Do You Have to Pee? A Design Space for Intimate and Somatic Data

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ABSTRACT

The management of bodily excretion is an everyday biological function necessary for our physiological and psychological well-being. In this paper, I investigate interaction design opportunities for and implications of leveraging intimate and somatic data to manage urination. This is done by detailing a design space that includes (1) a critique of market exemplars, (2) three conceptual design provocations, and (3) autobiographical data-gathering and labeling from excretion routines. To conclude, considerations within the labeling of somatic data, the actuating of bodily experiences, and the scaling of intimate interactions are contributed for designers who develop data-driven technology for intimate and somatic settings.

Author Keywords

Intimate and somatic data; bodily excretion; urination; research through design; interaction design; criticism

CCS Concepts

•**Human-centered computing → Interaction design;**

INTRODUCTION

With the increasing prevalence of data informing and revealing what we do and how we do it, the boundaries of where data-driven technologies could and should participate in our everyday lives are challenged. One such domain is intimate practices of bodily care, such as human excretion, in which designerly concerns extend from how intimate and somatic data can be put to use in responsible ways to how it can even be usable for interaction designers to consider and shape.

Bodily excretion is an essential and universal metabolic process of human beings. For many of us, "going to the toilet" might be considered mundane and instinctual, a process of waste disposal that we opt to forget or prefer not to consider. Yet, as an everyday physiological practice, how and where it is attended to has broad implications that extend to our

psychological well-being, somaesthetic experiences, social belonging, self-efficacy, occupational performance, and sanitary conditions. Yet despite the prevalence and consequentiality of excretion in our everyday lives, we are not born with the ability to manage the disposal of our own waste. From birth, we require guidance from a caretaker until assistance and supervision might no longer be required. Often referred to as toilet (or potty) training, this learning process is universally considered a developmental milestone during which a child becomes able to independently and hygienically manage the disposal of their own excretion [49]. While this might be achievable for many, it is not a final state for everyone, nor means that assistance will not be needed again.

Yet despite the broad significance of how, when, and where these basic biological functions are attended to, there is minimal design research concerning bodily excretion. This research gap might be attributed to the taboo nature of the topic, which for centuries and across cultures has long been associated with notions of filth, shame, and waste [24], in addition to the ethical concerns of implementing emerging technologies into such a psychologically and physiologically sensitive domain. Furthermore, the individualistic nature of childhood development, idiosyncratic familial practices, and a diversity of cultural norms make it difficult to develop paradigmatic solutions when a bespoke intervention might be ideal. Design challenges thus not only concern technology, but span across interpersonal, societal, and cultural traditions and fears.

Therefore, how might designers navigate these challenges and engage with highly intimate and unromantic bodily practices such as excretion? Or rather more specifically, what opportunities exist for leveraging personal data to empower vulnerable user groups and caretakers with when, where, and how they might manage private toilet practices? And when working with sensitive and somatic personal data, what should interaction designers consider regarding the externalization of internal sensations in private as well as social contexts?

To explore these questions and ground design work in this under-explored domain, I detail three provocations that predict when and how badly one has to urinate. While this paper is not advocating for these conceptual devices, their detailing and the accompanying design activities forms a broader design space. By following the design progression and more fluidly moving among representations from process activities, the design space reveals and exasperates social tensions, relational

frictions, and interactional loops with smart technology and personal data. In addition to building upon a body of work that details design processes [51, 65, 52], I contribute opportunities for re-conceptualizing bodily excretion and considerations for designers regarding the externalization of internal sensations through data-driven technology. These considerations include the labeling of somatic data, the actuating of bodily experiences, and the scaling of intimate interactions.

RELATED WORK

This body of work lies within the intersection of designing with data, bodily care and maintenance, and technologies of human waste. First, I give a brief overview of the multitude of ways of designing with data, including challenges resulting from bringing data into a design space. Next, I review related design research on bodily care and maintenance, including the role of data in personal health and identity in addition to approaches that address taboo topics within women's health. Lastly, I present a trajectory of approaches of technologies for bodily excretion to orient my own work.

Designing with Data

Bringing data into a design space is not an unusual practice for designers and is exemplified through a diversity of design research that has explored a multitude of ways in which data can contribute to or be a result of a design process. The Datacatcher is one such example in which the location-curated output of sociopolitical data is inherent to the design research artifact as a product [23]. Through its deployment, the project surfaced challenges of working with data sets and distribution at scale. In Metadating, Elsden et al. investigate the social life of data within our everyday lives through a future-oriented process by which participants directly engaged and reflected upon their own personal data relative to their identities and conversations [16]. Along with a speculative wedding documentation service [15], these projects surfaced questions regarding what might be actuated and how within the "lived-life" of data for our everyday lives. By contrast, OLO radio did not explicitly present data to users and instead leveraged metadata to support new experiences of listening to music [51]. Through process documentation, design challenges were raised regarding the labeling and representations of temporal data.

While these examples are by no means exhaustive regarding the extent that design research has engaged with data, what they all have in common is how they contribute to notions of data as a design material, foregrounding a designer's role and agency in shaping data. As highlighted by Feinberg, designers are "always designers of data, never its mere appropriators" when we select, collect, and assemble data within a design space [18]. Data is never objectively brought in or spontaneously emerges; it orients subsequent design decisions, solutions, and recipients of both [9]. Thus, this paper continues these conversations through which I assume a more active position in reflecting upon the design implications for labeling, actuating, and scaling of intimate and somatic data.

Bodily Care and Maintenance

There is a growing body of work within HCI design research investigating bodily care and maintenance. Within this there

has been an increasing shift from self-tracking and informatics to a deepened understanding of our felt bodies [35]. This turn is particularly salient in somaesthetic design [33] and in the domain of women's health [1]. A first example of the latter is Labella, a connected pair of underwear that supports women in exploring their intimate anatomy for reproductive health and sexual well-being [2]. Also motivated to celebrate rather than control changing bodies, Homewood takes a feminist exploration of how data-driven technologies shape identity and a sense of self [30]. PeriodShare, a design fiction of a connected menstrual cup, foregrounds the implicit culture and politics of intimate data-driven technologies through a critical perspective [61]. The politics of bodily care are also emphasized in Fox's work on menstrual resource development that investigates infrastructures of maintenance and labor, which expands upon how our felt bodies are entangled beyond the individual with governance through technology [20]. Taken together, these projects represent a diversity of approaches within and for bodily care: from solutions to speculations, from individuals to society, and from private to public. They also foreground a broader research aim that challenges bodily taboos and inattention that I draw heavily upon for the design space presented.

Technologies for Human Waste

The removal of human bodily waste has a long history with technology. Two of the perhaps most well-known and widespread inventions are sewage systems and the modern toilet. Although sewage infrastructures and the basic mechanics of flush toilets have remained relatively stagnant over the past century, technology continues to create new interactions, devices, and services for human waste. A reframing of waste as something useful is seen in biogas efforts to harvest potential energy from feces into electricity [64]. High-tech toilets in Japan have integrated such features as motion-activated covers, heated seats, deodorizers, illuminated bowls, and music. The idea of smart toilets also includes bodily excretion analysis for health monitoring and diagnostics, evidenced in patents [63] and market products such a Viome microbiome testing [38]. There are many other technology-driven initiatives including an immense variety of digital applications to help people find a toilet [19], learn how to urinate [54], overcome a fear of urinating [46], and find the best time to use the restroom during a movie [57].

Within HCI, the limited design research has largely focused on the augmentation of physical artifacts and environments where bodily excretion practices take place. For example, Mayer and Panek designed a robotic toilet system for elderly persons [44] and Hamada et al. designed a teleoperated bottom wiper to assist those who are unable to clean themselves following defecation [26]. An integration of data is seen in a project by Kurahashi et al., in which they were able to identify toilet users by paper roll rotation [41]. Most relevant to my own work is the Toilet Companion [8], an augmented toilet brush that explores social boundaries when excreting; Quantified Toilets, a thought experiment on data and privacy through biosurveillance in public restrooms [10]; and "U", a design fiction of an algorithmic birth control that resides in the bathroom and troubles dominant gender narratives [62].

A DESIGN SPACE FOR INTIMATE AND SOMATIC DATA

My method to critically engage with intimate and somatic data within the topic of bodily excretion was Research through Design [67]. I took a design-led approach by which an emergent process opened a design space that emphasizes problem framing through critique and conceptual exploration to question the status quo [22]. As such, over a six-month period I engaged with three design methods in response to specific domain challenges: (1) a critique of market exemplars, (2) the design of three conceptual provocations, and (3) autobiographical data-gathering and labeling of urinary practices. The outcomes from these three activities form a design space for intimate and somatic data, and more specifically urination. Prior to presenting their outcomes, I will first briefly motivate each method.

The first method was a critique of over one hundred market products available for purchase to manage bodily excretion, which I collected from English-speaking e-commerce websites that target western countries. Through reading individual product web-pages, reviews, and social media accounts, I then more rigorously critiqued a smaller selection for what humanities scholars would describe as reasoned and sensitive readings for a deliberate search for value [4]. A critique on market products was chosen due to the proliferation of commercial product development, prompting questions regarding what these products might reveal about societal perspectives on the management of excretion. *Who do these products target and who do they not, and how are their implicit values materially manifested?* The purpose for this search for value was to open a design space by grounding multiple perspectives on a problem space and to identify themes for ideation.

The second method was the design of three conceptual provocations of speculative devices that predict when and how badly one might need to urinate. Within the domain of bodily excretion, I chose this particular functionality for two reasons. The first is the practicality of its potential benefits for many marginalized people such as children and the elderly, or people with disabilities, medical conditions, and physiological changes that have triggered urinary incontinence. The second is its reliance on data-driven inference-making to surface interaction design challenges [28]. I grounded the design of each concept in a theme revealed by the critique of exemplars to conceptualize opportunities and implications implicit in intimate and somatic data to manage urination. Their visual and textual form most closely resembles *design projections* [52] by drawing upon a medley of methods for speculation, including user flows, design workbooks [21], design fiction [7, 59], critical design [14], and architectural speculation.

The third method was autobiographical data-gathering and labeling of urinary routines and habits over a six-month time period. I chose an autobiographical approach to defamiliarize myself as a designer and researcher with the automated perceptions of a practice that might be taken for granted [6]. In addition, a first-person perspective enabled looking at urination as not only a biological process of a body, but as Merleau-Ponty's notion of *the lived body* through which the author's own experiential and cultural body lives in the world [45].

The first-person perspective is not new in interaction design research [50], and can be seen in soma-based design and the articulation of everyday bodily experiences [34, 32]. Additionally, involving external participants in a topic that many consider private and even shameful raised methodological concerns, not only regarding privacy, but also in how to approach and interpret such data in the early stages of opening a design space. Thus, this approach considers what the collected data reveals, how it felt to track this data, and the possibility to become more observant of the spaces, artifacts, and social interactions that take place in and around places of bodily waste disposal. Lastly, the resulting insights are further used as a method of reflection for the three conceptual provocations.

Before proceeding, it is important to acknowledge what might be considered an unusual methodological decision and my positionality as a design researcher. The first is the order of my methods by which data-gathering follows, rather than precedes, conceptual development. This structure both accurately mirrors the design research process and also foregrounds autobiographical research as a way to revisit and reframe one's own design work for a reading difficult to obtain in such an intimate domain. Additionally, I am a female from North America and live in Northern Europe, whereby my cultural views on and observations of bodily excretion have heavily influenced what is and isn't discussed, and who might be provoked and how [27]. This body of work thus provides a narrow perspective on a domain that warrants a much broader and inclusive future engagement.

CRITIQUE OF MARKET EXEMPLARS

While reviewing commercial products for managing urination, I linked tensions and incongruity amidst visual and textual content with literature on bodily excretion practices for an informed and focused critique. I raised three themes from my critique, addressing the how, who, and where of urination. In the following, I exemplify each by a single product. The themes are: *a scheduled procedure*, *a gendered performance*, and *a dirty behavior*.

A Scheduled Procedure

The first theme that emerged from my critique was *a scheduled procedure*, exemplified by The Potty Watch [37]. The Potty Watch is a wearable device for toddlers during or after toilet training that reminds them to go to the toilet. It is designed for a guardian to set a timer that alerts the child through blinking lights and music that it is time to go to the toilet. It is motivated as a solution to overcome the challenges of confrontation and collaboration between parents and child by getting the latter to use the toilet through an entertaining device. I perceived the underlying messages of the product to be that urination occurs on command and technological devices can replace the recognition of internal bodily sensations and urges. This view shifts the focus from bodily awareness to being disciplined and systematized through reoccurring intervals of a particular time period. While establishing routines is undoubtedly important during toilet training [49], this raises questions regarding the implicit behavioral training of children; for example, as reported in the toileting practices at schools in the German Democratic Republic. Within state-run nurseries, all toddlers

were required to go to the toilet at the same time and could not leave until everyone had excreted, aimed at training children both to use the toilet and to submit to authority [17]. This suggestion that for many an uncontrollable urge can and should be controlled as a form of social education resembles how equipment automation in restrooms, such as flush toilets and hand dryers, encourages uniformity in public facilities [48]. This is what Lorber refers to as "potty-training by automation" [48]. This perspective can also be applied to the child-guardian relationship whereby the awareness and attention in learning the signals by a parent or caretaker is no longer necessary. Furthermore, while toilet training might be aspirational and achievable for many, the risks and consequences of a willingness to cope with the schedule of others can be seen in New York taxi drivers who face civic prohibitions on where to park and lack public infrastructures for where to relieve themselves [48]. This dilemma has resulted in health repercussions such as dehydration, infection, financial strains from parking fines, and exploding bottles of urine left in public spaces.

A Gendered Performance
The second theme that emerged from my critique was *a gendered performance*, exemplified by the Pee Pocket [53]. The Pee Pocket is a single-use, waterproof funnel designed for women to urinate while standing up and is marketed towards women who are pregnant, disabled, post-surgery, elderly, or travelers. While the predominate motivation cites sanitation concerns from skin contact in public restrooms, the product's packaging and advertising accentuate portability and discreteness, suggesting that women should be ashamed of their need to use such a device. Shame in sitting or squatting is furthered by marketing that promotes overcoming an embarrassing need for privacy or weak leg muscles while idealizing speed, convenience, and comfort in standing.

The underlying message I perceived is that it is empowering for vulnerable women if they can imitate a man to urinate. Standing to pee for hygiene, rather than addressing a lack of appropriately designed and maintained facilities, propagates the notion that women cannot be dirty or they risk being "intrinsically out of place and a sign of rot in the wider social order" [48]. Yet the societal implications of nowhere to go are vast, reflected in a staggering estimation of one in three girls in sub-Saharan Africa who drop out of school due to a lack of facility access [24]. This potential deviance and shame in sitting to urinate parallels the "urinary leash," a term derived from the lack of public facilities for women in the Victorian period to tether them to the home and away from public spaces [47]. This friction can be further seen as a misrecognition of the importance of experiential differences that often ignores the biological needs of sexes and the sociological needs of identities, while rendering people with disabilities as interchangeable [48].

A Dirty Behavior
The third theme that emerged from my critique was *a dirty behavior*, exemplified by the Toilet Night Light [60, 3, 56]. The Toilet Night Light is a motion-activated light that clips to the side of a toilet that uses an ultraviolet lamp to kill mold, bacteria, and viruses around the toilet bowl, and uses

Figure 1. Annotated sketch of a fictional product. © Karey Helms.

aromatherapy tablets to create a "hygienic smell". The predominate motivations of the product are safety from germs and accidents that can occur in the dark, in addition to soothing visual and olfactive aesthetic improvements to the atmosphere. These motivations are manifested through images that depict an injured child in the dark, agitated toddlers without the light functionality, quarrelling partners in bed, and abstractions of scary germs being killed. Ironically, the device only functions in a dark environment, implicitly promoting a use of the toilet without overhead lights as that is the only way for germs to be eliminated.

I perceived the underlying message of the product to be that toilets, the spaces they occupy, and the behaviors that take place are dangerous and should be feared as a result of contamination, conflict, and suffering. This notion of bodily excretion as a threat to purity and order, draws upon Mary Douglas' proposition of dirt as a "care for hygiene and respect for conventions" within humans' desire to harness one another into upholding certain moral values and social rules that are "defined by beliefs in dangerous contagion" [13]. Restrooms with toilets are thus inherently dirty as they are ambiguous spaces with conflicting practices of eliminating waste and washing oneself, whereby boundaries are uneasily crossed and thus culturally threatening [48].

THREE CONCEPTUAL DESIGN PROVOCATIONS
The design of the three provocations followed a process whereby I explored one theme from the critique within each provocation through three activities. First, I created a mood board to synthesize the chosen theme with predicting when and how badly one might have to urinate. Next, I sketched a fictional product combined with an annotating of data-driven interactions (see Figure 1). Lastly, I detailed a scenario as if it were a product going to market to reveal potential benefits, challenges, and implications. In the following presentation of each provocation, it is important to note that each concept is a playful exaggeration of a solution to emphasize their fictive nature, and for discursive purposes to prompt discussion around an important yet often difficult topic [29].
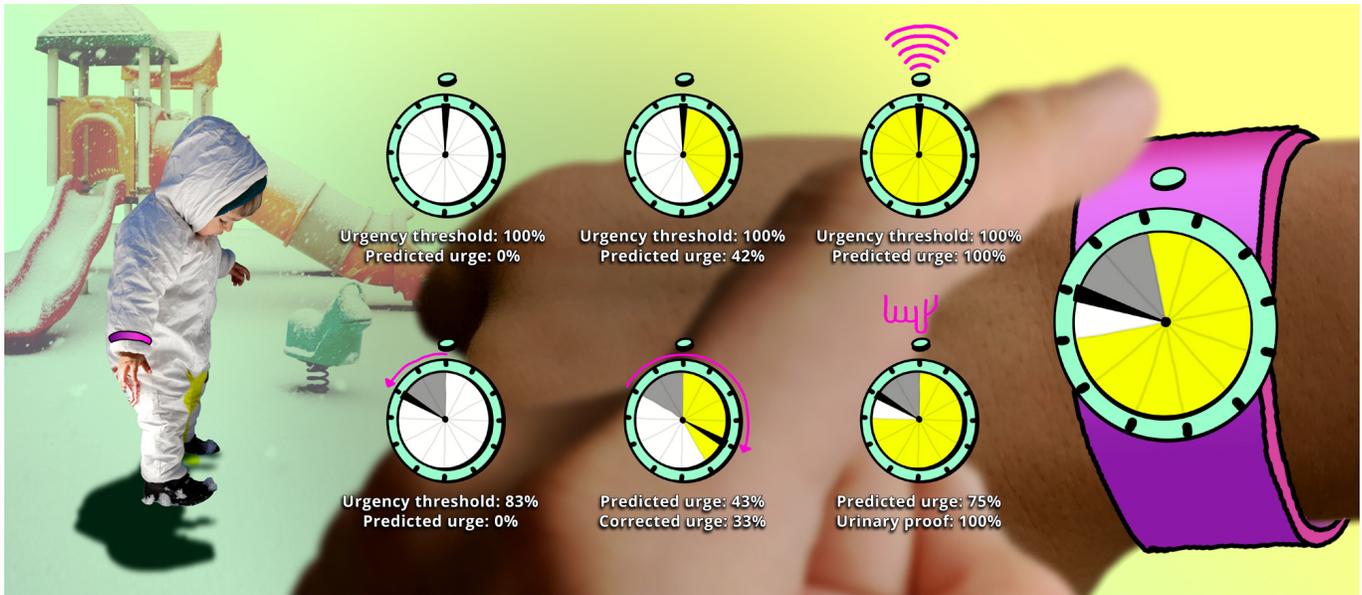
Figure 2. *Truth and Dial* is a design provocation that explores *a scheduled procedure*. © Karey Helms.

Truth and Dial

The first design provocation is a watch that explores *a scheduled procedure*. The watch is designed to be worn by a parent or guardian of a child that is not toilet trained. It is paired with an activity band worn by the child that collects activity data synced with the watch to display a predicted urinary urge of the child (see Figure 2). By default, after a toilet visit or upon system start-up, the interface is blank with a black dial pointed towards twelve o'clock. This means that the urgency threshold of the watch is set to 100% and the predicted urge is 0%. As the predicted urge increases, the twelve sections of the interface gradually fill in. When the predicted urge reaches the urgency threshold of 100%, an audio alarm goes off, indicating that the child has wet herself. To silence the alarm, the guardian must press the "peed" button above the interface that officially annotates a urinary excretion. This feature forces the guardian to urgently respond to the needs of a child by presenting him with the choice of untruthfully stopping the alarm and thus wrongly annotating data, or truthfully stopping the alarm and reacting quickly to resolve the situation.

If the guardian would like to be alerted by the watch prior to the child urinating, then he can rotate the black dial counter-clockwise to set the urgency threshold to a number below 100%, such as 83%. Also, if the guardian disagrees with a predicted urge, he can rotate the dial clockwise to the corrected urge, followed by counter-clockwise past twelve o'clock to complete the correction, and then back to the desired emergency threshold. Lastly, an excretion can and should be annotated at any time that it occurs. Similarly to silencing the alarm, this is done by pressing the "peed" button, upon which an excretion is annotated. The system will automatically determine if the urgency prediction should also be reset and to what amount, signifying if the child has fully peed or not.

While the most common use case for the watch is for co-located toilet training, it can also be used remotely to monitor a child while with other guardians, such as at daycare. Even though the main guardian will not be able to press the "peed" button with confidence, the changing patterns of predicted urgency will still be evident for informed speculation.

Another benefit of the watch is that it can be used during the entire lifespan of an individual, from birth to old age. This is because the watch interface can be moved from the guardian's band to the child's activity-tracking band once the child is potty trained. As setbacks or incontinence can occur at any age, this allows for continued self-tracking, during which the accuracy of the predictions increases with growing data.

As a provocation, Truth and Dial is helpful in thinking about the interpersonal relationship between a carer and the cared-for within the formation and maintenance of *a scheduled procedure*. In particular, potential interpersonal power imbalances and the social exposure of care-taking are highlighted in design choices as deliberate provocations for interaction designers. For example, a design intent in the setting of the urgency threshold is to highlight how a guardian through data-driven technology might assume further authority, with decreased attention, over a child. Although the guardian is necessary in assisting the child with urination, the preplanned establishment of a threshold to be alerted by negates providing continued attention to the child. In contrast, the power imbalance is intentionally shifted through the deliberately tedious interactions required by the guardian to calibrate thresholds, label urges, and annotate excretions. Another provocative design choice is the alarm and "peed" button by which the caretaker is intended to experience friction between social expectations of acting quickly on a child's need versus accuracy of system input, emphasizing a potential multitude of reasons as to why and how one might interact with technology truthfully or not.

Figure 3. *Clip and Snip* is a design provocation that explores *a gendered performance*. © Karey Helms.

Clip and Snip

The second design provocation is a garment clip that explores *a gendered performance*. The clip is designed to be attached to the bottom hem of a one-piece garment that fully covers the upper body and extends over the crotch to the legs; such as a dress, robe, or hospital gown (see Figure 3). Magnetic wheels [11] on either side of the fabric are used to secure it to the garment. Sensors in the clip detect the ambient temperature of the external environment and the movement of the garment to form a representation of the urinary urge of the wearer. As the detected urge increases, the magnetic wheels gradually move up the garment, catching the hem and causing the garment to bunch and rise as the clip rolls upwards. Thus, when the user is in standing position and the garment falls vertically straight, then the detected urge is 0%; and if the garment has been lifted above the crotch, then the urge has reached 90%. The upper threshold is 90% because the device assumes that this is when discomfort and harmful bladder implications begin.

The purpose of the hem rising is two-fold. Firstly, it serves as an implicit reminder to urinate prior to the urge reaching 90%. Secondly, when the urge has reached 90% and the hem is above the crotch, it is easier to urinate because then it does not need to be lifted or held up, removing an unnecessary step.

If the hem is lifted above the crotch by the user prior to reaching 90% urgency, then an excretion is annotated in the system. The length of time that the garment is lifted provides feedback for the system regarding the detected level of urgency. Similarly, to correct an urgency prediction by the system, the hem (and clip) can be tugged down or lifted higher. Though if the hem is pulled down to correct the prediction too many times, or if the person does not address a high urge in a healthy timeframe, the system questions the intentions of the individual and uses an emergency fabric razor to clip off the bottom of the garment and expose the crotch.

Through the tugging and lifting of the hem, the clip transforms the garment into an interface that utilizes both implicit and explicit body signals as input. This foregrounds the meaning of ordinary bodily movements while harnessing user reactions to the prediction. The clipping of the hem acts as a safety feature whereby healthy excretion habits are prioritized over the potential social embarrassment of a high hem by preventing too many corrections not based on urinary urge.

Clip and Snip as a provocation is valuable for considering how agency can be displaced between a person and technology through data-driven actuation within *a gendered performance*. While the wearable device is presented as empowering, the raising and the clipping of the garment are meant to be disturbing features to provoke interaction designers to reflect upon utility versus experience of technological assistance and decision making. The functionality of the raising of the hem as a design choice draws upon potential shame and embarrassment of exposing your undergarments or crotch, heightened by the discreetness of the interface, by which its gradual adjustment might not be noticed until the hem has already risen to an inappropriate position. Within this attribute is an intentional friction whereby wearing a longer, more conservative garment results in a higher fidelity of urge feedback, suggesting more agency for the wearer, while it also increases the subtleness of the change in feedback.

The clipping of the hem as a second intentional provocation is inherently more explicit. This is seen both in how the agency of the wearer is overtly challenged through the dramatic clipping, and for the potentially inappropriate and shameful nature of what the clipping might reveal. Both design decisions taken together foreground experiential challenges in designing implicit and explicit interactions with technology meant to proactively assist vulnerable users.
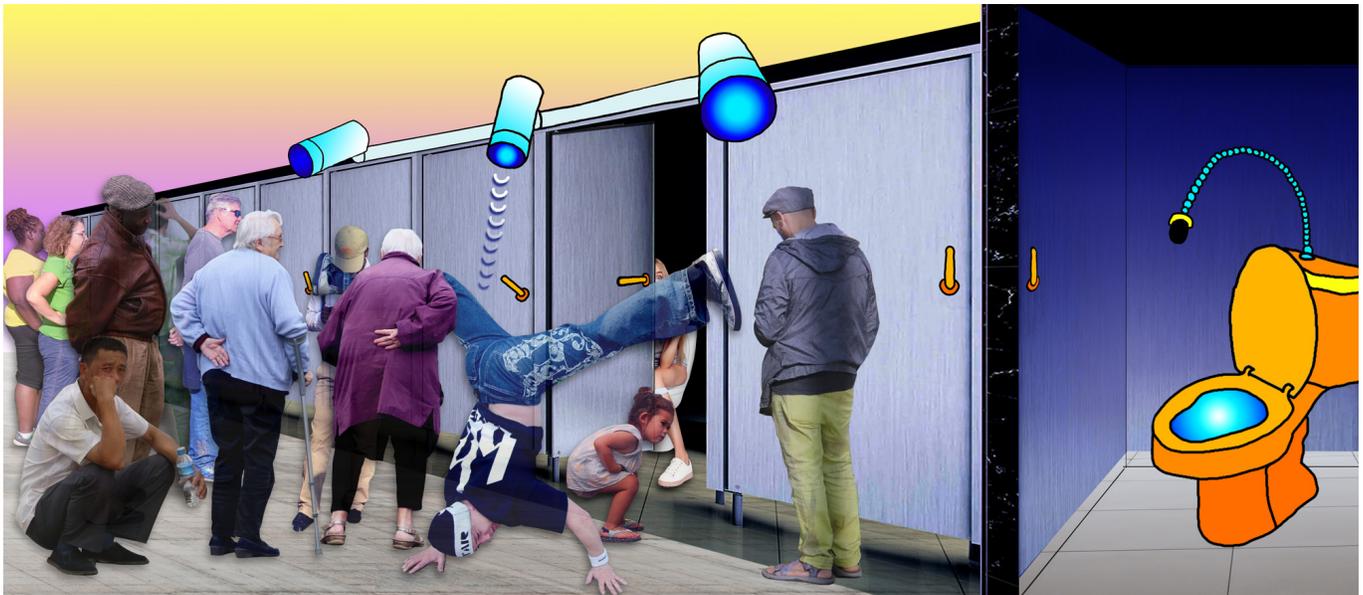
Figure 4. *Survey and Shoot* is a design provocation that explores *a dirty behavior*. © Karey Helms.

Survey and Shoot

The third provocation is a camera network that explores *a dirty behavior*. Surveillance cameras are placed in the vicinity of public restrooms to democratically determine who has the greatest urge to pee and grant access to the facilities accordingly (see Figure 4). The cameras use computer vision to form representations of urgency states for individual people passing through or gathering in the public space. As a toilet stall becomes available, the system identifies the individual with the greatest urge and implicitly notifies the person by shooting them with an air haptic, also known as a "poof." If you are the only person in the public space and your urge is low, you will have the greatest urge and will be shot until you go to the toilet, upon which you might need to hide from the camera or avoid loitering. If you are in a crowd, surrounded by many people with a high urge, you will need to make sure that you are properly surveyed by the cameras or practice high-urgency movements to gain access.

Simultaneously with the shooting of an air haptic at a person, the available stall automatically unlocks, which is visible by both a hinged door and the horizontal position of the door handle. Once inside the stall, as the door handle is turned ninety degrees into the vertical and locked position, a stall session timer is started. The amount of time an individual has in a stall is dependent upon their urge, which designates the speed at which the door handle rotates from the vertical locked position to the horizontal unlocked position. Also while using the stall, an adjustable microphone attached to the toilet bowl captures audio data. The audio data is used to verify accuracy of the predicted urge and to continue to train the system. The adjustable characteristic of the microphone enables finding the most appropriate location for capturing the best sound quality relative to any excretion position.

There are two primary benefits of the system as a public resource to prevent deviant behavior and establish order. The first is access control by only permitting stall entry to those with an appropriately determined urge. The second is the tracking of individuals within stalls to monitor behavior and contribute to the training of civic data used to distinguish and establish public norms.

Survey and Shoot as a third provocation is helpful in thinking beyond a predetermined number of participants and instead about *a dirty behavior* in the context of strangers-in-flux interacting with a public system. More specifically, three design decisions are intentionally disturbing to provoke reflections regarding the implications of data-driven technology being used at scale to govern facility access in the prevention of deviant behavior: the shooting of air haptics, the timed door handle, and the in-stall microphone.

The notification to an individual that they have been granted access to a toilet stall through a "poof" isolates one person within a crowd through an impression of violence. This is intended to reflect upon how being publicly selected without a clear understanding of how a system is assessing criteria can be uncomfortable and might generate animosity from strangers. The timed door handle deliberately attempts to prevent unwarranted practices inside a stall by limiting access to a time-frame considered appropriate relative to the urge of an individual. Through the overly simplified feedback of how much time one has to create public order, it is unclear if the system has taken into account the vast differences and needs of a population, and thus raises questions regarding how a designer might represent such complex decisions. Lastly, the recording of sound through the microphone crosses an uncomfortable boundary by making an aspect of excretion that is often preferred to be forgotten or remain private quite literally public by harvesting it for continued system use.

AUTOBIOGRAPHIC DATA-GATHERING AND LABELING
Data-gathering and self-labeling comprised a simple technical set-up of which I documented my urinary habits by messaging a custom bot in the Telegram chat application. Through a Google Apps Script, each message was automatically forwarded to a spreadsheet with the contents sorted into five columns: timestamp, day, type (i.e. text or image), status, and notes. While the first three are system-generated, status refers to the temporality of a urinary excretion, or more specifically, to distinguish among the future (need), present (going), and past (went). The notes column is for methodological reflections and miscellaneous thoughts. The tracking can be divided into three stages over six months. The first period was the most rigorous tracking and lasted for approximately three weeks. At the end of this time-frame, I went on the first of a few international trips, during which tracking became too burdensome and thus transitioned into a second stage of more casual documentation of bodily excretion spaces and reflections for two months. The third stage consisted of a renewed rigor in labeling for three months, including a one month gap due to a hiking vacation during which data-services and electricity were unavailable. In addition to rigor, the distinction of the third stage was the documentation of liquid intake and a percentage of how urgent my need to urinate was. The resulting selection of insights combine experiences of urination and self-labeling to reflect upon the three conceptual provocations.

Reflections on Truth and Dial

Deleting an Urge
Upon the start of autobiographical data tracking, one of the first reflections was the ease and prevalence of "deleting" going to the toilet, heightened by the realization of how frequently I needed to urinate. The initial labeling of urinary routines and urges, compounded by the later documenting of liquid intake, drew attention to how much unacknowledged time and coordination contributed to inserting urination into my daily routines and encounters. For example, the idea of a "security pee" emerged to describe going to the toilet before leaving a vicinity despite not needing to urinate urgently or at all; rather just in case a facility might not be readily available another time soon. This orchestration of when to urinate emphasized the interplay between a present urge and an unknown future within the inconsistencies and dynamics of everyday life.

In regards to Truth and Dial, this reflection complicates the idea of establishing an urgency threshold by which not only does the labeling of urges require constant care and attention, but so does the setting of thresholds in response to unpredictable and evolving happenings. Furthermore, the provocation does not account for past behaviors in the real-time interface such as how fast or slowly one might be approaching the threshold due to fluid intake or physical exertion. Thus, the prioritization of real-time occludes the complexity of the past and future in determining the right time to go, while highlighting the labor needed to make and maintain these decisions.

Quantifying an Urge
During the third stage of data-tracking, when I began trying to quantify my urinary urge through a percentage, the unclear relationship between urge and flow was foregrounded. In particular, it seemed as if an urge to urinate increased not only with a full bladder, but also when access to a previously unavailable facility was restored. For example, as I approached work following an one-hour commute, my urge to urinate became unbearable in a very short amount of time. In addition, urge appeared to not always be continuously increasing, and could also decrease when my mind was drawn elsewhere. This resonates with interactional or affective loops [36], whereby my urge fluctuated when I knew I was supposed to be thinking about it. For example, if you ask someone "Do you have to pee?", they probably could at that moment.

These reflections raised further questions, including: What else contributes to an urge? How can an urge be manipulated? Is there a healthy range in which one should act upon an urge? And is it unhealthy to go too frequently? When does an urge become urgent? When considering these questions in relation to Truth and Dial, it highlighted the difficulty in trying to quantify one's own urge, and even more so, determining it for someone else. Additionally, it also drew attention to an interesting relationship between urge and urgency, within which it is unclear who suffers more from an urgent urge in the provocation: the child or parent? While the child might possess a strong desire to urinate, through the device's alarm, the parent is attributed a sense of social importance, further confusing interpersonal power imbalances.

Reflections on Clip and Snip
Social Exposure
While it is common to use the restroom for many purposes other than excretion, I often went to urinate at home and work with low or no urge. One reason was my use of the toilet as a break from work in that it gave me a purpose to leave my desk and walk around. Going to the toilet was not only about what a facility had to offer, but also what it offered me to get away from. This extended to social encounters, during which the toilet was an unquestionable excuse to escape a conversation as people would not question whether or not I actually needed to excrete. Thus, the taboo of bodily excretion combined with an inability of others to gauge my urge was a benefit.

This led me to think about the social advantages and disadvantages of publicly exposing an estimated urge to urinate as in Clip and Snip. On the one hand, I could envision it being useful and validating in public situations when I have delayed an urge to avoid a social disruption or encounter, such as in a classroom setting or asking a stranger on an airplane to repeatedly get out of his seat. On the other hand, this very privileged perspective is contrasted by the potential embarrassment of exposing the "truth" of an intimate state that might be a source of anxiety or shame. Furthermore, this form of social exposure no longer positions the toilet as a potential safe space where one can escape to for any reason deemed beneficial. What kind of space then is a toilet facility transformed into when our inner desires and anxieties are exposed? For Clip and Snip, exposure refers not only to revealing our physical attributes, but also our private vulnerabilities.

Internal Exposure
While visiting a friend abroad for a week during self-tracking, we happened to notice that our urine was the exact, peculiar

shade of yellow, which we attributed to eating the same foods and having the same liquid intake habits during this time. Our sharing of this information made the unusual characteristic of my urine feel more "normal." Evaluating urine as a sign of health is not unusual as it is widely known that it can reveal many internal conditions and external choices, including dehydration, pregnancy, disease, and infection. This form of exposure more closely relates to an intimacy of knowing one's own body, and the potential shame of feeling "dirty" if it does not abide by cultural norms.

Although Clip and Snip only claims to communicate an urge, and not the characteristics of one's urine, it could implicitly signal a previously unnoticed increase or decrease of urination. During the end of my data-gathering, this reflection surfaced from knowing I was trying to conceive and thus was acutely aware of any perceived internal changes. When considering the clipping of the hem in the provocation, through its assertion that an urge has reached an unhealthy state, the conflict between a system's diagnosis of health and an individual's own intimate and somatic understanding of his or her body and broader lifestyle choices highlights questions for how disorder and order should be negotiated between us and our devices.

Reflections on Survey and Shoot
Leaky Access
In addition to being from a country other than the one I live in, gathering data while traveling prompted reflections on the differences and similarities in social behaviors while standing in a public restroom queue. In one instance, I was taken off-guard when a woman I had just met in line continued a conversation with me while we were both in our respective stalls. In another situation, I was pleasantly surprised to witness patrons at a paid public restroom holding the door open for strangers to avoid continued payment; an informal social system that "leaked" restricted access to a basic human need. Similarly, I also watched multiple people enter a paid toilet together for what I perceived to be a money-saving effort when evading payment risked a formal reprimand.

In relation to Survey and Shoot, these observations prompt further questions regarding being in queue, the relationship between a queue and the stalls, and more generally, how social behaviors are formed and boundaries crossed. Through the employment of urge to grant access, the provocation redefines being in a queue by removing a status formerly attributed by waiting time. As both people and urge are in flux, it might be difficult to discern who is next, which might shift outwitting the system to outwitting one another. Or, it could require outwitting the system in new ways, such as through conspicuous "pee dances" for the cameras.

Provisional Access
Opening a door to encounter a stall in use, and having a stranger try to open a locked door on myself, were not uncommon occurrences. On another occasion, although the door was locked, the large gaps between the stall door and walls of this particular public restroom left me feeling especially vulnerable to strangers' gazes as I was wearing a one-piece jumpsuit that required more unclothing than usual to urinate. Not only did I not want to be seen urinating, but even the fear

of being seen resulted in anxiety. While "civil inattention" [25] might have prevented most people from peeking, both types of situations highlighted the importance of being able to limit unwanted social encounters for a safe and secure space.

This lead me to think about the sociality of a somatic experience, by which potential encounters impact whether an experience is enjoyable or not; while for others this might mean whether a bodily excretion can occur at all. In the provocation Survey and Shoot, this social vulnerability is heightened by having an unknown time allocation for an individual stall, and thus no control over when access will be relinquished. This results in a provisional access that once granted can also be taken away, resulting in a continued uncertainty.

DISCUSSION
In the following, I first contribute three considerations for designing with intimate and somatic data, presented through the challenges of labeling somatic data, actuating bodily experiences, and scaling intimate interactions. I next contribute opportunities for re-conceptualizing bodily excretion through methodological reflections. I conclude by reflecting upon my own positionality to invite other interpretations of the design space presented and of what has not been included.

Designing with Intimate and Somatic Data
Labeling Somatic Data
The first consideration for designing with intimate and somatic data concerns the complexity of externalizing bodily sensations, both within the labeling of somatic data and within the representations of these labels. This is not a new challenge for interaction designers, and can similarly be seen in the field of affective interaction with the categorization of emotions [31]. Within my focus on urination, a difficulty lay in resolving conflicts between what is sensed by the system and what is sensed by the self. This is shown through the reflections on Truth and Dial whereby the urge to urinate can fluctuate depending on one's knowledge of facility access. Thus, quantifying an urge and determining when an urge becomes urgent, and for whom, is a significantly more fluid concept than expected as it is contingent on many other situational factors. This opens further questions regarding how to design with data and present it in a meaningful way when nothing is stable.

Instability and uncertainty also contribute to challenges for interaction designers aiming to keep humans in the loop with data-driven technologies. As exemplified by the provocations and my own struggle for consistent and long-term data-gathering are the efforts involved in making a product or system intelligent. While labor has been raised as an important concern for design [66] and as interaction designers think about the labor of labeling somatic data, it is also important to consider how having a human-in-the-loop might implicitly influence this particular person by noticing something that was previously deleted. Thus, in addition to prompting questions such as *who or what is being trained*, within this risk of relying upon a system to inform individuals that someone needs to urinate, there are additional implications on interpersonal relationships and power imbalances as attention and care might also be transformed.

Actuating Bodily Experiences

Within designing with intimate and somatic data there is also a concern for the actuating of bodily experiences, by which actuation both reveals and displaces. Through the transformation of somatic interpretations into the actuation of an external device or system, something previously implicit, unnoticed, or unacknowledged is made explicit, available, and recognizable. As shown through Clip and Snip, this resulting judgment has the potential to be both useful and shameful in social and private situations. For example, as previously mentioned, a system's diagnosis of health through the clipping of a hem might also be understood as a symptom of something else, whether accurate or not. Thus, furthered through the autobiographical reflections, I highlight that functionality and use of automated actuations prompt considerations regarding unintentional expositions and interpretations.

While actuating bodily experiences might create new opportunities for empowering people, it might also displace existing opportunities and individual agencies. As discussed in autobiographical reflections, going to the toilet can also be an excuse to escape a conversation, have a conversation, or take a break. While some of these might involve a genuine urge to urinate, they might also take advantage of bodily excretion as a taboo topic and the restroom as where for some might be considered a safe space, such as to address personal and private issues. For many, "going to the toilet" is much more than bodily excretion, but the externalization of a perceived somatic state risks a loss of agency for people to use or misuse the internalization of their own bodily experiences relative to particular situations. Thus, designers might consider how to maintain some things as unquestionable as others become available through on-body and device actuation more broadly.

Scaling Intimate Interactions

The third consideration for designers is the scaling of intimate interactions, within which lies designing for a population rather than an individual. As usage becomes shared as interactions with devices participate in public services, how can potential power structures between different types of users and stakeholders be made more salient in the design of data-driven systems? Design and power is not a new topic [12], and through Survey and Shoot I foreground that despite attempts for a more equal or just system, the knowledge of intimate data does not remove, rather transforms, power and access. With my reflections on Survey and Shoot, this concern is furthered by considering not only how technology can be used and misused to enforce power structures, but also how power structures can be counteracted through an understanding of how such technology works, such as in speculative "pee dances" to attract rather than evade a camera network.

Lastly, I would like to highlight the sociomateriality [39] of intimate interactions at scale and in public situations, a perspective that builds upon intimacy as an interactional outcome rather than a property of data [42]. Relative to autobiographical reflections on Survey and Shoot, the social significance of something intimate is also loaded with something that affects performance, resulting in a somatic experience of that sociality. More specifically, as demonstrated through provisional access

to a toilet stall whereby safety and security are compromised, and whether in the context of friends or strangers, designing intimate interactions at scale also includes considerations of the broader network and fluidity of individuals in a population.

Design Opportunities for Bodily Excretion

While it might be expected that through this design space I identify concrete opportunities to empower marginalized or vulnerable user groups, I instead contribute methodological opportunities for re-conceptualizing bodily excretion for a growing body of notable research that has already identified important areas of intervention. For example, the arts-based research project Around the Toilet has engaged in a long-term participatory process, with a rare trans-inclusive approach, to understand and identify both relational and functional flaws of public toilets in the United Kingdom [58]. Yet despite such research and significant funding towards better solutions for bodily excretion [40], many solutionist approaches within commercial markets continue to proliferate stigmas and values such as those identified in my critique [43]. Thus, for interaction designers working in this domain on solutions, I offer my methodological process for the reprogramming of a design space, through which emerges "the ability to see something as quite different than it is" [55]. In particular, through an autobiographical approach, I was able to divergently reflect upon relationships with technology and people to see what was previously obscured within my own practice. My own future work includes inviting other perspectives through the continued development of the three concepts in other forms to investigate new conflicts and practices that would arise if in the world as real objects.

Reflection on Positionality

Each step within my design and research process was heavily influenced by my own Western, situated perspective. The three resulting themes from the market critique reflectively omit many other possible and valuable design directions for bodily excretion that might be seen by people with other backgrounds and experiences. My privileged position is also overtly evident in the design intentions of the three provocations, and in particular within how they are intended to be provocative. For example, someone who prefers to wear a revealing dress or is not capable of lifting their garment might not find Clip and Snip provocative. Also, positionality can change, illustrated through my own, more recent interpretation of Truth and Dial. The concept was designed six months ago and now, at the time of writing this paper, I am five months pregnant. As I prepare for a baby, I no longer find the provocation as provocative as I originally intended it to be, and instead find it appealing. This new reading of Truth and Dial and the invitation of others is embedded within this body of work as a Research through Design contribution [5] and thus I consider my own analyses and design intentions only one fluid perspective of many.

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