [Rosner 2018], and troubling design, in its endeavor to “stay with the trouble” rather than finding quick individual solutions, builds on and contributes to feminist approaches to design practice and knowledge in women’s health.

3 A DESIGN PROGRAM

Troubling design is a design program. As articulated by design researcher Johan Redström, a design program is a way of building a theory in design by proposing what design could also be(come) [Redström 2017]. The design program is a knowledge contribution that is particularly well-suited to articulate how research through design can produce analytical and generative knowledge for other designers and researchers [Binder and Redström 2006; Löwgren et al. 2013; Binder and Brandt 2017; Redström 2017]. Redström even argues that a design program is where “research through design may make its most important contribution to design” [Redström 2017, p. 41]. A design program is characterized by being situated between the particular (what a design is), and the general (what designing is) (Figure 1). Thus, it does not contribute with generalizable knowledge, but knowledge that is inspirational and aligned with feminist knowledge practices. A design program consists of (1) a set of transitional (open and unstable) definitions for what (form), how (practice), and for whom (users) the design program is practiced, (2) a specific worldview including core values, beliefs, and theories, and (3) a set of design experiments that visualize and bring shape to the design program.

Within HCI research, design programs are less well-known as a form of design contribution, compared to, e.g., strong concepts, annotated portfolios, and experiential qualities. It is generally agreed that an interaction design contribution exists somewhere between specific instances (or, ultimate particulars) and more generalizable theories. These kinds of intermediate-level knowledge can be separated into generative design knowledge (knowledge that contributes to the generation of new designs) and evaluative design knowledge (knowledge that contributes to evaluating existing designs). Strong concepts are a form of generative design knowledge, residing between instances and theories, which carry a core idea with the potential to cut across particular use situations and generate new solutions for other design situation [Höök and Löwgren 2012]. Annotated portfolios operate closer to the specific instances; here the role of theory merely is to annotate a

number of design examples instead of replacing them [Gaver 2012]; making annotated portfolios a both generative and evaluative form of knowledge. Lastly, experiential qualities are an evaluative form of design knowledge that characterizes a specific aesthetic quality of an interaction that goes across a number of designs [Löwgren 2007]. What distinguishes design programs from these examples of design contributions is that design programs instead of operating between instances and theories operates between the particular (a design) and the general (designing). A design program is conceptually shaped, and it evolves through practice-based experiments; it is a conversation between a world view and a practice. In this way, a design program both goes further than, e.g., annotated portfolios, strong concepts and experiential qualities, since it spans a worldview and particular designs, but a design program also stays situated and concrete by always being anchored with a particular designer or group of designers, bringing more attention and awareness toward the role that a designer or researcher plays in producing knowledge [Redström 2018]. This spectrum between a design and designing, and the program's specific focus on a researcher's world view, values, and beliefs, is what motivates me to articulate my design contribution as a design program. The specificity of the particular design experiments, which are presented in the following sections, is the core of the design program. Each design experiment is different; they involve different interactions, technologies, material and participants, responding to different yet interconnected topics, and they were developed in different times and spaces. Still these design experiments have been developed in relation to each other, each one challenging the previous world view of the design program, developing the program into a more stable yet nuanced way of seeing and acting in the world. The criteria for this design program's success and validity is first of all judged through looking at the program's intention (what it sets up to do) and following through how the intention is accounted for in the conceptual structure [Redström 2017]. Second, a design program's knowledge contribution can be judged on if it is generative for other designers and researchers; does it have the potential to spread beyond the original program into inspiring new design work and thinking? It is my hope that the design program is so open and evocative that it allows designers and researchers to try out how the definitions and world view of the design program might be adapted into their practices and research.

4 TROUBLING DESIGN: A DESIGN PROGRAM FOR WOMEN'S HEALTH

Troubling design is a design program for designing with the trouble of women's health; explicitly grappling with trouble and troubling as implicit conditions and actions of designing with intimate and tabooed areas. The preposition of designing *with*, rather than designing *for*, acknowledges and emphasizes the entangled, intimate and situated approach of troubling design and its origin in first-person methods where "women's health" is the material that designers design with and become intimately entangled in. Troubling design consists of three core elements. In combinations, these three elements point toward what designing could be within or with inspiration from this design program. The design program Troubling Design consists of the following:

- (1) definitions of what is designed, how is it designed, for whom is it designed, and with what intentions. This includes the concepts of trouble and troubling, and the three practices of staying with the wrong, curious visiting, and collective imagining;
- (2) a specific worldview from which the designer operates, including core beliefs, context, and a set of core theories (from gender theory, feminist technoscience, and critical theory);
- (3) design experiments that characterize what a design might look like within the design program (e.g., PeriodShare, Marcelle, Ingrid, AYA, and U).

Troubling design is theoretically grounded and practice-oriented and has evolved in conversations between the literary tradition of trouble in feminist theory and the design knowledge produced in

Fig. 2. Design examples of troubling design: (a) PeriodShare, (b) Marcelle, (c) Ingrid, (d) AYA, and (e) U.

my research through design practice. Troubling design has developed from and is situated in my design research in a Scandinavian context. Rather than be seen as a universal program that can be replicated or transferred, troubling design proposes intermediate design knowledge that may be inspirational or evocative for other designers and researchers. Its validity and novelty lie in whether the program will prove generative for other design and HCI researchers working in and beyond women's health to further strengthen design discipline and the research field [Cambre and Kulkarni 2019; Campo Woytuk et al. 2019; Fox et al. 2019; Lindström and Ståhl 2019; Rogers et al. 2019; Strengers et al. 2019; Tran O'Leary et al. 2019; Tutia et al. 2019]. In the following, I present the three core elements of the troubling design program.

4.1 Open Definitions of Troubling Design

4.1.1 What is Designed? Within troubling design, digital technologies are designed to respond to intimate and tabooed experiences of women's health. The design experiment in the design program "makes a kind of definition that is close to what a design is" [Redström 2017, p. 105]. The following can stand as examples of what design could look like within this program (Figure 2): PeriodShare [Søndergaard and Hansen 2016], Marcelle [Søndergaard and Schiølin 2017], Ingrid [Søndergaard and Hansen 2017b], AYA, and U [Søndergaard and Hansen 2018].

These examples differ in topic and medium, but they all share the worldview of the program, since they all represent designs that respond to intimate and tabooed experiences. PeriodShare is a menstrual cup that automatically tracks and shares menstruation data online. Marcelle is a wearable sex toy that responds to surrounding WiFi activity. Ingrid is a woman living with electromagnetic hypersensitivity (EHS). AYA is a voice assistant pushing back on sexual harassment. And U is a toilet voice assistant that tracks hormone levels and acts as birth control. These examples were designed to explore how technologies are becoming increasingly intimate, being used on/in intimate places on the human body and in intimate parts of human's everyday life. Designing for intimate areas in this case also means designing for tabooed areas, but each example pushes and challenges what is considered intimate and tabooed in each case. Furthermore, as designs for intimate and tabooed areas, these design examples also engage with trouble and the act of troubling. The examples' prototypes incorporate different technological mediums, including wearables, IoT, and voice assistants, through designing with data-driven wireless technologies and smart materials. The examples can be argued to be "categorized" as critical design, speculative design, design fiction, and design ethnography. This variety of mediums and possible ways of categorizing the

design examples points to that the medium and genre are less important than the particular experiences, interactions, and reflections that the designs enable. Consequently, for a design to be exemplifying troubling design it must be considered to be somehow intimate and engaging with taboos through the feminist action of troubling. Thus, even if the design examples are exemplifying and to the point of almost defining what the design program is about, it is important to see them through the program's worldview, and hereby abstract values and concepts from the particular design examples into a more general idea of what designing could be.

4.1.2 How is it Designed? Three Practices of Troubling Design. The design examples of troubling design were designed through three practices: (1) staying with the wrong, (2) curious visiting, and (3) collective imagining. These practices contribute with three important ways to better understand the relationship between people, society, and technology within the context of women's health; and better understand how design can shape this relationship toward creating "better" futures of women's health. These three practices should not be seen as methods or tools for design, but ways of attuning our design sensibilities toward particular ways of seeing the world, technology, people, and society, and our situated position within it; anchored in feminist theories and values. These three practices allow the designer to develop various forms of knowledge embedded in criticality and questioning the status quo, which will inform, shape, and expand the perspective of their design practice. The practices help the designer to broaden their perspective on the world, so instead of reproducing an already dominant story, the designer will be better prepared for challenging the dominant story and find alternative stories, which are more aligned with the future they want to impact. This is a move from one story, to multiple stories; a move from talking about *the* present, to a multitude of presents. Even if dominant voices and stories affect our understanding of the present to the degree that we talk about *the* present as if there was only one, it is important that we challenge this dominant understanding of the present; otherwise we get fixated to status quo and a present that only the privileged few can participate in. By broadening their perspective on *the* present, designers will be better prepared for projecting future change for the better. The three practices contribute with three interconnected ways of moving from challenging the present to proposing future change. The first practice (staying with the wrong) focuses on critically analyzing and challenging the dominant present. The second practice (curious visiting) focuses on widening perspectives on the present by seeking alternative presents. And the third practice (collective imagining) focuses on imagining different possible futures that can positively impact the present toward the better.

4.1.2.1 Staying with the Wrong. The first practice seeks to develop emancipation from stigma and current norms and values that negatively impact women's health. To accomplish this, the practice explores and exposes the social and moral order and normative ideas of *the* present, in order to suggest critical alternatives to what is perceived by society as wrong. Staying with the wrong embodies the self-reflective practice of troubling design by focusing on a designer's subjectivity, positionality, and willingness to make trouble. It is a continuous process of becoming a feminist designer and it includes actively learning to be present, questioning the given as given, continuously practicing self-reflection on own positionality, and using feminist humor and parody when troubling the norm. The naming of this practice is inspired by feminist Sara Ahmed, who argues "feminism helps you to make sense that something is wrong [...] It is not an easy or straightforward process because we have to stay with the wrongs [...] We have to stay with the feelings that we might wish would go away" [Ahmed 2017, p. 27]. Consequently, this design practice embraces that which is perceived to be wrong in society and gives it a privileged status in order to change the feeling of wrongness. Concrete examples of this practice could be inspired by critical discourse analysis, aesthetic criticism [Bardzell and Bardzell 2018] and critique of market

exemplars [Helms 2019]. In women's health staying with the wrong prompts designers and researchers to keep working with taboo and marginalized topics, especially if these are perceived as wrong or troubling by a research community or political structure that oppress marginalized subjects' positions and experiences [Balaam and Hansen 2017].

4.1.2.2 Curious Visiting. The practice of curious visiting seeks to challenge techno-optimistic and simplistic views of technology toward a more nuanced appreciation of the opportunities and more problematic aspects of technology in the context of women's health. It does so by going beyond current norms and values, to explore the pluralism of technological use cases and realities that exist in ongoing pasts and alternative nows. If design is about exploring the yet-to-come [Löwgren et al. 2013], then troubling design is an act of curiously visiting that which is not present in order to make it present. In designing with women's health, it means bringing attention to and involving lived bodily experiences that are currently not present in design and research on women's health. It encourages the designer and researcher to seek beyond their own worldview by curiously visiting and touching the unknown, actively and carefully listening to multiple voices and stories of pain and pleasure, and by allowing the world to become interesting. This practice challenges the designer's notion of the present by interweaving fact and fiction, and it highlights that this practice is never innocent but involves risks of being touched. It is inspired by Haraway's "curious practice": "Curiosity always leads its practitioners a bit too far off the path, and that way lies stories [...] Visiting might be risky, but it is definitely not boring" [Haraway 2015, p. 6]. Concrete examples of curious visiting could be inspired by home visits [Brereton 2013] or interviews [Bardzell and Bardzell 2011] with marginal users and use cases, or the use of fiction to visit other worlds [Buttrick et al. 2014]. This practice helps design researchers to reflect on how their research practice reproduce or challenge dominant technology paradigms, meanings, and matters. Troubling design is not an autonomous and individual practice, and curious visiting of other people, times, or places demonstrates the ethnographic-inspired practice of troubling design.

4.1.2.3 Collective Imagining. The third and last practice of troubling design, named collective imagining, seeks to develop alternative futures in order to identify what is desirable/undesirable and take those learnings back to the design processes for women's health in the present. The practice accomplishes this by collaboratively exploring and expressing still possible futures, hereby troubling dominant, disembodied and detached visions of the future. Collective imagining highlights how design by proposing future change can respond to and/or with trouble and how we can engage collectively with futures to tell other possible stories within and across social and cultural contexts of women's health, and hereby take action in the present to work toward the futures we want. In opposition to the previous two practices, this practice also focuses on futures, but always with the intention to point back at the present and to be better at responding in the present. Furthermore, it also focuses on the participatory and collective process of troubling, as different worldviews based on, e.g., different cultures or bodily experiences bring different voices into the process of imagining. This practice combines Haraway's use of storytelling, speculative fabulations and science fiction with the design discipline's use of materials and focus on how design artifacts tell stories and take part in stories. In HCI, this is exemplified by for instance design fiction [Fox et al. 2019] and fictional inquiry [Dindler and Iversen 2007]. Within women's health, this practice shows directions for future change and political impact by drawing on imagining's quality of bringing voice and action to individual and collective hopes, dreams, and concerns.

4.1.2.4 How the Three Practices Relate to Pasts, Presents, and Futures. To better understand the complexity of women's health and what opportunities we have to challenge status quo and positively change women's health experiences, we must seek to better understand how

Fig. 3. Sketched diagram of the three practices of troubling design.

present experiences are influenced by interconnected past and future narratives. The three practices of troubling design connect to temporalities of past, present, and future (Figure 3). By focusing on temporalities, we can develop knowledge about the configuration of women's health. In paraphrasing Haraway, we can learn about how women's health is "entwined in myriad unfinished configurations of places, times, matters, meanings" [Haraway 2016, p. 1]. Through better understanding these configurations we can become better capable of reconfiguring them. This is a process of becoming "truly present" [Haraway 2016]. To be truly present requires us to reject universal, one-dimensional and linear narratives of the past, the present, and the future, and instead care for our situated entanglement with different times: ongoing pasts, thick presents, and still possible futures. *Ongoing pasts* refer to the way that pasts still influence our present and future, either in how traditional norms and values come to matter in current societies or how neglected stories from the past still (can) influence us. *Thick presents* are a reference to the anthropological term "thick descriptions" [Geertz 1973] and refer to the plurality of lived experiences of the present, implausible but real nows, that are equally real as one's own situated now. *Still possible futures* are the imagined futures of our future generations; how we think about the future today will both influence the future; and how we live today. Here *still* refers to that it is crucial that we act today, otherwise these futures will not be possible.

In troubling design, past, present, and future interweave with the three practices in the following ways (Figure 3): (1) *staying with the wrong* exposes a dominant present by exploring *thick presents*, (2) *curious visiting* challenges a dominant present and a static already-written past by exploring *alternative nows* and *ongoing pasts*, and (3) *collective imagining* challenges a disembodied narrow future by exploring *still possible futures*.

4.1.3 For Whom is it Designed? The design examples of troubling design are designed for designers and researchers to open reflection and debate about the current design of digital technologies (in academia and industry) for women's health, and how designing could be different.

This means that the designs were not designed with a specific “user” in mind, or the “user” was not necessarily the audience of the design. In many cases, the designs developed through a first-person approach, where I was the designer and user of the design. While in some cases people were involved in the design process, they were not necessarily intended to ever directly use the resulting design. Instead their active involvement in the process brought plural perspectives that were intended to broaden and nuance the design space. In any case, the designs are implicitly designed for those people who are limited and oppressed by stigma and current norms and values of women’s health, since the end goal of the designs is to challenge the current role of technology design for women’s health, in order to provide better possible futures of women’s health. This will potentially bring positive change to the end user in the long term. To reach this end goal, the design examples of troubling design has sought to directly impact designers and researchers (in academia and industry) for women’s health through academic publications, but also to impact societal discourse through public conversations happening in public exhibitions of the designs.

As I now have articulated some of the definitions of the troubling design program—such as what is designed, how is it designed, for whom is it designed and with what intentions—I will now turn toward the program’s worldview: the specific worldview or lens from which the designer operates, including core beliefs, context, and a set of core theories (from gender theory, feminist technoscience, and critical theory) related to trouble.

4.2 A Worldview of Trouble and Troubling Design

Following feminist and queer definitions of trouble and troubling, I argue that as designers and researchers in women’s health, our task is to better understand what best way to *make* trouble; what best way to be *in* trouble; what best way to *design with* trouble. Troubling design works with *trouble* in four ways:

- (1) Designing can be a *troubling* action; through the design of technologies we could trouble fixed gender identities, the social construct of gender, and marginalized people’s position in society.
- (2) The *troubling* action of design might bring the designer/researcher *in trouble*: in suggesting a radical change to dominant beliefs and practices, a designer/researcher can become a problem to people in power and to the structures that maintain oppression.
- (3) *Trouble* can be used to refer to complex challenges and experiences of women’s health. Topics of women’s health are historically and politically embedded with trouble that cannot easily be resolved. Referring to these as *trouble* rather than problems proposes a way to engage with topics of women’s health beyond solution-oriented approaches that treat bodily transitions as problems to be solved.
- (4) *Designing with*, rather than out of, *trouble* refers to an approach to how designers/researchers can engage with and respond to women’s health, hereby navigating between the three previous-mentioned definition of trouble.

4.2.1 Context of this Worldview. I have argued that the design program can contribute with analytical and generative design knowledge beyond the program and my design practice itself. However, it is important to state and reflect on the specific local context in which the program and the experiments have been developed, since this inevitably shapes the program’s worldview. The program and experiments of troubling design is rooted in my experience as a white, cisgender, menstruating woman in a Scandinavian country (mainly Denmark), and this context has shaped what has (so far) gone into the program. The program must therefore also be read through the specifics of my bodily experience and the political and educational structures of a Danish context.

The women's movement in Denmark dates back to the second half of the nineteenth century [Andreassen 2004]. After Danish women were granted right to vote and access the Parliament in 1918, they sought to positively influence and promote access to women's health through women's organizations and political parties. Most notably in 1960s–1970s, Danish laws on sexual and reproductive health were radically changed in response to the women's movement's advocacy for gender equality, sexual liberation, and education. Since the 1960s the Danish academic feminist environment and the women's movement have been closely connected [Andreassen 2004], and highly influenced by Marxist and socialist ideals. Some milestones of legal changes in Denmark include: In 1966, contraceptive pills were introduced. In 1969, visual porn was legalized. In 1971, sexual education was made obligatory in public schools. In 1973, Denmark legalized abortion. In 1976, Denmark passed a law on equal pay for woman and man, and in 1978 a law on equal opportunities. In my research program, I have mainly been focusing on sexual and reproductive health and specifically on the social norms and practices around self-exploration and knowledge production on women's bodies. The 1970s "Rødstrømpebevægelsen" (Redstockings movement) were particularly invested in the exploration and knowledge-creation of intimate health, for example through workshops in self-explorations of the vulva with a speculum, happening in women's houses and women's camps and facilitated by the iconic Danish book "Kvinde kend din krop" (Woman know your body) [Tiderne Skifter 1975]. In 2011 the foundation of this book funded a project "Kussomaten" (a vulva machine); an installation through which people anonymously can take a picture of their vulva by sitting on a chair, after which the picture is shared online. Current Danish fourth-wave feminist and artists, such as Maja Malou Lyse, are finding ways of building on this history through modern practices, e.g., by hosting self-gynecology workshops where the participants can live-stream their cervix. With new technologies, Danish academics are questioning how sexual education are taught in Danish public schools, arguing that education is still not of high enough quality and that young people need to be educated in how digital technologies and society shape how they understand the body, gender, and sexuality [Roien et al. 2018]. Modern sex education, they argue, must be more diverse, inclusive and focus on children's active participation in knowledge creation. The program and experiments that I have developed speak into such a Danish context, by particularly focusing on young people and technology industry. This was manifested by collaborating with a Danish high school and by exhibiting my design as part of Internet Week in Aarhus, Denmark. However, to also challenge my and the program's worldview, two of the experiments, which are included in the program, were carried out outside a Danish context. One experiment was carried out in Umeå, Northern Sweden, in collaboration with a woman living with the unrecognized medical diagnosis EHS. The other experiment was developed in Kyoto, Japan, in collaboration with both design students and artists from Tanpopo-No-Ye (a nonprofit organization for people with learning and physical disabilities).

As a summary, the goal of the program is to respond to women's health, gender equality, and access to sexual and reproductive health education, yet such issues are differently materialized and structured in specific contexts. Thus, the program as it is articulated and reflected in this article must be understood through my specific and partial worldview. It is my hope that I and other designers and researchers can further explore and challenge this worldview through other contexts and bodily experiences, in which socio-material and political agencies shape women's health and gender equality differently.

4.2.2 Theories of the Concept and Practice of Trouble/Troubling. The origins of the concept and practice of trouble/troubling is in the literary tradition of feminist and queer theory and feminist technoscience, and recently, it has been taken up by design and HCI research particularly in the wake of feminist technoscientist Donna Haraway's book "Staying with the Trouble" [Haraway 2016].

4.2.2.1 Trouble in Feminist Theory. The word “trouble” originates from a thirteenth-century French verb meaning “to stir up,” “to make cloudy,” “to disturb” [Haraway 2016]. Trouble has been a close ally in feminist, gender and queer theory, since Judith Butler wrote her influential book “Gender Trouble” [Butler 1996], in which she turns the negative valence of the term “trouble” on its head, and points to that trouble is both a noun/a description (*the* trouble) and a verb/an action (*to* trouble). Butler wittfully introduces the euphemism “female trouble” as “that historical configuration of a nameless female indisposition which thinly veiled the notion that being female is a natural indisposition” [Butler 1996, p. viii]. Referring to the seriousness of the medicalization of women’s bodies, she also states that the term “female trouble” is laughable and “laughter in the face of serious categories is indispensable for feminism” (ibid). In “Gender Trouble,” Butler troubles the significations of the terms “woman” and “female” and how they support gender hierarchy and compulsory heterosexuality. In doing this, she proposes the action of “troubling” as a disruption of repetitions of (gendered) acts; a performative act of reconfiguring gender identities, hereby propelling social and political change. Butler argues that discussions on gender lead “to a certain sense of trouble” and that making trouble will get one *in* trouble. Hereby she points to how trouble also refers to the questioning and resistance of power, and that in trouble both rebellion and its reprimand are caught up in the same term. Consequently, she states that “trouble is inevitable and the task, how best to make it, what best way to be in it” [Butler 2006, p. vii]. Butler argues that parody is a common practice of troubling, because it serves to obscure and trouble the original, the authentic, the real, and “the natural.”

Furthering the concept of trouble, feminist scholar Sara Ahmed argues that “Feminist trouble is the trouble with women. When we refuse to be women in the heteropatriarchal sense as beings for men, we become trouble, we get into trouble” [Ahmed 2017, p. 255]. In her writing on the feminist killjoy, she describes the feminist as a sensationalist figure: “It is as if the point of making her point is to cause trouble.” For example, in pointing to sexism and racism, she argued that “We become a problem when we describe a problem [...] as if these problems are not there until you point them out” [Ahmed 2017]. Like Butler, Ahmed proposes that feminist trouble as an action that aims to challenge women’s position within heterosexual and patriarchal discourses. Both Butler and Ahmed argue that when challenging these societal discourses, women might get into trouble. This means that trouble both points to an action you can perform, and a position that you can get in, or rather; a position you can be put in by external forces (by, e.g., people in power, or society as such).

In “Staying with the Trouble” [Haraway 2016], Haraway contributes to feminist theories of trouble. She argues that we live in troubling times, and that we need to become capable of response:

“Our task is to make trouble, to stir up potent response to devastating events, as well as to settle troubled waters and rebuild quiet places. In urgent times, many of us are tempted to address trouble in terms of making an imagined future safe, of stopping something from happening that looms in the future, of clearing away the present and the past in order to make futures for coming generations. Staying with the trouble does not require such a relationship to times called the future. In fact, staying with the trouble requires learning to be truly present not as a vanishing pivot between awful or Edenic pasts and apocalyptic or salvific futures, but as mortal critters entwined in myriad unfinished configurations of places, times, matters, meanings” [Haraway 2016, p. 1].

In Haraway’s theory, trouble is a concept referring to global challenges, e.g., environmental change, great acceleration in human numbers and the threat of species extinction, arguing that present times can be considered particularly “troubling.” “Staying with the Trouble” proposes

that in order to address the urgency and uncertainty of trouble, we must let go of the binary choice between proposing “technofixes” or believing that “the game is over,” but rather stay with the trouble, make trouble and hereby respond to trouble. For Haraway, one approach to stay with the trouble is to write “speculative fabulations”: written fictive stories that speculate on still possible futures, deeply anchored in situated practices and facts of the present.

4.2.2.2 Trouble in Design and HCI Research. Within the last decade of HCI and design research, trouble and troubling have come to refer to at least two different strands; that which orients itself in line with queer theory and queering [Light 2011; Spiel et al. 2019] and more recently research that is committed to stay with the trouble [Haraway 2016].

Through the concept of Queer HCI, Ann Light has been a proponent for bringing queer theory into the design of new technologies. Light argues that “Queer Theory offers the tactic of troubling as a form of resistance to dominant messages about who we are supposed to be” [Light 2011, p. 436]. She proposes the queer strategy of troubling to explore the dominant workings of digital technologies and create a space that is flexible enough for diversity to flourish: “A bit of troubling in the designing and designs produced ultimately addresses the higher purpose of keeping society in flux too” [Light 2011, p. 437]. More recently, it was proposed that “Queer HCI, in its theory- and queering-based strand, works to analyse and challenge the structures and norms underlying sexism, i.e., the rigid classification of humanity into static forms, through troubling” [Spiel et al. 2019]. Although Queer HCI use troubling to address sexism and gender norms, recent calls in HCI have been made for using troubling more broadly to design against the status quo without necessarily relating this to gender norms or structures underlying sexism [Harmon et al. 2016; Khovanskaya et al. 2018]. In these calls, tactics of troubling are considered “appealing because they aim to intervene more indeterminately and as refusal to dictate what is right—creating space for alternative values to emerge and allowing for processes of becoming” [Khovanskaya et al. 2018]. In contributing to previous definitions of troubling, Light has proposed the concept of “troubling futures,” which brings together anthropology and participatory design in understanding cultures and moving them toward sustainable living [Light 2015]. On troubling as action, she writes: “If we regard ‘troubling’ as a description, we nod to the global uncertainties and societal challenges with which we live. If we view ‘troubling’ as an action, we acknowledge the problematising of the ethics of intervention that has accompanied some participatory design practices” [Light 2015, p. 91]. While these recent contributions of the queer strategy of troubling contribute to design theory, they do not propose specific design approaches or projects that design against sexism or use troubling as an act of disturbing gender norms. Troubling design builds on this related work and contributes with specific examples of how troubling could be practiced in design research related to women's health.

There are several reasons why I conceptualize the proposed design program as “troubling design” and not “queering design.” Although part of the motivation of the program is to locate and highlight the potential of troubling and queering from queer theory (and queer HCI) in the context of women's health, part of the motivation is also to work with the notion of trouble/troubling that feminist technoscience scholars have made without directly referring to queer theory or gender and sexuality. However, within women's health in HCI the relation between queering and troubling is particularly explicit, since women's health is a field that implicitly relates to gender and sexuality by working with sexual and reproductive health and/or the health and wellbeing of people who may be marginalized because of their gender or sexuality. Although queering relates to a queer reading and action toward discourses of heterosexuality and binary gender, troubling, following recent feminist technoscience, more widely relates to a feminist tactic for taking action in a changing world to build more livable futures where human as well as nonhuman can flourish. As

I am advocating for a design program—a program of designing and of taking action to build more just futures—I deliberately term this “troubling,” but the worldview of troubling is theoretically grounded in both queering and feminist technoscience. As such, if some readers might find that the concept of “queering” is more useful or evocative for their design practice in women’s health than that of “troubling,” such linguistic difference could potentially be a way of furthering the design program.

The second strand of trouble/troubling in design and HCI research engages less with queer theory and comes in the wake of Haraway’s recent book [2016]. Haraway’s theories on situated knowledges [Haraway 1988] and the cyborg figure [Haraway 1991] have had enormous impact on the field of interaction design, e.g., on feminist HCI [Bardzell 2010]. “Staying with the Trouble” has been taken up by HCI and design researchers committed to feminist practices with a particular focus on how it may inspire new design methodologies. In Daniela Rosner’s “Critical Fabulations,” she refers to “staying with the trouble” as “a slogan that summons scholars to look beyond resolutions-seeking methods to live with and between contradictions and breakdowns” [Rosner 2018, p. 48]. She follows Haraway’s thread to position “Critical Fabulations” as an activist agenda looking beyond solutions to methods and margins of design that trouble the stories that we tell in technology research. As examples of staying with the trouble, she highlights “Making Core Memory” [Rosner et al. 2018] and the zine made from the “Hacking Culture, Not Devices” project [Fox et al. 2015]. Speculative design has also been argued to be a way of staying with the trouble [Galloway and Caudwell 2018]. Anne Galloway presents cases of how her designs have been “troubling” for the audience, and argues that speculative design can “constitute new kinds of public that are not bound to being citizens but, following Donna Haraway, are still encouraged to ‘stay with the trouble’” [Galloway and Caudwell 2018]. She writes “I consider the methodological value and validity of this work to be its capacity for what Haraway [2016] calls ‘staying with the trouble’—for creating and inhabiting spaces ‘without guarantees or the expectation of harmony with those who are not oneself’” [Galloway 2018, p. 327]. Galloway and Rosner also point to “staying with the trouble” as a process of troubling oneself, hereby nodding to its tradition in queer theory. In memorizing her childhood spent entering fictional worlds through fantasy books and dressing-up, Galloway describes “Putting on special clothing was an integral part of troubling my sense of self and entering these worlds, and costumes still signify a transition to new ways or states of being” [Galloway 2018, p. 320]. This idea of troubling one’s sense of self in a process that is more characterized by asking questions than finding answers, is also prevailing in Rosner’s story of transitioning between design paradigms: “By following emergent questions and tensions—‘staying with the trouble’, after Donna Haraway—I began to challenge my theoretical tool kit, contesting the idea of the user as a stable frame or the idea of the designer as a universal subject” [Rosner 2018, p. 258]. Galloway and Rosner’s stories are characteristic of feminist technoscience, as explained by feminist scholar Barad: “This is not about solving paradoxes or synthesizing different points of view from the outside, as it were, but rather about the material intra-implication of putting “one-self” at risk, troubling “oneself,” one’s ideas, one’s dreams, all the different ways of touching and being in touch, and sensing the differences and entanglements from within” [Barad 2012, p. 77].

Whereas the above-mentioned research uses *troubling* to refer to changing design paradigms and the role of the design researcher, other related work draws on Haraway’s “Staying with the Trouble” to care for and design with living and more-than-human materials, hereby fostering multispecies kinship in order to respond to environmental crisis and existential threats. Through an ethnographic study mixed with design methods, Kristin N. Dew and Rosner have explored what it might mean to design with living (wood) materials [Dew and Rosner 2018]. Through this, they open conversations on making within limits of resources and local material production [Dew et al. 2018]. Jen Liu et al.’s work on human–fungi relationships connects more explicitly with Haraway’s

proposal of staying with the trouble. They introduce the concept of “collaborative survival” in technology design to prompt humans to “become compassionately concerned with the wellbeing of nonhuman species,” hereby responding to destructive processes we might prefer to ignore [Liu et al. 2018]. Also work by design researchers Kristina Lindström and Åsa Ståhl has engaged deeply with what it might mean to stay with the trouble of environmental changes [Jönsson et al. 2019; Lindström and Ståhl 2019]. Similar to Liu et al., they engage with Haraway’s methodology of “speculative fabulations” as a method of engaging times and spaces in telling stories about better futures.

Haraway’s “staying with the trouble” has thus already impacted sustainable interaction design practices within HCI, and rightfully so, since her proposal primarily concerns multispecies kinship and environmental crises. However, with my proposal of troubling design, I propose that “staying with the trouble” also can impact design of women’s health. With this, I contribute to current strands in HCI research that are “staying with the trouble,” while positioning my work in line with Queer HCI and feminist design approaches to women’s health; hereby acknowledging the literary tradition of troubling in queer and feminist theory.

4.3 Design Experiments in Troubling Design

I will now introduce four design experiments (PeriodShare, Marcelle, Ingrid, and U) that characterize what a design might look like within the design program troubling design. These experiments follow a research through design methodology. In the following, I describe each experiment, reflect on how they individually respond to particular intimate, tabooed, and troubled areas of women’s health, and analyze how each project manifests a particular practice of troubling design. I will mainly focus on the intention of the projects and analyze how this intention unfolded in the process. For a more detailed description of the design process, including the design methods, and so on. I encourage the reader to read each project’s accompanying publications.

4.3.1 PeriodShare: A Menstrual Cup that Automatically Tracks and Shares Menstruation Data Online. The design project PeriodShare (Figure 4) addresses the intimate and tabooed area of menstruation and brings shape to the practice of staying with the wrong. In PeriodShare, I stayed with the societal perception of menstruation as wrong, in order to tell the story that menstruation is not wrong [Søndergaard and Hansen 2016]. I explored how self-tracking technologies shape the experience and meaning of menstruation and the subjectivation of living in a menstruating body. The speculative design PeriodShare is an internet-connected menstrual cup that tracks menstruation data and automatically shares it on social media. I designed it through a process characterized by critique and speculation. The process included analyzing and critiquing dominant examples of menstruation technologies, a world-building activity of imagining a different near-future through creating fictional prototypes, the development of a Kickstarter campaign and a functional prototype, and lastly, a performative intervention and exhibition at a public technology fair in Denmark.

In the project, I worked with how menstruation is troubling on three levels. First, the conceptual idea of sharing menstrual data became a way of making feminist trouble. Menstrual data is something that could be perceived to be too private to share in public. Due to its taboo status, it should rather be “hidden” inside a smartphone. This is the impression that one would be left with when critically analyzing the menstrual tracking apps in 2015: the apps did not allow one to share menstrual data and many app icons camouflaged that this was indeed a menstrual tracking app, or the icons were shaped as locks. I stayed with this trouble by designing a menstrual cup that would automatically share the menstrual data, thus countering the normalized use of menstrual apps that most often conceal the data, and hereby bringing forth the emotions and conflicts related to the social role of menstruation. Menstruation is a messy practice, and this messiness should be

Fig. 4. PeriodShare is a menstrual cup that shares menstruation data.

a central element of technology designed for menstruation. Second, menstruation has historically been used by artists as a trope and material to trouble gender norms and inequality in society. By exhibiting PeriodShare at a male-dominated technology fair in Denmark, I troubled the norms and inequality of gender in technology industry and research as it was present at the fair. This intervention became a way of responding to gender issues from my own positionality as a woman, interaction designer and researcher. Third, current menstrual technologies are troubling in the way that they are embedded with politicized world views. An example is how menstrual apps are often gendered and perform gender stereotypes of women, thus excluding nonbinary people [Spiel et al. 2019] and norm-critical feminine representations. In PeriodShare, I performed a parody of this by re-appropriating a pink color scheme and using “girlyness” to counter stereotypical representations of women, however since I did not include transmen and nonbinary people’s experiences of monthly bleedings in the design, I did not succeed in challenging all aspects of how menstrual trackers are gendered.

Through staying with the wrong of menstruation and exhibiting this in a public context, I opened up for a space where the local audience in Aarhus, Denmark could discuss the otherwise tabooed topic of menstruation and imagine how a product like PeriodShare could matter in their lives. PeriodShare generated heterogeneous conversations with the audience about the trouble of menstruation; trouble related to data privacy, gender norms, taboos, and biases within self-tracking practices and society in general. For example, I had educational conversations with adolescent girls and boys about the biological functions of menstruation; about the number of times I had menstruated and whether it was painful. A woman curiously questioned “If menstrual data is like running data, how would you compete in menstruation?” And a man said “this would be great, so I would know when to bring chocolate for my wife!” Although some people experienced it as a feminist activist tool or an educational or medical solution, other people thought of it as provoking and silly. Working with menstruation also became a way of troubling gendered technologies, by questioning which bodies and bodily experiences go into designing technologies. The technology fair was highly dominated by men as the majority of visitors, speakers, and exhibitors

were men. A menstrual technology troubled the expectations of many visitors, and indeed some questioned “did you really make that?” referring to the electronical engineering involved in the prototype. PeriodShare was a specific intervention into a specific gendered context, but issues related to gender are not easily resolved as they are tied to histories and traditions in society. My responsibility as design researcher was not to resolve this, but to carefully respond to it. As a feminist intervention, PeriodShare contributed with a small story that potentially can trouble the larger histories that we tell in technology industry. Hereby, PeriodShare exemplifies a way of designing with, rather than for, women's health in the specific topic of menstrual health. Designing *with*, in this case, means not keeping a distance to the topic and material that is designed *for*, and not aiming to design a solution *for* it. Designing *with* women's health proposes a conceptual and concrete move from designing *around* an experience or *for* an experience, to designing *with* the experience: Situating yourself in the experience, intimately coming close to it and being-with it, in order to explore the materiality of the experience—all the interesting and curious ways that the experience takes shape and come into being—and use that materiality of the experience as an active participant in the designerly process of bringing matter into being and suggesting possible change. In PeriodShare, I designed with the sociodigital material of menstruation. My goal was not to design for menstruation, but rather to use the sociodigital material of menstruation itself, such as menstrual data and people's attitudes to menstruation, as materials to design with.

4.3.1.1 Practicing Staying with the Wrong. Given that staying with the wrong requires us to revisit our present and explore conflicting values within the social and moral order of women's bodies and health practices, it is important to attend to that this practice is also a subjective practice; it is practiced from a particular body. In my case of staying with the wrong of menstruation, I practiced from a Danish white, cisgender, menstruating woman. This positionality is important as it also frames the worldview of the design practice and research; in my worldview sharing menstruation was something desirable that challenges the discourse around menstruation as shameful and impure. However, the worldview of menstruation as desirable might differ from other women's worldview, where menstruating could be seen as undesirable and a cause of pain, e.g., for transmen, or for people wanting to get pregnant, or for those that are not currently menstruating due to menopause or endometriosis treatment based on continuous intake of contraceptives. Disclosing and reflecting on positionality is crucial, since it highlights what is at stake when taking on the practice of staying with the wrong; a practice that in challenging the social and moral order is risky and not innocent. Apart from being not innocent, it is also not an easy or straightforward process; those who go against the flow are in the danger of being wronged by staying with the wrong [Ahmed 2016]. However, the practice of staying with the wrong can also be empowering, since by perceiving that, e.g., menstruation as wrong is wrong, you understand that you are not wrong, and this may lead to a redistribution of power between those that are perceived as right and wrong. By exploring thick presents through design objects and interventions, we can trouble what is judged as wrong in the dominant social order and potentially create space for different values and identities.

4.3.2 Marcelle: A Wearable Sex Toy That Responds to Surrounding WiFi Activity. The design project Marcelle (Figure 5) addresses intimacy and taboos related to women's sexuality and brings shape to the practice of curious visiting. In this design project, I curiously visited (at least in my mind) the fictional protagonist Marcelle, who is living in the pornographic novella “Story of the Eye,” written in 1928 by surrealist Georges Bataille [Bataille 1928]. “Story of the Eye” explores sexuality in and through literature, and the character Marcelle depicts one way of performing sexuality. Marcelle is a depressed teenage girl, who commits suicide due to her shame of sexuality and sexual desires. My vision was to design a sex technology for Marcelle, as a tribute to her

Fig. 5. Marcelle is a wearable sex toy that responds to WiFi activity.

character, in order to make her painful story present today and suggest a critical alternative to current sex toys. The project explores how sex technologies shape women's sexuality, the ongoing pasts of women's sexuality as shameful and passive, and how technology development is influenced by human sexual desires. The resulting design, which I named Marcelle (Figure 5), is a wearable sex toy that reacts on the activity of the surrounding WiFi network [Søndergaard and Schiølin 2017]. The more open WiFi networks in the immediate surrounding, the more the vibrators vibrate. Marcelle was developed through critical analysis of present commercial sex technologies, design methods of storytelling and world-building, the development and testing of a functional prototype, and lastly, an exhibition at a public technology fair in Aarhus, Denmark.

Marcelle is a tribute to women's sexuality, and it explores the eroticism of ambiguous and unpredictable stimulations. The design explores and makes use of the missing control that random and invisible WiFi-networks provide, to enable an erotic interaction between a woman and nonhuman actors (in opposition to a partner). Simultaneously, Marcelle acknowledges the trouble involved in the performance of sexuality. As the vibrators are more active in a public context with more open WiFi networks, the project challenges women's sexuality as either seen from the male gaze or hidden and tabooed, by bringing it into the public sphere. As the vibrators are activated by WiFi networks in opposition to a partner, it discusses women as sexual beings with sexual autonomy and agency. This implicit interaction with unknown, autonomous WiFi networks also explores another troubling aspect of sexuality, relating to power relations, control, and consent. This aspect unfolded when I tested the prototype. As I tried them on and walked around, I later found out that people around me, who knew how the prototype interacted with WiFi infrastructure, had intervened the WiFi networks by creating local hotspots, thus indirectly stimulating me without my consent. The design aimed at exploring the feelings of giving control over erotic stimuli to WiFi networks, but it did not intend to explore feelings of losing control over one's body to human agents and a power structure, where women's bodies are objects for men's use and pleasure. The people, who added local hotspots, could only partially intervene in the random and ambiguous interactions with my vibrators; thus, they did not have full control. However, they intervened consciously and they intentionally executed control over my body, thus pointing back to the power relations between women's sexuality and men's dominance that the design projects intentionally tried to trouble and avoid falling into. In this way, the experience turned from troubling gender norms, to being caught in trouble. My rebellious act of making (gender) trouble, eventually got me in trouble. By designing with this trouble, I troubled the perceived innocence of IoT and WiFi and manifested their harmful effects. IoT and WiFi execute power and control over users, and vulnerable subjects might get exploited in the process of implementing internet-connected devices, such as sex toys, in intimate spaces. The project does not aim to resolve this, but rather it problematizes

Fig. 6. (a) To better care for her health, Ingrid hides her WiFi router in the closet, (b) Ingrid pointing to her computer being her favorite digital technology, (c) Ingrid's cultural probes.

this relationship, suggesting that although technologies intervene and enable interaction, the trouble also exists within social norms and behavior, institutional frameworks and social constructs of women's bodies as sexualized objects. Technologies are part of this narrative, and in order to trouble this narrative, we must consider the wider social, political, and legal structures that enable certain interactions to happen, while hindering others.

4.3.3 Ingrid: A Woman Living with Electromagnetic Hypersensitivity. The design project Ingrid (Figure 6) addresses the intimate bodily experience of electromagnetic fields, such as WiFi, and the taboo of the diagnosis EHS. It exemplifies and demonstrates the importance of the practice of curious visiting. The project Ingrid is named after a woman (though the name is a pseudonym), who is living with EHS in Umeå, Northern Sweden [Søndergaard and Hansen 2017b]. EHS is the heightened sensitivity of electromagnetic fields in WiFi, microwaves, and LED's, which leads to bodily discomfort and pain such as headache, fatigue, and skin itches. Although the experiences are medically acknowledged, EHS is a medically unrecognized diagnosis. However, in Sweden EHS patients can receive economical support to adapt their home to their condition. I stayed in Ingrid's house for 3 months and found her stories of feeling pain from WiFi to be deeply troubling for

dominant understandings of technology and my own research into wireless connected technologies. The project evolved as I started documenting her life through ethnographic studies, cultural probes, and interviews, which evolved into a small collection of edited photos and videos. The design project does not propose any new technologies. Instead it tells a story of Ingrid's ways of living a modern technological life while suffering from the EHS diagnosis, through photos and videos. This includes how she constantly and consciously negotiates her technology use and routes in a city covered by networks through her embodied, painful experiences of WiFi.

As a design researcher designing internet-connected objects, such as PeriodShare and Marcelle, that contribute to Ingrid's diagnosis and daily pain, the project unfolds the unpredictable ways that technologies influence people's everyday lives and how designers and researchers' implicit assumptions marginalize people like her. Ingrid's diagnosis is deeply intertwined with her social life. The design projects showed that EHS influences how she navigates the city, as there are only four places in the city that she feels at ease. It influences when and where she meets with friends, how she takes care of her children and grandchildren, how she perceives her own identity, and how she furnishes and designs her home. For example, Ingrid has designed a tangible extended system for her WiFi router; the router is placed in the back of a closet (Figure 6), so she has created an extended button and visual clue to signal between her and her husband if they have turned the WiFi on or off. This helps with daily communication and bodily comfort in the home. Looking from a problem-solving perspective on Ingrid's situation, it might be possible to suggest further solutions that would make her life easier or better. But my intention was not to design simplified solutions, since after having lived with her for 3 months, I experienced the complexity of her everyday life and how her habits have evolved through years of lived experiences of EHS. Her situation is not a technical problem, but an experience and diagnosis to be responded to. By using storytelling to position her voice and perspective in the field of interaction design, I trouble the implicit assumptions of IoT and WiFi as unharmful and always good. Ingrid's life may appear to be an alternative now, but this alternative is a very particular present reality that is equally true to all other present realities. By staying with her trouble, we as interaction design researchers can cultivate our response-ability: our ability to respond differently with more inclusive technological infrastructures, but also our ability to let other people's responses affect us.

4.3.3.1 Practicing Curious Visiting. In Marcelle and Ingrid, I explored two contrasting ways of experiencing the same technology. More precisely, I explored the bodily trouble of being connected to WiFi and how different bodies experience WiFi differently. The two projects each represent an alternative way of living with WiFi. Although fictional protagonist Marcelle is finding pleasure in being connected to WiFi, the real-life protagonist Ingrid is feeling pain when she is in close contact with WiFi.

By exposing the power relations built into WiFi infrastructure and telling stories from the margins about those who are also users of WiFi, Marcelle and Ingrid are both troubling dominant, universal ideas of technology use and ideas of the user as a stable frame. Together, the projects contribute to a more contradicting, but also more complete picture of current bodily and affective experiences of being connected to WiFi. For example, even if Ingrid feels bodily pain from WiFi, she still turns on the WiFi when her grandchildren are home so they can be online, thus sacrificing her bodily comfort for their needs. Similarly, even if Marcelle is enabled to feel pleasure from WiFi activity, this pleasure can quickly turn into pain, as the example of my test revealed. Neither Marcelle nor Ingrid resolve their troublesome situations that have multiple responsible actors. Rather, by proposing present alternative realities, they ask us to revisit our assumptions of the present. Even if Marcelle and Ingrid resemble extreme ways of experiencing and living with WiFi, they are also examples of how we all interact with WiFi in our mundane everyday lives, and how

Fig. 7. U is a toilet assistant that tracks hormone levels through urine samples.

it influences our bodily movements and experiences. We find pleasure in WiFi, when we arrive at a conference venue and finally get connected after being offline all morning. We find pain in WiFi, when we receive too many notifications or when it breaks down. We negotiate our Internet use by constraining children's "screen-time" or having dedicated time to answering email. These are mundane examples of the trouble involved in the simple yet ubiquitous technology of WiFi, but by curiously visiting the worlds of Marcelle and Ingrid, we now see that this technology is not universally experienced, but brings different experiences to each body; experiences that are deeply embodied and potentially harmful.

Although the protagonist Marcelle lives in a fiction, the woman with EHS Ingrid lives in reality. However, as Ingrid's experience is marginalized and by medical science considered unreal, fake, or made-up, her experiences are also often interpreted as fiction; in popular media, medical science, and also in research communities in which I have disseminated her story. But what is counted as fact or fiction is also a temporal question. As Ingrid expresses it: "Today I'm considered a bit unusual, that I'm so sensitive to this, but maybe it's different in 50 years. I'm just a bit ahead" (Ingrid). These examples of curiously visiting point to the importance of visiting ongoing pasts and alternative nows in order to challenge techno-optimistic and simplistic view of technology toward a more nuanced appreciation of a pluralism of technological use cases. Curious visiting brings forth the blurred relation of fact and fiction and the unfinished relation between past, present, and future. It points to how design researchers can only learn to design with the trouble by understanding how different realities, times, fact, and fiction are deeply entwined.

4.3.4 U: A Toilet Assistant That Tracks Hormone Levels and Acts as Birth Control. The final design project that I want to highlight is U. This design project is addressing intimacy of using voice assistants and the taboo of toilet practices, including menstruation. U is also manifesting the third practice of troubling design: collective imagining. In the design process of U (Figure 7), participants and I collectively imagined a still possible futures where voice assistants push back on gender stereotypes, thus troubling dominant gendered visions of voice assistants [Søndergaard

and Hansen 2018]. We explored how a voice assistant would help with intimate and personal issues, the trouble of algorithmic bias, and how future visions are also culturally situated. The design fiction, *U*, tells a story about a woman who uses a toilet assistant to track her hormone levels, and her trouble with using this assistant as a trust-worthy contraceptive method. *U* is one of the outcomes of *Intimate Futures*: a 1-year participatory and speculative design process, in which I invited Danish high school students, Japanese design students and Japanese artists with physical disabilities to collectively imagine futures for voice assistants. The process included interviews, experience prototyping, a number of co-creation workshops, design fiction methods, such as storytelling and the creation of protagonists and future scenarios, developing a script for a voice interaction and testing different voice actors, and lastly recording and editing two short films, which were distributed online and exhibited at a film festival.

The design fiction short film *U* is troubling how gender is represented and reproduced in voice assistants through their names, voices, personalities, and functions.¹ It does so by proposing a voice assistant in the intimate areas of the bathroom and women's health, but without falling into the stereotypes of either a medical (often male) doctor or a caring mother. The relation between gender and voice assistants embodies a deeply complex issue, since as conversational agents are often designed to be human-like, gender seems impossible to ignore. From human language, to bodily movement and how people define themselves, so much is defined in relation to gender, and when computers are designed to imitate and understand human language, there is a risk that gender stereotypes are reproduced unconsciously or without reflecting on the deeper consequences and implications [UNESCO 2019]. *U* takes this concern seriously by carefully troubling gender bias and assumptions and exploring how particular socio-technical situations manifest this. Furthermore, *U* creates a parody that troubles implicit assumptions in relation to reproductive health and errors in prediction algorithms. In the design fiction short film of *U*, the toilet assistant is problematic as it assumes heteronormativity, that is, the woman protagonist wants to get pregnant and has a male partner. Following this, the protagonist becomes pregnant even if the assistant had promised her that she could not get pregnant when using it. As algorithmic contraceptive methods become integrated into a (future) everyday life of algorithmic biases, irregular periods, governmental health surveillance, and so on, then designers must also understand the kinds of mistakes that may arise and how they can respond to them. This manifests the trouble of using voice assistants, in trusting them and giving them agency to manage important aspects of our everyday life and health. In responding to gendered voice assistants, *U* proposes that this is not only a technical problem, but also an issue that is deeply connected to social, cultural and political factors in society, and one where the burden of contraceptive use should not be put on the individual. To better care for these socio-material-political factors, the design process requires a wider sociocultural perspective in order to understand which futures are desirable/undesirable. The practice of collective imagining proposes that designers use future potential implications to reflect on how we can change the design of technologies today to better respond to the futures we want.

4.3.4.1 Practicing Collective Imagining. The aim of *U* was to cultivate design researchers' responsibility in how they design voice assistants. This was done through collectively imagining of a future of an assistant for women's health inspired by different cross-cultural contexts. The design outcome is a manifestation of a design concept that came up in one of my co-creation workshops in Japan. How I chose to develop the concept expresses not only where it was developed but also how I and my positionality as a Danish design researcher carrying out a design project in Japan have influenced this. Although a Danish context brought one possible

¹Watch the short film on: <https://vimeo.com/258780690>.

imagining of a future, which was highly critical toward automation, the research practice in Japan brought a radically different imagining, where gender stereotypes were performed differently and the collective imagining of automation related more to trust and co-existence. By collectively imagining within two different cultures, the project troubled universal and disembodied visions, and situated the practice within the hopes, concerns and values as expressed by the participating young Danish and Japanese people. This points to the opportunities of collective imagining as a collaborative process that is situated yet worldly, critical yet speculative.

5 WHO AND WHAT IS TROUBLED?

Troubling design is a proposal for how designing could (also) be done within women's health, focusing particularly on what the designer's role is in designing for intimate and tabooed areas and engaging with politics of the body, gender, and sexuality. The troubling practices of staying with the wrong, curious visiting, and collective imagining suggest different ways of designing, which are concretized through the particular design experiments PeriodShare, Marcelle, Ingrid, and U. These examples and practices are part of the wider design program of troubling design, and their purpose is to explore, challenge and manifest what troubling design might be, how troubling design is practiced, and what it might add to the ways we are currently designing with women's health. The crucial definition that provides the conceptual structure to this design program is the notion of trouble and the action of troubling. In the following personal reflection and synthesis, I offer more depth to the concept of troubling by discussing *what* exactly is troubled in the previous examples, *who* is troubled, and *who* this troubling is for.

5.1 What is Troubled?

The design experiments trouble dominant ideologies of women's health by contributing with different bodily expressions, gestures and interactions that challenge the habitual repetitive performance of "women" that technologies shape. They seek to create new performances of women's health outside the restricting frames of what "women" might be by refusing to be "women" in the heteropatriarchal sense as beings for men. As acts of social performances, the design experiments either refuse to repeat the normalized repetition of gendered performances, or they perform a parodic repetition of gendered stereotypes.

In the design experiment PeriodShare, the norm of menstrual blood as dirty, private and tabooed is troubled by sharing menstrual data in a public context on social media. The performance of sharing menstrual data, troubles the inner and outer boundaries of one's body, and the disciplined power put on women and people who menstruates' bodies by patriarchy to hide or ignore their menstruating bodies and internalize the stigma surrounding menstruation within their bodies. Marcelle troubles masculine domination and heterosexual norms of women's sexuality, by proposing an autonomous sexuality where pleasure is performed in co-existence with WiFi networks. Ingrid troubles dominant ideas of who the users of internet-enabled devices are, and medical scientific definitions of what "healthy" technology use is. Lastly, U troubles how voice assistants' voices and functions are gendered, and how women (may) use artificial intelligent systems in reproductive and sexual health practices.

These technologies do not aim to resolve the conflicts of past, current or future gendered performances, nor do they aim to find solutions to how technologies could contribute to the performance of gender differently. Rather, the design experiments grapple with the moral complexities involved in responding to contemporary existential challenges, in particular to challenges that relate to designing for women's health, such as gender equality, body knowledge, and sexual and reproductive rights. They neither aim to fix problems nor to fix identities. Rather they aim to keep responses and identities open for continuous change, in order to flourish in a world of uncertainty and

complexity. In this world, technological proposals for change co-exist with their consequences; the problematic co-exists with solutions. Trouble, hereby, is both a human and societal condition that a designer designs with and within, it is a state that needs response and it is something that needs to be created, though never blindly without caring for responsibilities and possible consequences.

5.2 Who is Troubled and Who is this Troubling for?

Troubling design questions the universality of “good” design by attending to the political, moral and ethical practices and implications involved in design, thus also attending to the bad and the ugly sides of technological solutions [Sambasivan 2019]. In doing so, it is important to understand the different actors involved in a design and the practice of designing. When practicing troubling design, who is troubled and who is this troubling for?

My design experiments were situated in the intersection of design, art and technology industry. My intention was to design technologies for women’s health that through a critical and speculative approach challenge designers and researchers of digital technologies (in academia and industry alike) with the aim of bringing positive change to how technologies participate in the performance of gender and societal norms. So, in practicing troubling design, my aim was to trouble how designers, researchers, and industry understand and practice the design of technologies for women’s health and how gender matters in this process. This process of troubling focuses on enabling reflection and positive change in how technologies are designed, with the aim of creating more responsible and ethical design in women’s health that redistributes power from technologies and technology companies’ control over women’s bodies to women themselves, enabling performative possibilities of gender and autonomous intimate body practices. However, if we briefly look into two of the design experiments, we see that this argument gets complicated, and that more actors play into the questions of who is troubled and who this troubling is for. This includes how I in my own role as designer and researcher got troubled, and how the audience, such as visitors of exhibitions, also got troubled.

In PeriodShare, I chose to perform a parodic act of a start-up owner, in order to trouble menstrual norms in technology industry and designers of menstrual technologies. This was done by performing a parody in the Kickstarter platform and at a technology fair. The purpose of this was to obscure and exploit how gendered norms in a male-dominated technology industry reinforce the social construct of the menstrual taboo. Parody thus both troubled the authenticity of technology industry and proposed a different direction forwards, situated directly within the dominant structure. However, in the performance, not only technology industry such as investors and technology designers got troubled but also public visitors at the technology fair got troubled. In talking with nurses, activists, teachers, and adolescent girls and boys, I found that the perception of PeriodShare varied from those that thought of it as provoking, silly or disgusting, to those that saw it as an activist and feminist tool, or as an educational tool to cultivate curiosity and knowledge about menstruation. Some of those who got troubled were eventually also those that I imagined this troubling was “good” for. Another example, Marcelle shows how the practice of troubling is composed of both its rebellion and reprimand. In this design, I aimed to trouble designers of sex technologies and people with the privilege to (historically) execute power or domination over women’s sexuality. With the design and performance of Marcelle, I aimed to trouble these people in order to create better futures for women’s sexuality. However, when I tested Marcelle on my own body, the same type of people that I aimed to trouble, executed their domination over my body as they stimulated the sex technology without my consent. Consequently, they both manifested their power and the objectification of women’s bodies, and the flaws or possible unintended consequence of my design. In this case, troubling did not immediately lead to a better outcome,

but rather pointed to the moral complexities of designing sex technologies and the necessity for more responsible and ethical responses to how women's sexuality may be performed through technologies.

In speculating about the possible intended and unintended actors of troubling design, it is also important to consider the questions: who has the privilege to trouble? And how long is one troubling? These two questions have only been surfaced in this article, but they are key elements that need further reflection and future work. In my exemplar of troubling design, the main troublemaker has been me, who with my power and privilege as design researcher have decided when and how to intervene in and with trouble. However, the participants in my design experiments do not have the same privilege. Ingrid, for instance, lives a constant life in trouble, where there is no other option than to stay with this trouble. She troubles our dominant ideologies of which and how bodies get affected by digital technologies, but no one is responding to it. We might ask, would it not be better to enable a world where she does not have to live in trouble, rather than stay with it? Similarly, the question of how long you are troubling, how long you are staying with trouble, is relevant in thinking about the longevity and scale of design research projects. My design experiments were rather short, speculative, and interventionist, making use of exhibitions and online media to elicit responses. However, we could imagine that these methodological practices could evolve into scaled and participatory processes, where the design researchers and participants together trouble dominant (gender) ideologies in technologies and design with trouble over a longer period of time. I see this as an opportunity to ally with Shaowen Bardzell's proposal of a feminist utopian participatory design [Bardzell 2018], where the practices put forth in this article can help cultivate more feminist, critical, and speculative thinking in interaction design and HCI.

6 IMPLICATIONS OF TROUBLING DESIGN

Troubling design is a design program deeply situated within and evolving from my design research practice, but as a theory of designing with women's health it proposes knowledge about what designing could also be, which is generative for other designers and researchers of women's health. In the following, I discuss some of the implications of this design program, including the concept of "problems" in designing with the trouble, what kinds of knowledge this design methodology may produce and what impact it might have in teaching and industry.

6.1 On "Problems" in Designing with the Trouble

Troubling design is one possible response to how designers and researchers could design with the trouble of women's health as an alternative to problem-solving approaches. To start discussing some of the methodological implications of this program, I want to address some potential pitfalls in conceptualizing what "a problem" is, and hereby nuance the motivation for the program of troubling design. Imagine that if we appropriate a strictly anti-solutionist and critical design approach to designing with women's health, then we risk to ignore severe problems experienced around the globe that are in deep need for better solutions. For example, while menstruation should not be seen as a problem to be fixed or as an abnormal bodily process, there are still many problems of menstruation in need for response; such as period pain, endometriosis, excessive bleeding, premenstrual dysphoric disorder, luxury taxes on sanitary products, the inability to go to school or work due to lack of sanitary products, and so on. These are worthy problems to be addressed in the short-term by exploring the individual problem space and possible design opportunities. Troubling design does not aim to ignore these problems or dichotomize between such problem-solving approaches and approaches that are more focused on social and cultural issues. Rather, troubling design wants to highlight that there are limitations to a problem-solving approach that merely aims to solve problems in a short-term within a dominant discourse. While fixing problems,

e.g., related to menstruation within our current status quo can possibly improve many people's individual lives, technological solutions can also hold the limitation of implicitly accepting an oppressive status quo as immutable. Such technologies tend to be individualistic and put the burden of dealing with the problem on the individual who is affected by it and oppression, rather than challenging the wider structures, other's attitudes and beliefs, or enabling support by others in dealing with the problem. In doing so, it perpetuates and is complicit in existing bodily stigma and self-objectification as well as wider systems of oppression. Resisting, opposing, and seeking to transform the oppressive elements of the status quo is a strength of feminist and critical theory, and feminist and critical design practices in HCI [Bardzell 2010; Bardzell and Bardzell 2013]. However, it is crucial that in promoting social and cultural change, designers and researchers do not persuade people into the one correct set of values or the better future. Rather, building on the strength of pluralism in feminist theory, designers and researchers should seek to cultivate practice and skills that allow individuals to develop their own, situated conclusions, rejecting the notion of giving a singular, definite, and "correct" answer. This could potentially highlight the opportunities of designing technologies for women's health that help individuals through a sense of collective responsibility and support, and not (only) individual solutions, and through resisting and transforming stigma and oppression, while keeping options open for interpretation and unfinished conclusions through which individuals can bring their own values and plural experiences. The design experiments of troubling design presented in this article offer some first examples of how such an approach to technology design could look like. However, these examples are limited to my positionality and context in the Global North and cannot necessarily be transferred beyond this location. Rather, they should be seen as offering design knowledge (such as values, qualities, interactions, approaches) that could be inspirational in other contexts. Therefore, it would be crucial to explore how troubling design could be practiced in sites and by people of the Global South, and/or by underrepresented populations in the Global North which have not been involved in the current design examples of troubling design. Similar, it would be crucial to better understand how troubling design could possibly co-exist as a worldview in projects that align themselves with short-term problem-solving approaches. It is beyond the scope of this article to speculate on the details of such opportunities. However, I see great opportunities for deeper analysis and alliances with current research on sexual and reproductive health rights, education, and sustainability in the Global South [Mukherjee 2019; Murthy 2015; Tuli et al. 2018], and for partnering to design and research the local and global impacts of the menstrual movement and how technologies could be designed with sustainable and educational aims in mind.

6.2 What Knowledge Does Troubling Produce?

The four design experiments presented in this article have interweaved feminist approaches with design practices such as design fiction, critical and speculative design, and participatory design. This demonstrates that more than sticking to a particular genre, form, or method, the important aspect of troubling design is a commitment to the conceptual, philosophical, and political worldview that the design program articulates and performs. Troubling design presents a partial perspective, because it is situated in my design practice and my partial reading of the literary tradition of troubling, but I aim to support an openness and pluralism in exactly how the methodology can be put into practice in other design researcher's positions, beyond my design program on intimate technologies in women's health. This includes how the action of troubling could be used in designing more-than-human worlds [Galloway and Caudwell 2018], telling neglected stories related to craft practices in the history of technology [Rosner and Ames 2014; Posch et al. 2019], designing with the body [Höök 2018], or more broadly support design against the status quo [Khovanskaya et al. 2018]. As troubling design produces analytic and generative design knowledge, designers and

researchers can use the program in two ways. They can use the program analytically to analyze their own or other's design experiments through the troubling design worldview and/or compare them to the examples mentioned in this article. And they can use the program generatively to generate new research questions and design experiments inspired by the definitions and worldview expressed in this article, and hereby challenging and developing the borders and impact of the troubling design program.

Importantly, when designers and researchers produce knowledge on the uncertainties, complexities, and plural experiences of women's health, it is important that we do not reproduce a universal and stable knowledge paradigm. Troubling can support an alternative to this. As argued by Blythe, troubling ourselves and what we thought we knew is a fundamental part of knowledge-production in interaction design research: "The result of psychological lab tests, the findings from ethnographic field studies and the fictions we produce all help to trouble and disturb that which we might think we already understand" [Blythe 2017, p. 5401]. In proposing troubling as a research method in speculative design, Galloway argues that "I believe that the ability to invoke, trouble and 'inhabit' other worlds and worldviews is instrumental to qualitative research's critical and creative role in knowledge-production" [Galloway 2018, p. 320]. Following this, the knowledge that is unfolding through troubling design is characterized by being critical and creative; it is critical toward dominant worldviews and creative in proposing alternatives. The three practices of staying with the wrong, curious visiting, and collective imagining do support a critical and creative role of knowledge production, but they also, perhaps more importantly, support knowledge production that is *unfolding*, *speculative*, and *open*. This knowledge production is *unfolding* in the way that knowledge is not a fixed endpoint, but an ongoing process of expressing differences; it is *speculative* in the way that knowledge proposes change and points in a direction toward a possible future; and it is *open* in the way that knowledge is open for plurality and responses.

To embrace the uncertainties, transitions, and diversity of women's health, we must *think* in addition to *know*. More knowledge does not necessarily provide better decisions, better solutions, or better answers. Understanding does not make us capable of response, when the understood is always in flux. It does not always elicit action, when action is what we need. If knowledge is produced through troubling, then it is a kind and practice of knowledge that embraces unknowing and the process of thinking-with, thinking anew, and the willingness to be uncertain and open, as literally indicated in the verb "I think." This kind of knowledge is unfolding differences, speculating on futures, and open for response. These three characteristics of knowledge is what is needed if designers and researchers want to create action and positive change on how technologies could shape women's health and experiences for the better.

6.3 Troubling Beyond Design Research

The design program troubling design is drawing on critical and speculative approaches to design, but I argue that the generative definitions of trouble and troubling, as well as the practices of staying with the wrong, curious visiting, and collective imagining, could be broadly useful in even the most pragmatic and constructive interaction design practices of women's health. Hereby I also trouble the presumption that critical and pragmatic design research should exist as a binary [Forlizzi et al. 2018]. Troubling design has the potential to help designers and researchers of women's health being more attentive to their responsibilities, and create more ethical and inclusive technologies and systems, by asking them to consider their positionality and a range of possible experiences and consequences for a diversity of people, not *a priori* or when a project is done but throughout the design process. The three practices of staying with the wrong, curious visiting, and collective imagining can more pragmatically help designers and researchers with this, by respectively troubling gendered norms, including different bodily realities, and imagining

possible futures. To expand on the implications of this beyond what is already stated in the article, I want to speculate on the potential risks of the program and the role troubling design might have in teaching and industry. How does troubling design help us to work with, stay with, and attend to important commitments of ethical and responsible design in teaching and industrial practices? And what are the risks of such a practice?

6.3.1 Potential Risks and Consequences of Speculative Research and Capitalist Appropriation. By focusing on feminist values of social justice, a speculative design approach could through the program of troubling design prove useful in designing with women's health. As stated in [Prado de O. Martins 2014], a feminist approach to speculative design is crucial, in order to not reproduce the privileges that can accompany speculative design when it is practiced without self-reflexivity and a pluralistic perspective on future change. Another risk, which could come with speculative and critical design practices, is their potential appropriation into capitalist mechanisms. When troubling design goes beyond an academic context, there exists (as with all interaction design research) a risk that the particular design instances are appropriated and changed into something that the researcher did not intend or anticipate. With troubling design's specific focus on the designer's positionality and intention with a project and through its exploration and critique of status quo and technologies' potential future implications, I argue that troubling design is heightening its resistance for being appropriated by capitalism mechanisms, as compared to other speculative and critical design practices. This is particularly because troubling design does not aim to design solutions or critical artefacts that fit into a dominant present but aims to design objects that deliberately resist to fit status quo, hereby challenging it for the better. However, it may also be worth speculating; if capitalist mechanisms would appropriate such designs that actively work against a societal status quo and capitalist logics, then perhaps this would have a potential to change those logics for the better from within? In troubling design, design actively plays with the border between alternative design practices and the technology industry through parodies and critical and creative use of new technologies. To better understand the particular political or societal change that such speculative practices can create, designers and research must keep asking themselves how their proposed possible futures are making an impact in their present.

6.3.2 Including Troubling Design in Industry Practices? Troubling design proposes that troubling of technologies is more powerful when it is done within or on the border of industrial structures, rather than practiced within the comforting boundaries of art galleries or academic institutions. The feminist approach of troubling design could help industries to be more ethical and inclusive in designing technologies and more responsible in accounting for the intended and, perhaps more importantly, unintended consequences of their technologies. Troubling design could work in industry, not only as an introspection of how the technology industry has contributed to many of the inequalities and existential and environmental disasters that face us, but also to elicit more responsible design responses for future generations. Industry is increasingly adapting futures thinking and speculative approaches to shift from designing near-future solutions to grapple with the uncertainty of future challenges. In this shift, it is crucial to adopt a feminist approach that accounts for implicit norms and biases, and the ways that technologies reproduce or challenge gender and oppression. To account for this, it is crucial that the Femtech industry seek beyond the commodification of women's bodies and women's health and change their approach from putting further burden on the individual person and furthering bodily stigma and self-objectification through technologies, toward a collective responsibility of enabling better women's health. If digital technologies for women's health will empower women, it should not only be women who are already in privileged positions. Rather than empowering an already privileged woman through technologies, technologies could be designed to redistribute power to women in less privileged positions

through supporting political practices. Such an approach would have the collective rather than the individual as intended user group. For such feminist approaches to happen in industry, it is necessary to have different embodied experiences represented in powerful positions and to explicitly and transparently engage with how politics and belief systems influence industrial design, development, and production of technologies, which bodies go into the making of these technologies and how does bodies come to matter in the use of these technologies.

6.3.3 Teaching Troubling Design. Design and engineering educations rarely teach students how to work with women's health and gender issues. Teaching troubling design could help students in the process of creating more ethical and responsible technologies for women's health, to better understand and act on how gender gets shaped, reproduced, or challenged through technologies. Teaching, demonstrating, and practicing the three troubling practices could attune students to their responsibilities of how their situated position influences their design, and help push students to think beyond solution-oriented design approaches prevalent in design and engineering educations. Teaching how gender matters is crucial, since so much technologies and industrial design is gendered. A more nuanced perspective on this would potentially create more troubling design that disrupts gender norms and identities. As the Femtech industry is booming, it is important to teach students how technologies for women's health can be carefully designed through feminist values of pluralism and resistance and the feminist and queer strategy of troubling. Not only could this enable more ethically aware design educations, but it could also encourage students to be more engaged in political-charged topics and break with taboos and cultural limits of design. To do this, students must be encouraged by teachers to curiously go beyond the safe and (presumably) innocent path to propose radically new and diverse possibilities for interactions, bodily expressions, and technologies that account for a plurality of bodies and gender performances. Teaching with such qualities could include critical and feminist pedagogical approaches such as reading feminist and queer theory, writing design manifestos, sharing work through public exhibitions, using student's own bodies as political tools, using storytelling and writing fiction, and establishing partnership with people in less privileged positions.

7 CONCLUSIONS

With pressing questions on how technology research and development have contributed to many of the inequalities that face marginalized bodies, it is time to reimagine how our community could (if at all) contribute to responses. In this article, I help refining HCI and interaction design research aiming to support new activist and speculative practices that seek to reimagine social, cultural, and political change in designing with women's health. I unfolded how the action of troubling can contribute to practices that design researchers can use to unfold design knowledge relating to and with trouble in women's health. The design program troubling design proposes a conceptual shift from designing solutions to responding to and with trouble, as demonstrated in the three practices of staying with the wrong, curious visiting, and collective imagining. A design methodology where trouble has a privileged status seems fundamental to design, since designing is inherently about trouble. Designing is about being open toward complexity, conflicting concerns, emotions, and needs. Designing is about uncertainties and about holding open and actively searching for possibilities and surprises to arise. Designing is about the excitement and concern that something is about to happen. As a nonlinear and iterative process, designing is messy, complex, and risky, and at times it might feel frightening, because the uncertainty of not knowing is frightening. All this articulates the process of designing and all this articulates trouble. Polemically speaking, when we are out of trouble, when we think we have a solution, we are not designing any longer. In the particular domain of designing women's health, this is increasingly important, since although

women's health is embedded with trouble, technology design often proposes simple solutions that ignore the social, cultural, and political implications of women's health and the complex and diverse bodily transitions women can go through. Through the design experiments and practices, I have demonstrated how design researchers can use the feminist and queer strategy of troubling to critically and constructively move from ignoring or simply noticing this trouble to actively engage with and respond to trouble in women's health. This proposes a shift from seeing women's bodies as problems to be solved and identities as something to be fixed, to fully immerse oneself in designing with the trouble of women's health and troubling how gender gets performed through technologies.

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