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Margherita Motta
EPFL+ECAL Lab, Switzerland

Delphine Ribes Lemay
EPFL+ECAL Lab, Switzerland

Sebastian Baez-Lugo
EPFL+ECAL Lab, Switzerland

Annelaure Klaus
EPFL+ECAL Lab, Switzerland

Nicolas Henchoz
EPFL+ECAL Lab, Switzerland

See next page for additional authors

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Designing for intimate wellbeing: Aidee, a qualitative approach to urine home monitoring

Margherita Motta*, Delphine Ribes Lemay, Sebastian Baez-Lugo, Annelaure Klaus, Nicolas Henchoz, Emily Groves

EPFL+ECAL Lab, Switzerland

*Corresponding e-mail: margherita.motta@epfl.ch

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Abstract: Despite the widespread use of self-tracking technologies for promoting personal wellbeing, there is limited research on the monitoring of intimate data, particularly urine. To shed light on the design possibilities within this unexplored domain we designed Aidee, a prototype system composed of an app and interactive device that assists users in performing urine monitoring through qualitative data expression and ambient physicalization. To evaluate our prototype we conducted an exploratory between-subjects study involving 54 participants. Our findings indicate user acceptance for qualitative data expressions in the domain of personal wellbeing. Moreover, our study underscores that the combination of an app and interactive device helped people in consulting their urine analysis results with serenity and in experiencing feelings of support and companionship. With this paper we discuss the opportunities and challenges for designing monitoring experiences to promote intimate wellbeing by combining innovative ways of representation and interaction with data.

Keywords: Self-tracking, Quantified Self, Personal Data, Intimate Data, Urine monitoring, Data Visualization, Ambient Devices, Situated Design

1. Introduction

Self-tracking technologies have transformed the way individuals manage their health and wellbeing, and can support self-determination and motivation in these domains (Ayobi et al., 2017; Bentley et al., 2013). However, such technologies have been linked to increased anxiety and hypochondria (Gabriels & Moerenhout, 2018) and a disconnection between users and their lived, physical experiences (Smith & Vonthethoff, 2017). Furthermore, over-medicalizing self-tracking has been criticized for overlooking the everyday aspects of wellbeing management (Nunes, 2019).

Intimate data tracking, particularly urine analysis, presents additional societal and cultural complexities (Kama & Barak-Brandes, 2013). And whilst the biomarkers in urine can give valuable health insights (Graff, 1983; Pisitkun et al., 2006), help with disease diagnosis and management (Warren et al., 2014) and provide general wellbeing assessments (Helms, 2019), urinalysis is often limited to medical settings, involving reagent strips or time-consuming hospital procedures (Bae & Lee, 2018; Mao et al., 2021). Building on the growing interest in human-computer interaction (HCI) on the self-monitoring of body fluids (Helms & Campo Woytuk, 2021; Søndergaard & Balaam, 2022), our work aims to make some first steps in addressing the existing deficit of research in the complex area of urine-tracking outside of the hospital setting.

In this paper, we introduce Aidee, a prototype system composed of an app and interactive device known as the Aidee Light. Aidee is designed to support users in performing automatic urine analysis at home through a sensor installed in the toilet developed by a partner institution. Our design work focused on mixing qualitative data representation (Lockton et al., 2017) with an ambient approach to data physicalization (Jansen et al., 2015).

We first outline previous research on intimate and urine monitoring as well as personal data interaction. We then describe our methodology, from preliminary studies to the final design of the Aidee prototype. Finally, we report on the results of a between-subjects study evaluating Aidee. We position this work and its discussion as an exploration on how design studies can navigate challenges such as social norms, privacy and self-discovery associated with intimate data to promote personal wellbeing. With this, we aim to enrich the understanding of self-tracking practices for urine home monitoring.

2. Background

2.1 Urine and the monitoring of intimate data

Care of intimate bodily functions is shrouded in taboo and stigma. Bodily fluids such as urine have been historically associated with shame and uncleanliness across various societies (Kama & Barak-Brandes, 2013). This can make research and design in these areas emotionally charged (Almeida et al., 2016) and pose ethical and experiential challenges beyond those encountered in tracking other biometric data such as exercise or heart rates.

Though the market for the self-tracking of intimate data is expanding, little attention is paid to its differences and specificities (Helms, 2019). Standard commercial approaches tend to overlook the complexity of intimate functions, turning their data into a commodity (Søndergaard, 2016) and can lead to misleading perceptions of objectivity, diminishing personal experiences and raising questions about surveillance and privacy (Lupton, 2015).

There has been a call for a shift from a medicalized to a mundane approach (Nunes, 2019), which emphasizes empowering individuals with self-knowledge and decision-making skills. It is argued that to create compelling and fulfilling experiences, the development of digitized

and automatic health practices can't be left solely to technical disciplines (Søndergaard & Balaam, 2022); design has a critical part to play in its advancement.

The HCI community has recently begun to address the challenges of intimate data, specifically regarding period management. PeriodShare, a speculative design fiction project, proposes a menstrual cup to reflect on cultural norms surrounding the subject (Søndergaard & Hansen, 2016). Ambient Cycle uses a phenomenological approach to discuss opportunities in the design of menstruation trackers (Homewood & Vallgårda, 2020). Other forms of intimate data, including gut microbiome (Boer et al., 2020; Lenskjold & Wilde, 2022), fertility tracking through saliva (Homewood et al., 2019), and vaginal bacteria (Tomasello & Almeida, 2020) have also been the subject of design research. These projects shift from a purely clinical approach to explore the societal role of self-tracking and body function. They also open up the design space around these areas by promoting experiences based on self-care, knowledge and personal exploration.

Spurred by the popularity of mHealth technologies, several technical projects dedicated to urine tracking have been presented in recent years. These initiatives introduced innovations such as smart toilets with built-in sensors for analyzing urine components (Bae & Lee, 2018), multi-sensing devices based on flexible electrodes (Mao et al., 2021), and independent toilet modules for analyzing human waste data (Park et al., 2020). Although these devices provide crucial technological advancements, little or no focus is put into design or user experience.

In HCI, work focusing on urine has speculated on the possibilities of designing for its management (Helms, 2019), and has investigated the norms that surround the private space of a toilet room (Boer et al., 2015). With provocative approaches, these studies provide insight on the relationships and conflicts between technology, body functions and privacy. However, they do not encompass experiential aspects of urine tracking and related data interaction. The absence of comprehensive research in the area highlights an existing gap in the literature, particularly concerning experiences of urine analysis in domestic settings. Building upon methods and insights from HCI in other areas of intimate tracking, we see value in research that engages with the experiential dimensions of urine tracking in the domestic setting. Such an approach could foster interest in a subject often overshadowed by societal norms and shame, encouraging new avenues for engagement with the body and the self.

2.2 Interacting with personal data

Most commercially available tracking devices use mobile applications to present data to users. The data is typically represented through visualizations consisting of numerical charts and tables. This kind of system, although familiar, risks inducing stress and anxiety in users about not fitting into idealized results (Gross et al., 2017; Orji et al., 2018). Moreover, the challenges associated with interpreting the data can lead users to lose interest in self-tracking technologies (Choe et al., 2014). Indeed, relying solely on numbers has been suggested to be meaningless for the user, and even harmful (Snooks et al., 2022), as quantification of-

ten falls short of capturing the complexities of bodily phenomena. Therefore, balancing nuanced approaches of individual experience with medical precision is a notable challenge in digital self-tracking for health and wellbeing (Jenkins et al., 2019).

In response to the shortcomings of strictly quantitative methods, there is an emerging emphasis on qualitative data representation. Lockton et al. define this paradigm as an approach in which information is represented primarily through qualities of phenomena (Lockton et al., 2017), preserving the complexity of lived experiences.

Physicalization of data (Jansen et al., 2015) aligns with the qualitative approach by offering physical representations of information, diverging from traditional formats limited to screens or paper (Willett et al., 2017). Many projects explore the potential of physicalization in encouraging reflection and enabling new ways of making sense of data with both static (Lean, 2020; Sauvé et al., 2020; Stusak et al., 2015) and dynamic approaches (Damen et al., 2020; Ju et al., 2019; Menheere et al., 2021). The significance of the physicalization in the field of self-tracking and intimate body functions is underscored by projects like Shit! (Wilde, 2022) and Curious Cycles (Campo Woytuk et al., 2020). These initiatives illustrate the potential of physical, sensorial representations of biodata in empowering individuals to cultivate healthier relationships with often stigmatized aspects of their bodies.

Physicalization can also embrace intangible modalities and interaction can assume subtle forms. Weiser and Brown's well-cited term Calm Technology describes technologies that seamlessly integrate into users' daily routine, allowing for interactions that can take place in the background but can be brought to the foreground when needed (Weiser & Brown, 1995). Bakker et al. have recently extended the concept by exploring how peripheral interactions can be designed to focus on the contexts and routines in which these interactions occur (Bakker et al., 2015). Many recent HCI projects engage with this idea, encouraging self-knowledge through seamless integration in the home (Lee et al., 2020; Mols et al., 2020; Sauvé et al., 2017). The use of light as a medium has been extensive in this context, as it allows for an unobtrusive expression of feedback and information with freedom and flexibility (Aliakseyeu et al., 2016; Kim et al., 2022; Noh et al., 2020; Snyder et al., 2015; Yu et al., 2018).

3. Methodology

3.1 Project background

The Aidee project emerged from a collaboration with a technical partner interested in developing a product for urine home monitoring. The envisioned system - still in its ideational phase - involves a toilet add-on, biosensor cartridges and an app for consulting results. The cartridges were designed to measure three biomarkers: pH, glucose, and sodium ions (Na+) which were selected as they can provide valuable health insights.

3.2 Preliminary studies and experimentations

We began our design process by conducting semi-structured interviews with 16 potential users. The aim was to investigate personal relationships with self-tracking and initial impressions on the concept of home urinalysis. This led us to experiment with different forms of data representation via two rounds of workshops (Figure 1) and evaluation sessions with low fidelity prototypes (Figure 2).

Figure 1 Participants interacting with low-fidelity prototypes during two workshops.

The first round, involving 12 participants, explored ways of visualizing and representing data through different media. The second round, held with 7 design and engineering professionals, aimed to improve our initial prototypes, identify usability issues and redefine the design process. Our results underscored the importance of addressing urine tracking's inherent complexities and the need for data representations that foster personal reflection and understandability beyond numbers. A comprehensive description of these first research phases is given in (Motta, Groves, et al., 2023). Guided by these insights, we integrated qualitative expressions alongside traditional numerical data into our subsequent designs. Our aim was to try to capture the nuanced dynamics of urine tracking and to explore how to open intimate spaces for reflection and self-knowledge.

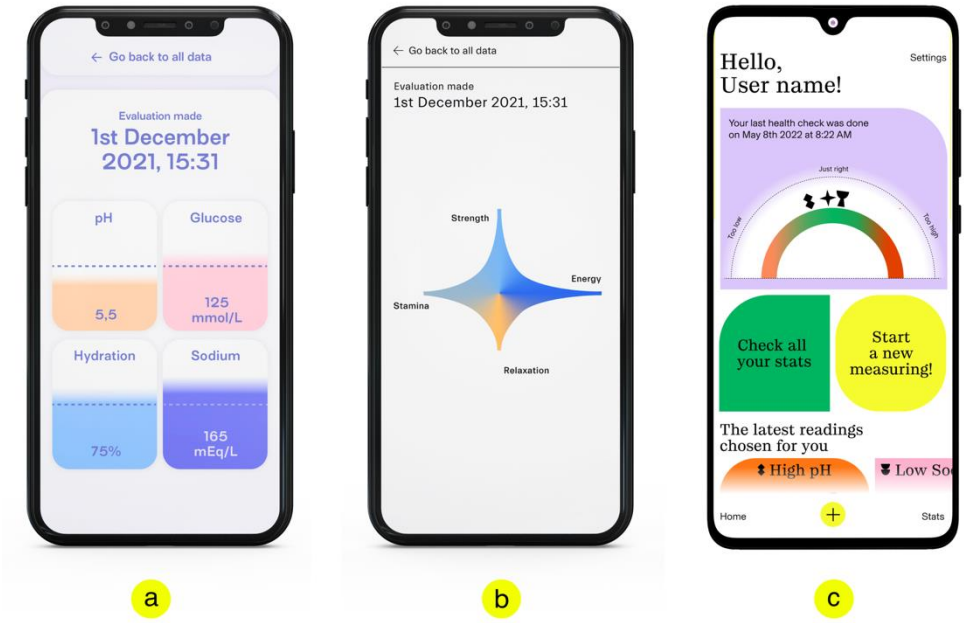

Figure 2 Prototypes employing different data representation modalities evaluated in the first (a & b) and second (c) workshop.

3.3 Aidee, combined app and interactive device

The final prototype, Aidee, is a system composed of an app and an interactive device designed to facilitate home tracking of urine biomarkers.

The application: The app, designed as an interactive Figma prototype, features a dashboard (Figure 3a), settings (Figure 3b), and urinalysis results. It guides users through urine measurement via a conversational system offering sequential instructions (Figure 3c). This choice was motivated by a desire to engage users informatively during the waiting period associated with the in-toilet sensor's processing time. Users can indicate their emotional state during the process (Figure 3d), with the aim of facilitating long-term correlations between their emotional states and urinalysis results. Emojis, effective in conveying health-related information (Lin & Luo, 2022), are used for this.

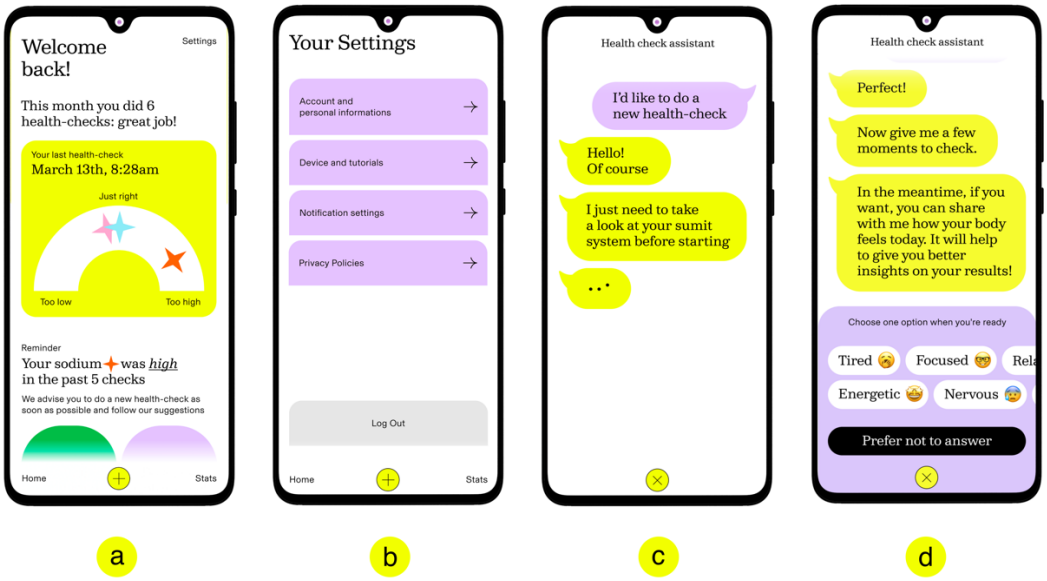

Figure 3 App interface overview a) Homepage, b) Settings, c) Conversational system, d) Conversational system asking the user's emotional state.

With a non-medicalized and qualitative approach, we designed the app's results section (figure 4) around the concept of balance. We drew on the idea that using ambiguity in systems engages users in critical thinking and interpretation (Gaver et al., 2003). This can promote deeper understanding and personal connection to systems, and, in our case, to the body function we are tracking (Sengers & Gaver, 2006). The daily data representation therefore employs a number-free gauge that ranges from "too low" to "too high", with a "just right" midpoint (Figure 4a). This allows the three biomarkers, represented by colored stars, to be viewed together despite differing units of measurement. Clicking on a star opens a biomarker detailed page (Figure 4b) providing the precise numerical value, trend analysis, and practical advice for maintaining balance, including lifestyle suggestions. The historical overview of results (Figure 4c) follows the same qualitative scale. The app's overall tone aims for approachability and warmth, using direct language and vibrant colors to ease any awkwardness associated with urine analysis. It's important to note that the app prototype was developed with limited functionalities and paths but allowed for autonomous interaction, enabling users to engage with the presented system independently..

Figure 4 App results section a) Daily results, showing on top the biomarkers on a gauge visualization and a on bottom narrative description, b) Focus on sodium biomarker, c) Over time overview of the results.

The Aidee Light: The Aidee Light (Figure 5) is a device designed to provide real-time feedback on urinalysis results through the use of lights and sounds. Comprising a base with a Raspberry Pi, a small speaker and a lampshade containing two LED strips, the device guides users through daily monitoring and offers information on ongoing technical processes.

The design concept of the Aidee Light is grounded in theories of situated visualization (Willett et al., 2017), data physicalization (Jansen et al., 2015), calm technology (Weiser & Brown, 1995) and peripheral interaction (Bakker et al., 2015). Guided by these theories, we intended that a subtle, ongoing display of intimate data could encourage internal reflection on bodily functions. Additionally, for healthy users who often receive in-range results, we sought to minimize obsessive focus on numbers, reducing potential stress or loss of interest.

The appearance of the Aidee Light is intentionally neutral and avoids a clinical look, opting for rounded shapes and home-friendly materials. The white ceramic base and frosted glass lampshade can integrate into different home environments and allow smooth LED behaviors, both static and animated. The device also communicates through sounds, such as a tonal bell chime that signals that urinalysis results are ready for consultation. Chosen for their metaphorical and evocative qualities, such sounds can facilitate diverse interpretations and enhance engagement (Caiola et al., 2022). Functionally, the Aidee Light helps in the tracking process, serving as a digital assistant. However, in a deliberate design choice inspired by feminist critiques on digital personal assistants (Søndergaard & Hansen, 2018), we aimed for

the Aidee Light to avoid relationships of control or dependency with the users. Instead of focusing on data accuracy or medical substitution, our aim was to create a supportive setting for users' wellbeing.

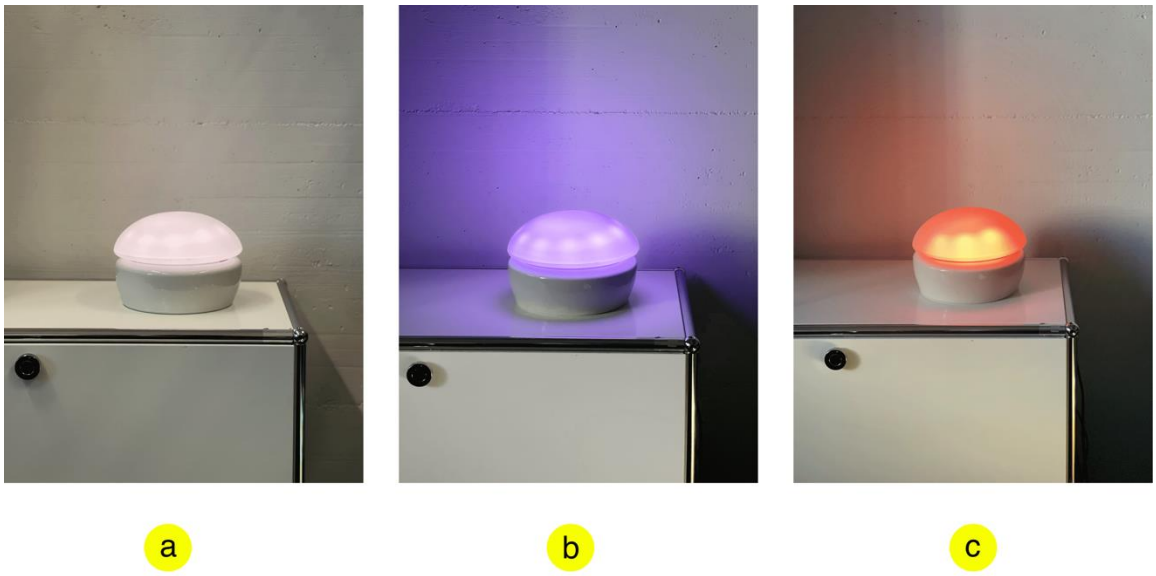

Figure 5 The Aidee Light: a) Basic state, b) Notification that results are ready to be consulted through static lilac lights, c) display of results through orange, circular animations.

4. User evaluation

4.1 Study design

We set up a user study with our prototype to investigate:

1. How the combination of qualitative data representation through the app and the Aidee Light might facilitate new forms of emotional and cognitive engagement in the field of wellbeing and urine tracking.
2. How the Aidee Light might support the user in urine tracking activity.

Our study focused solely on the app and the Aidee Light, without incorporating the physical urine capturing and tracking device, which was not ready for evaluation. Our intent was to gauge the potential impact of the app and light in isolation, as an explorative step towards a more comprehensive system evaluation. To this end, we implemented a between-subjects study comprising two conditions (Figure 6), with an equal number of participants assigned to each:

- **Condition A**: Participants interacted solely with the app.
- **Condition B**: Participants interacted with both the app and the Aidee Light.

Ethical approval was granted by the Human Research Ethics Committee at the Swiss Federal Institute of Technology Lausanne (EPFL). An information sheet was presented to each participant and written consent was obtained before each session.

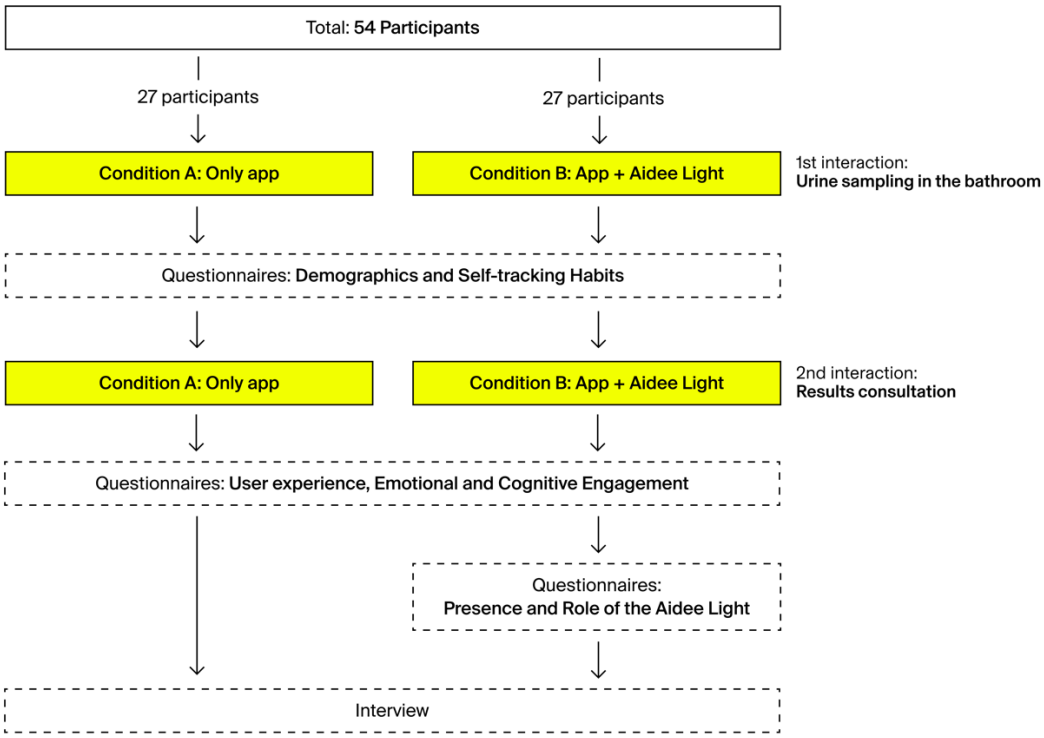

Figure 6 Diagram of the testing procedure, showing the division of participants into two testing groups and the associated data collection methods.

4.2 Participants

To recruit participants, we promoted the test as a study about personal wellbeing at home through adverts on local university platforms, flyers in gyms and word of mouth. A total of 54 participants (P1-P54) took part in the study, with 27 assigned to each condition. Out of the total, 28 identified as female (51.85%), 26 as male (48.15%). The ages of the participants ranged from 18 to 41 years old (M=23.11, SD=4.47). As compensation for their participation, they each received 20 Swiss francs.

4.3 Procedure

The study was conducted in a studio apartment styled to replicate a domestic setting (Figure 7). Participants were briefed about the study and were asked to imagine being in their own home. They were then led to the bathroom, where they used the application to follow the urine measurement process. Ethical considerations permitted participants to opt out of physically urinating, while being informed that the forthcoming results would be fictional. After this simulation, participants filled out pre-study questionnaires. They then accessed their urinalysis results either through the mobile app or, in condition B, also the Aidee Light. Every participant was given the same results, displaying normal pH and glucose levels but high sodium concentrations. No time constraints were imposed on participants as they reviewed their results. The session concluded with additional questionnaires and a semi-structured interview facilitated by a member of the research team.

Figure 7 Testing environment, including the main room, kitchenette, and bathroom.

4.4 Data collection and analysis

The questionnaire was divided into five sections to evaluate the following aspects:

1. *Demographics and Self-Tracking habits*: Basic demographic details were collected, along with perceptions of self-tracking through five 7-point Likert scale items.
2. *User experience*: Evaluated using the short form of the UEQ questionnaire (UEQ-S) (Schrepp et al., 2017), composed of 8 semantic differential items.
3. *Emotional engagement*: Assessed through custom 7-point Likert scale questions focused on affective reactions and self-reflection, like: "The representation of the results confused me".
4. *Cognitive engagement*: Assessed via 7-point Likert scale items exploring understanding and interest around the results, like "I didn't understand my results". The open-ended question “Could you briefly describe the results you got after your health check?” was also included in this section, and was evaluated using a 3-point scale, rated from 'incorrect' to 'totally correct' based on the ability to recall tracked biomarkers and their relation to the normal range.
5. *Presence and role of the Aidee Light*: Investigated through one open-ended question, "Describe your impressions and feelings regarding the environment", and seven 7-point Likert scale items, like "The lights were helpful in understanding the experience".

During the interviews, we addressed the following themes: comparisons with other tracking technologies the participants have used, opinions on the data visualizations, positive and negative parts of the experience, perception of the Aidee Light and connection within the system. The full questionnaire, interview script and testing procedure can be found at (Motta, Ribes Lemay, et al., 2023).

Quantitative analysis was performed using RStudio (version 4.2.2). Descriptive statistics were used to determine the means and standard deviations of our variables. Subsequently, inferential statistics were applied to assess between-group differences (Condition A vs. B) on the UEQ-S score, pragmatic quality, and hedonic quality (UEQ-S subscales). Data normality was assessed using the Shapiro-Wilk test, with nonparametric Mann-Whitney U tests applied when needed.
For emotional and cognitive engagement, a composite score with a maximum value of 7 was created for each dimension by averaging the values of their specific items, with negative items reverse-scored.
For qualitative data, a thematic analysis (Braun & Clarke, 2006) was employed to identify recurring themes. This process was independently carried out by two authors, and the results were reconciled to establish a final consensus on prevalent themes.

5. Results

Analysis of the UEQ-S (Figure 8) indicates that both Condition A and B received overall positive user experience evaluations (values>0.8). Specifically, Condition A achieved an excellent score (M=1.66, SD=0.75), as did Condition B (M=1.69, SD=0.79). When directly comparing Condition A to B in terms of overall user experience, no statistically significant differences were observed between them (U=345, P=0.73).

Regarding the UEQ-S subscales, Condition B received a higher hedonic quality score than Condition A (MB=1.75, SDB=0.9; MA=1.55, SDA=0.8) and a lower pragmatic quality score than Condition A (MB=1.6, SDB=0.8; MA=1.7, SDA=1). However, statistical tests revealed no significant differences between the conditions in hedonic (U=298, P=0.2) or pragmatic (U=424, P=0.3) quality ratings.

Figure 8 Results of the UEQ-S, both overall and subscales, divided per condition and compared.

During the interviews, around half of the participants (26/54, 48.15%) spontaneously described the general idea of home urine monitoring as interesting or helpful. For example, P24 mentioned how the system "can help to improve your life". P37 was one of four participants who unpromptedly expressed appreciation for the application's qualitative focus, differentiating it from other medical apps: "It's not just about today's numbers…it's about your wellbeing in general!".

Analysis of the emotional engagement indicates that both Condition A (M=5.5, SD=0.63) and B (M=5.44, SD=0.69) fared very positive results, indicating robust levels of affective engagement across the board. When directly comparing the conditions, no statistically significant differences were observed (U=334.00, P=0.941). In a corroborative vein, 41 participants (75.93%) asserted a connection with their individual results. Similarly, 40 participants (74.074%) saw themselves reflected in the results (Figure 9).

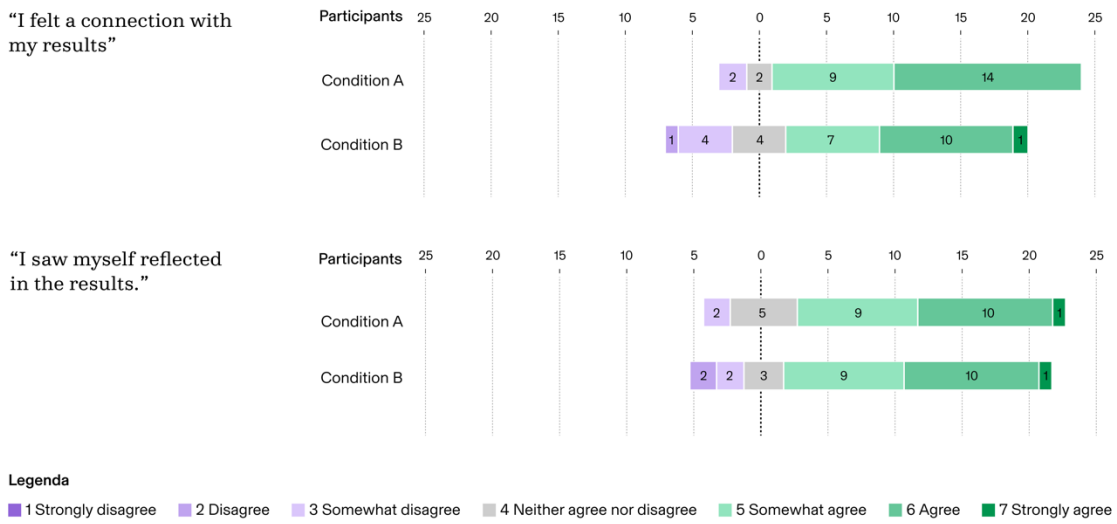

Figure 9 Stacked bar graphs, divided by condition, for the questions "I felt a connection with my results" and "I saw myself reflected in the results".

On the dimension of cognitive engagement, participants displayed a robust understanding of the experience for both Condition A (M=5.78, SD=0.81) and Condition B (M=5.49, SD=0.80). Again, no statistically significant differences were found between conditions (U=413.00, P=0.169).

Regarding understanding of their results, Condition A had 13 participants who were totally correct and 12 partially correct, adding up to 92.6% accuracy. In Condition B, 11 were totally correct and 10 were partially correct, totaling 87.5% accuracy. Across both conditions, 43 out of 54 participants (79.63%) reported a clear understanding of the significance of their results.

Figure 10 summarizes the answers to the items regarding the qualitative visualizations. A substantial proportion of participants (45/54, 83.33%) expressed a favorable opinion to our visual representations. In addition, they were found to be useful for understanding their results by 46 participants (85.18%), clear by 43 (79.63%), and non-confusing by 37 (68.53%). These results were reiterated qualitatively during the interviews, with comments like "It's easy to understand without numbers" (P20) and "It's really nice, catchy, fast and easy to understand" (P7).

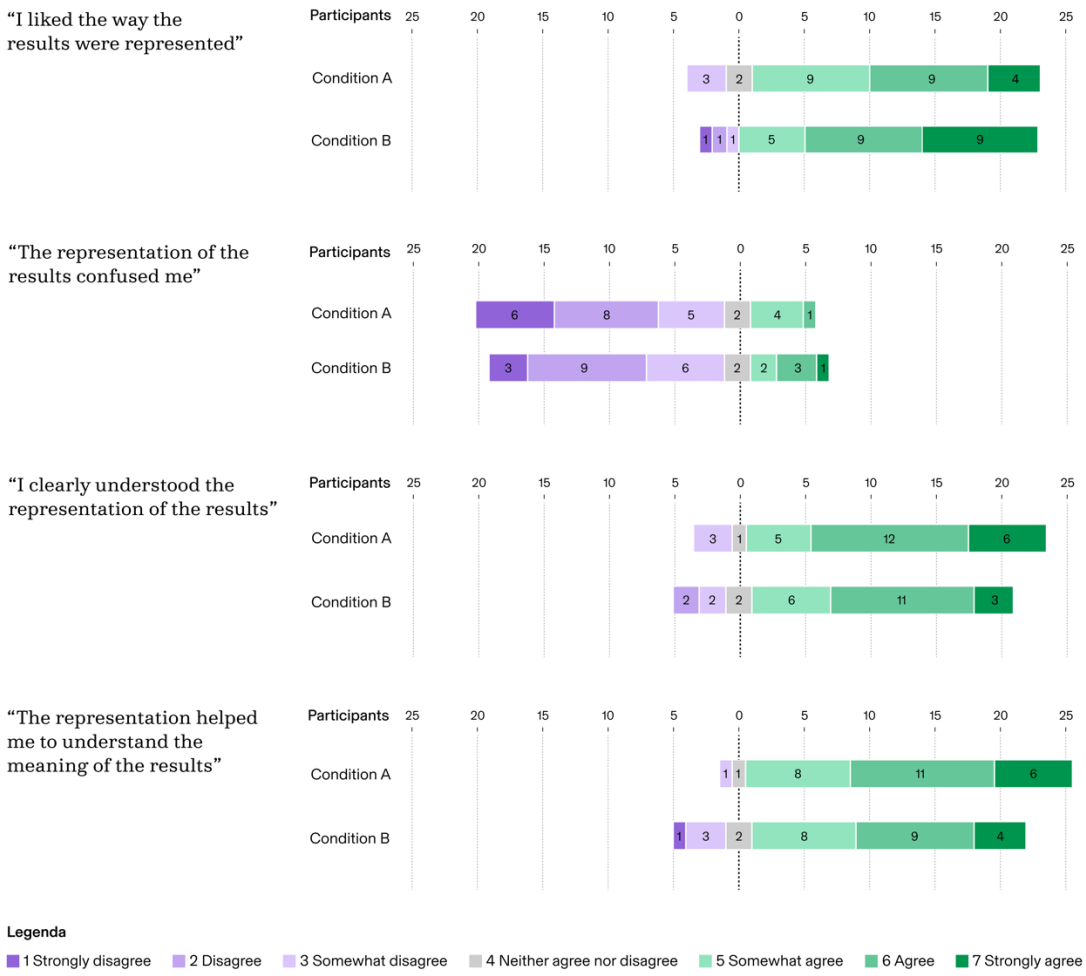

Figure 10 Stacked bar graphs, divided by condition, for the questions "I liked the way the results were represented", "The representation of the results confused me", "I clearly understood the representation of the results" and "The representation helped me to understand the meaning of the results".

Regarding the Aidee Light, the results also show that the majority of participants appreciated the combinations of lights and sounds (19/27, 70.37%). More specifically, the vast majority of participants were not disturbed by the lights (25/27, 92.59%) and found them to be helpful in understanding the experience (17/27, 62.96%). These results are reiterated by the interviews, where the lights were described as "helpful in understanding how my urine was" (P44) and like "it's very interesting [...] to understand what is going on with the app" (P40). Furthermore, the sound elements were also well-received, characterized as "almost soothing" (P11) and "calm and peaceful, it doesn't add stress" (P52). Although 20 (74.07%) reported that the sounds did not interfere with the experience, only 10 (37.04%) found them directly helpful for interpreting their results.

When contemplating the future adoption of the Aidee Light, a majority of participants (20/27, 74.07%), envisioned the device fitting into their home environment. Moreover, 22 participants (81.481%) saw a link between the Aidee Light and the app in the experience,

with 11 (40.74%) mentioning the functionalities of the device and interactions with it to be the main point of connection. In this regard, P46 said “I don't think I would use the Aidee Light without the app, but also the opposite is true".

In both the questionnaire and the interviews, when asked to describe their impressions and feelings regarding the Aidee Light and the environment, 14 participants (51.85%) described comfort and relaxation. What’s more, others (8) impromptu mentioned seeing a companion-like presence in the Aidee Light. P52's observation, “you feel like you are with someone in the process,” and P34's sentiment that “it's almost like there's a real person with you,” describe these feelings. This concept was nuanced by participants like P47, who observed that this quality of the device could function as an "outside perspective," alleviating the intense burden they associate with personal health management. Similarly, P33 stated: 'You're not alone with the results and the phone, we're two together,' they explained. They elaborated that the interaction with Aidee Light was “kind, almost uplifting”, thereby mitigating guilt or stress often associated with health self-monitoring.

Full results can be found at (Motta, Ribes Lemay, et al., 2023).

6. Discussion and future work

6.1 User acceptance of qualitative data representation

Our research aimed to explore methods for fostering a deeper emotional and cognitive connection between users and their personal data. This led us to design the Aidee system with a focus on qualitative data representation. We minimized numerical information on the app by using a number-free scale and a narrative style. The Aidee Light, complementing the app, uses situated visualizations based on subtle lights and sounds.

The positive UEQ-S results show acceptance of a qualitative approach in this context. Results from emotional and cognitive engagement questionnaires indicate that, through our design, users were able to understand their intimate information and experienced emotional engagement. Importantly, the ability of participants to recall their results indicates that using qualitative representation did not make it harder for them to comprehend their data. Furthermore, the qualitative data representations were also appreciated for their aesthetic and conceptual characteristics in the interviews, underscoring an effective response to our design strategy.

Additionally, in our system, the qualitative data expression was not limited to the app but was also implemented in the Aidee Light. The situated visualizations employed by the device were found by participants to be non-invasive and non-disturbing and were considered helpful in enhancing the understanding of the experience.

Collectively, our results show that qualitative expressions of data, even in the complex domain of intimate wellbeing, offer valuable avenues for user comprehension, emotional response, and overall experience. Indeed, the positive responses from our participants highlight the relevance of the qualitative approach, encouraging a reevaluation of the prevailing

quantitative frameworks. The link perceived by participants between the app and the device also suggest how the integration of different interaction modalities could support a deeper and more diverse understanding of personal monitoring. Here, we see it as important to allow space for quality while also providing precise data when needed or desired. These findings open up future research to further explore the benefits of qualitative methods in the creation of intimate digital self-tracking experiences. An integrated system like Aidee's could, for example, be used to study long-term effects on the consistency of self-monitoring and the creation of stress-free tracking routines in healthy users.

6.2 Designing for companionship and support

When we designed the Aidee Light, we did not aim for it to compete with medical expertise, but rather to allow users to establish a deeper connection with an intimate aspect of their wellbeing. By situating the Aidee Light in living spaces rather than secluded bathroom areas, our intention was to normalize the act of urine monitoring and discussion around it. The device, characterized by neutral aesthetics and subtle, non-intrusive interaction modalities, was conceived to address initial user barriers like feelings of discomfort or aversion.

Our results show that the physical presence of the Aidee Light was indeed perceived by participants as soothing, almost imperceptible until activated. Yet once engaged, it asserted a meaningful role in the monitoring practice. Its design and peripheral interaction modalities were noted for offering privacy in shared spaces and striking a balance between intimacy, exploration, and self-awareness.

Furthermore, feedback from participants brought to light an unforeseen part of the experience; the subtle design and interactions went beyond their primary purpose, and helped the Aidee Light become a companion through the urine measurement process. Participants expressed feelings of support and security. They also described a sense of being accompanied by a tangible presence, which can transform the act of urine analysis into a more comforting experience. This sense of companionship was further described as providing an "outside perspective," helping to lighten the perceived burden of personal health management.

As the literature on self-tracking acknowledges the risk of becoming overly fixated, anxious or compulsive with one's personal data (Costa Figueiredo et al., 2018; Gabriels & Moerenhout, 2018; Lupton, 2016), these insights prompt us to consider the long-term implications of employing such a device. Paired with previous research emphasizing the integration of data into the daily life of users (Kim et al., 2022; Lee et al., 2020; Menheere et al., 2021; Odom et al., 2019; Ylirisku et al., 2013), our study indicates the potential for intimate technologies that leverage physicality and situated visualization to create innovative and personal ways of understanding and interacting with data. Such a combination could facilitate a more balanced relationship with monitoring practices by conveying support, security and even companionship.

6.3 Limitations and further research

Our study's primary limitation is its narrow exposure time, limiting our understanding of users' evolving emotional and cognitive responses, such as disengagement, which vary with usage frequency and context. Another limitation stems from the use of mocked results, which affected participant immersion, and a sample predominantly comprising young, educated individuals, narrowing the cultural context of our findings. Additionally, our between-subjects study design, paired with the broad nature of our research questions, did not lead to significant differences between conditions, suggesting that this approach may not have been optimal for capturing the nuanced impact of our solution. Future research should instead focus on gathering detailed insights into participant experience over a longer period of time, also including the physical urine tracking device for a comprehensive assessment.

7. Conclusion

In this paper, we open up the design discussion around urine monitoring by presenting the Aidee system and its exploratory evaluation. Our findings emphasize user acceptance of combining qualitative data representation and ambient physicalization in this sensitive domain. It also highlights the potential of this approach for providing emotional support and companionship. Despite its preliminary nature and inherent limitations, this study lays essential groundwork for future research into the design of technologies for tracking urine and other intimate data.

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About the Authors:

Margherita Motta is a designer and research working in the fields of user experience, interaction design and communication. Her practice revolves around the relationship between digital realities and the human, embodied experience.

Delphine Ribes Lemay, Head of Creative Coding at EPFL+ECAL Lab, specializes in medical image processing, leads AI research, manages healthcare projects, and lectures on machine learning and creative coding.

Sebastian Baez-Lugo is a UX researcher and cognitive neuroscientist, his primary interests lies at the crossroad of human centered technologies and digital health.

Annelaure Klaus is a researcher with a background in psychology and criminology. Her main interest is the influence of technology on well-being.

Nicolas Henchoz is the founding director of the EPFL+ECAL Lab which explores the perspectives of emergent technologies through design. Trained as a scientist, he previously worked in science journalism and at the direction of the Ecole Polytechnique Fédérale de Lausanne.

Emily Groves is a design researcher and educator. With a background in anthropology, experience design, and inclusive design, her interests lie at the intersection of technology and culture.