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DESIGNING FOR SLOW REFLECTION: USING A PHYSICAL ARTIFACT TO REFLECT ON SCREEN EXPOSURE

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Master thesis, 15 hp
Master's Programme in Human Computer Interaction and User Experience
SPM 2025.02

Abstract

This thesis explores how slow technology design qualities can be applied to personal informatics to encourage sustained reflection on daily behaviors, specifically screen exposure before sleep. We developed a low-fidelity, tangible artifact - a figurine - whose appearance gradually transformed based on participants' self-reported data over three days. The design incorporated three key slow technology qualities: explicit slowness (deliberate delays in feedback), ongoingness (cumulative transformation), and pre-interaction (a morning audio message). Our findings show that the pre-interaction phase primed participants for reflection, with voice journaling fostering anticipation and self-awareness. The figurine's gradual transformation made participants more conscious of their habits. However, explicit slowness - delaying the feedback -was often perceived as a barrier rather than an opportunity for reflection. While one participant appreciated the delay, others expressed frustration, revealing challenges in aligning slow design with fast-technology expectations. Additionally, though reflective moments were observed, not all participants specifically reflected on screen use before sleep as intended. Overall, the study demonstrates the potential of slow technology qualities to foster reflection in personal informatics, but suggests further refinement is needed to sustain engagement and support the shift from fast to reflective interactions.

Keywords: Slow technology, personal informatics, reflection, explicit slowness, ongoingness, pre-interaction, artifact, human-computer interaction.

1. Introduction

1.1 Overview

In today's digital age, technology is often designed to be fast, efficient, and productivity driven. Modern applications and most devices focus on providing quick feedback which helps users to complete their tasks efficiently. Speed optimization has become essential for digital tool interaction since this approach improves effective working and streamlining the daily routines (Norman, 2013).

In addition to efficiency-focused approaches, digital tools have also facilitated self-tracking, where the users can monitor and reflect on different elements of their daily routines, including screen time, sleep and physical activities. Users gain self-knowledge through data collection and feedback by using self-tracking technologies within personal informatics (Li, Dey, & Forlizzi, 2010). However, meaningful self-tracking goes beyond data collection; it also requires reflection to help users derive insights from their behavioral patterns and make informed decisions (Li et al., 2010; Bentvelzen, Woźniak, Herbes, Stefanidi, & Niess, 2022). It also involves reflection, which provides insights about the behavioral patterns that support users to make better decisions regarding their daily habits and personal wellbeing. According to the Stage-Based Model of Personal Informatics Systems, self-tracking involves five key stages, one of which is reflection (Bentvelzen et al., 2022).

However, the most current self-tracking applications rely on their instant feedback system and goal settings mechanisms. While these applications support self-knowledge, their rapid nature and constant connectivity can sometimes leave little space for deep reflection. Although some studies have explored reflective aspects of self-tracking (Bentvelzen et al., 2022), there is a gap in research on how intentional design can enhance long-term reflection beyond data visualization and immediate feedback mechanisms. This situation reveals the need to develop alternative approaches which drive users toward meaningful engagement with their data.

Hallnäs and Redström (2001) have introduced a concept, slow technology, which promotes reflection, presence and gradual engagement over speed and instant gratification. Even though slow technology has been explored in various domains, its application in self-tracking and personal informatics remains underexplored. This research aims to bridge this gap by examining how slow technology design qualities should be applied to self-tracking artifacts to foster reflection on screen exposure before sleep.

Slow technology allows us to consider how technology can be designed to encourage users to pause and reflect on their day-to-day activities before they can reach their goals, while gaining insights and awareness about their everyday practices rather than merely streamlining them. This shift in focus can play a vital role in areas including personal informatics, where understanding human behavioral patterns is crucial for long-term health and well-being.

1.2 Research Objectives

Previous examples of slow technology have primarily focused on personal data, such as photos, music, and messages (Odom, Selby, Sellen, Kirk, Banks & Regan, 2012; Odom, 2015; Tsai, Chen, Hsu & Liang, 2015; Chen, Odom, Zhong, Lin & Amram, 2019; Odom, Wakkary, Hol, Naus, Verburg, Amram & Chen, 2019; Odom, Yoo, Lin, Duel, Amram, & Chen, 2020). However, its application in the context of personal informatics has received less attention. One example from the literature is research by Menheere et al. (2021), which explored shape-changing feedback through artifacts to help runners reflect on their exercise routines over time.

While these prior studies examined slow technology in long-term, media-related personal informatics (e.g., photo collections, music listening history), our study focuses on behavioural self-tracking (screen time) within a much shorter timeframe (daily cycles over a week). This introduces a new setting in which slow technology design qualities have not been widely explored.

Furthermore, Odom, Stolterman, and Chen (2021) make further suggestions for researchers to investigate how slow technology design qualities function within different contexts. Our research responds to this call by applying Odom, Stolterman and Chen's (2021) slow technology design principles to a non-screen based interactive artifact which promotes at fostering reflection on screen usage and sleep. Through this, we aim to evaluate the applicability of slow technology design qualities in this domain and explore how they might enhance engagement with personal informatics data. Using a Research through Design (RtD) approach, we explore these concepts by developing and studying a tangible prototype, allowing us to investigate slow technology in practice.

More specifically, this thesis will explore the integration of slow technology design qualities (appendix 1) into a non-screen-based interactive artifact to promote reflection on screen time and the effects on individuals' sleep quality. Therefore, we aim to answer the following research question:

- *How can slow technology design qualities be implemented in an artifact to foster reflection on screen exposure before sleep?*

This study will contribute to research on slow technology by providing a low-fidelity, tangible prototype that fosters awareness and reflection of circadian rhythms, specifically the effects of blue light on screens and its impact on sleep. By examining how slow technology principles function in this new domain, we aim to extend the theoretical understanding of slow technology beyond traditional applications. Given the immensity of the personal informatics space, this thesis represents a small step towards opening the discussion on how slow technology can be integrated into this area. We hope to inspire further exploration and development in this direction by initiating this conversation in the research community.

2. Related Work

2.1 Reflection in HCI

Reflection has been a recurring theme in HCI research, particularly in personal informatics. Despite its recognition as a key element in designing technologies, the literature highlights the lack of a consensus definition of reflection (Baumer, Khovanskaya, Matthews, Reynolds, Sosik, & Gay, 2014; Baumer, 2015; Loerakker, Niess, & Woźniak, 2024). Previous studies have failed to provide a clear definition, while others have offered their own, often drawing on Schön's concept of reflection-in-action (Baumer et al., 2014; Bentvelzen et al., 2022). Schön introduced two distinct types of reflection: reflection-in-action which refers to the ability to think critically while performing a task, enabling real-time learning through new perspectives and experiences and reflection-on-action that involves intentionally reviewing and analyzing a situation after it has occurred (Schön, 1987).

While the definition of reflection in the HCI community remains open, some scholars have explored different aspects of reflection to inform the design of technologies (Sengers, Boehner, David, & Kaye, 2005; Baumer, 2015; Bentvelzen et al., 2022). For example, Sengers et al. (2005), drawing from two case studies, identified six reflective design principles as a guide to reflective design and proposed strategies to achieve them. Reflection is also a key element in the five-stage model of personal informatics introduced by Li et al. (2010), which includes the following stages: Preparation, Collection, Integration, Reflection, and Action. However, this model's reflection stage assumes that reflection occurs through reviewing lists of collected personal data or engaging with information visualizations. How people reflect on their experiences or behaviors while using personal informatics tools is still not well understood (Cho, Xu, Zimmermann-Niefield, & Voida, 2022). Personal Informatics systems often take reflection for granted, assuming it happens as long as users interact with their data.

Moreover, Bentvelzen et al. (2022), through a review of existing research prototypes and smartphone applications, established four design resources for reflection: temporal perspective, conversation, comparison, and discovery. Specifically, the resource of temporal perspective is broken down to the categories of past, future, memories and slowness highlighting how different perspectives on time can serve as a catalyst for reflection by encouraging users to revisit past experiences, project themselves into the future, recall subjective memories, or adopt a slower pace to gain deeper insights. This emphasis on slowness and reflection is closely related to the philosophy of slow technology, which encourages a thoughtful engagement with technology, allowing time for reflection rather than prioritizing speed and efficiency (Hallnäs & Redström, 2001).

2.2 Slow technology

In a design space oriented to efficiency-driven digital interactions, slow technology offers an alternative approach that prioritizes reflection and engagement, over instant feedback and immediate gratification (Hallnäs & Redström, 2001). Instead of prioritising speed and seamlessness, slow technology promotes awareness and reflection, fostering more mindful interaction with digital tools. The slow design philosophy was described through three core concepts: reflective technology – focusing on designing technology that not only encourages users to pause and reflect but also embodies reflection on its own form and function; time technology – rather than accelerating processes, technologies can create experience that slow things down allowing users to appreciate the moment of time; and amplified environments – technology that enhances the presence of objects or experiences, transforming them into more than just passive tools for quick access.

Over the years, slow technology has been implemented in diverse projects around communication, music and photo archives, mobile application for well-being and everyday appliances (Cheng, Bapat, Thomas, Tse, Nawathe, Crockett & Leshed, 2011; Odom et al., 2012; Grosse-Hering, Mason, Aliakseyeu, Bakker & Desmet, 2013; Odom, 2015; Tsai et al., 2015; Odom et al., 2019). Examples like Photobox, a wooden chest that sporadically prints a past photo from a user's digital archive and JuicyMo, a fruit juicer that operates gradually to provoke curiosity and contemplation during mundane tasks, illustrate how slow technology can create moments of anticipation and opportunities for reflection (Odom et al., 2012; Grosse-Hering et al., 2013).

The initial theory on slow technology was considered vague and abstract and since then several authors have sought to explore it further. Strauss & Fuad-Luke (2008) introduced the slow design principles providing a open framework that encourages diverse interpretations, and deeper reflection on both the design process and the designer's role. These principles include reveal, expand, reflect, engage, participate, and evolve. Later on, Odom, Stolterman, and Chen (2021) extended on slow technology theory, by conducting an artifact analysis and identifying 8 design qualities that characterize slow technology artifacts, including: 1) Implicit Slowness, 2) Explicit Slowness, 3) Ongoingness, 4) Temporal Drift, 5) Pre-interaction, 6) Temporal Modality, 7) Temporal Interconnectedness, 8) Temporal Granularity. These qualities can act as guiding features that designers can consider based on the intended experience of slowness and reflection, rather than as rigid criteria. This extended theory

provides designers with a more structured framework to navigate the slow technology design space, offering concrete qualities that can be selectively integrated into artifacts (Odom, Stolterman & Chen, 2021).

2.3 Slow technology and Data representation

Another area well-discussed in HCI related to data representation and engagement is data physicalisation, which moves beyond traditional screen-based visualization by embodying data in tangible, physical forms. By transforming abstract data into trends and patterns that are more visible and explorable, data physicalisation strengthens communication and sense making (Vande Moere & Claes, 2015; Hornecker, Hogan, Hinrichs & Van Koningsbruggen, 2023). Examples in the literature have explored the physicalisation of related to health data to improve emotional engagement, self-expression and creativity, reflection and deeper exploration (Khot & Mueller, 2013; Menheere et al., 2021; Eslambolchilar, Stawarz, Verdezoto, McNarry, Crossley, Knowles, & Mackintosh, 2023; Tsaknaki, Reime, Cohn, & Pérez-Bustos, 2024). Given its emphasis on alternative ways of engaging with data, data physicalisation shares some common ground with slow technology by encouraging more deliberate and reflective interactions. This is well illustrated in Laina, a shape-changing artifact that manifests the slow technology philosophy through its slow transformation on running behavior (Menheere et al., 2021).

2.4 Slow technology and self-tracking for sleep

While slow technology provides a theoretical approach for designing meaningful interactions, the biological and behavioral components also affect screen time together with sleep quality on well-being. Screen exposure is closely related to sleep quality, particularly before bedtime, since excessive screen use can disrupt circadian rhythms (the body's natural 24-hour cycle of sleep and wakefulness) (Cajochen, Frey, Anders, Späti, Bues, Pross, Mager, Wirz-Justice, & Stefani, 2011). These rhythms are known as circadian rhythms. They are controlled by environmental factors including light exposure. That blue light produced by digital screens, is particularly disturbing to these rhythms since it blocks the melatonin, a hormone essential for sleep (National Institute of General Medical Sciences, 2023). The existing scientific studies demonstrate that people who spend long hours with screens, especially right before sleeping can lead to a delay in bedtime onset with reduced sleep quality and unfit daily tasks (Lockton et al., 2020).

Modern tracking tools for monitoring screen time and sleep detection do not help users gain insights about how their screen habits affect their circadian rhythms despite increasing knowledge about such effects. Self-tracking tools often focus on collecting numerical sleep data and do not provide mechanisms for promoting behavioral reflection and long-term habit changes (Choe et al., 2011; Baron et al., 2017). The current digital tracking tools require development to fulfill their purpose because they track data without helping users understand how these behaviors affect them.

3. Methods

This section outlines the methodological approach of the study, including participant recruitment, study design and data collection procedures. It also describes the processes followed for the data analysis.

3.1 Research Approach: Research through Design (RtD)

This study adopts a Research through Design (RtD) approach, a methodology that positions the design process itself as a mode of inquiry. RtD is particularly suitable for exploratory and practice-based research, where the creation and evaluation of artifacts contribute to generating new knowledge. In this study, RtD enabled us to explore how slow technology design qualities can foster reflection on screen time and sleep. By iteratively designing, implementing, and studying a tangible figurine artifact, we investigated how specific design decisions influenced participants' engagement, reflection, and behavior. The artifact served not only as a research tool but also as a conceptual probe to examine the experiential impact of slowness in personal informatics.

3.2 Pilot study

Prior to proceeding to the study implementation and data collection, we did a pilot study. Pilot studies can provide valuable insights into potential challenges in the main research project (Van Teijlingen & Hundley, 2001). The purpose of this pilot was to test the feasibility of our study design, identify any potential risks and refine the methodology and set up before proceeding to the actual implementation. Specifically, we aimed to assess the feasibility of modifying the figurine based on participant data and identify any unforeseen challenges that could affect the data collection.

We conducted the pilot study with one participant, following the same setup as intended for the full-scale study. The participant was invited to an introduction session where we explained the study's goals and process. Following that and over the course of three days the participant interacted with the figurine in a common study space. Each morning, the participant sent a voice message, from which we used the content to modify the figurine before their arrival in the study space. The message included information about their sleep routine from the previous night, subjective sleep quality, their energy levels at the current day, any disruptions (e.g. noise), and a screenshot of their screen time. At the end of the last day, a semi-structured interview was conducted to learn about their experience.

The pilot study provided us with valuable insights into the study design that we discuss below. First, we noticed that it was challenging to modify the figurine. Initially, we intended to consider three variables for modification: sleep, energy levels and screen time. However, managing all three variables proved challenging as they introduced too many factors to consider and adjust within the available timeframe and resources. Secondly, the interview with the participant revealed that they did not always recognize the figurine modifications as intentional. Instead, some changes were perceived as "honest mistakes" on our part (e.g. visible, misaligned threads on the clothing). The participant assumed that these imperfections were simply the result of the materials not being altered properly – defective clothing, rather than intentional modifications. This interpretation resulted in the participant overlooking the modifications, ultimately leading to the main objectives with the figurine to be missed.

Thirdly, the participant mentioned that they did not fully understand the figurine's role and its representation, they made some connection with their data, but they expressed high uncertainty.

Based on the three main findings, we decided to proceed to the following adjustments to address respectively:

1. *Reduction of variables*: We decided to focus primarily on-screen time and secondly on sleep, eliminating energy levels as a variable to reduce the complexity of figurine modifications.
2. *More noticeable changes*: To avoid misinterpretation, we introduced the figurine to the participants (during the briefing session) dressed in well-maintained clothing to show a baseline state. Following modifications during the study were made more distinct - instead of "bad stitching", we intentionally tore, removed elements of the outfit, and created dirt on the figurine.
3. *Revision of briefing*: We revised the briefing material and stated that the figurine aims to encourage reflection on screen time and sleep.

Although the pilot study followed the same procedure as the main study, the data collected from the pilot participant was excluded from the final thematic analysis. While the participant engaged with the process and made some initial connections between their behavior and the figurine's modifications, they also expressed a high degree of uncertainty about the artifact's intended purpose and the meaning of its changes. This ambiguity led to limited reflective insights, which did not align with the aims of the main study. Therefore, the pilot data was used solely to refine the study design and improve clarity for subsequent participants.

3.3 Participants

Our study included 6 participants, one of whom was a pilot participant, ranging in age from 24 to 33 years old. Among them, two were women and four men. All of them were master's students in human-computer interaction and user experience (HCI & UX). They often worked in the UX Lab, which made it a natural choice for the study. They already spend a considerable portion of their day, usually 3 to 4 hours daily there. Therefore, it was easy to recruit them through their availability and proximity to the research setting. This study was employed by convenience sampling which is a common method to recruit willing participants (Etikan et al., 2016). The UX lab itself became a shared & communal space for both the research team and the participants, creating a comfortable and familiar environment for everyone involved.

3.4 The Artifact - Figurine

An artifact was used in this study to explore the implementation of slow technology design qualities. The artifact was a figurine, similar to the art mannequin figures, designed to serve as a reflective medium for participants. The main purpose of the figurine was to visually represent participant's data. In order to achieve that, clothing and accessories were designed to be used for altering the figurine's appearance in response to the participants' data. These modifications included changes in posture, clothing quality (e.g. neat, torn, dirty), hair

condition – where allowed (e.g smooth vs tangled), and other visual markers such as uneven and visible threads. Figure 1 illustrates the figurine and some of the materials designed for modifications.

The figurine was designed as a low-fidelity artifact. Considering the fidelity dimensions proposed by McCurdy et al. (2006), we refer to the figurine as low-fidelity in terms of richness of interactivity, depth and breadth of functionality, and richness of the data model (McCurdy, Connors, Pyrzak, Kanefsky & Vera, 2006). Any changes were manually controlled by us rather than dynamically responding to user behavior, and the figurine provided only a simple representation of self-reported daily data without integrating a dataset. Therefore, we needed to have access to the figurine to be able to perform any changes without the participants' presence. Unlike previous studies on slow technology that placed artifacts in home settings, in this study we positioned the artifact in a shared study space. Considering that students spend a significant portion of their day at university while studying, we believe that situating the artifact in their study environment would offer opportunities for observation and reflection. Moreover, a public study space allowed us daily access to maintain and modify the figurine daily based on participants' input.

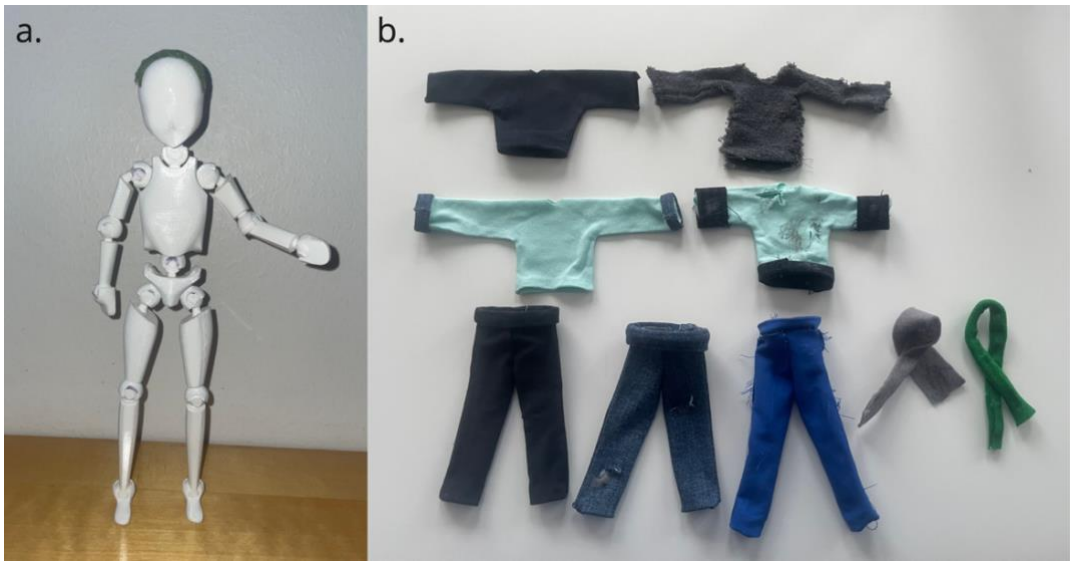

Figure 1: Picture a. illustrates the figurine and on picture b. a sample of the clothing for modifications.

3.5 Study Design

Upon recruitment the participants were invited to a short briefing session, during which they were informed about the study's purpose and introduced to the figurine. Each participant received their own figurine, and the process of their participation the following days was explained. Participants were also given written instructions outlining what was expected of them during the study period. Additionally, during this session the participants were informed about their data collection, privacy considerations, and a consent of personal data processing and information was signed.

Over a period of three consecutive days, participants were instructed to send a short voice message each morning via WhatsApp. In their messages, they were asked to include their sleep routine from the previous night, subjectively sleep quality, any disruptions (e.g. noise), and a screenshot of their screen time generated from their phones. The screenshots, generated from the participants' phone screen time monitoring features, typically showed total screen time, usage breakdown by apps, and peak usage periods. This helped us assess not only how long participants used their phones, but also what types of activities they engaged in and when, particularly close to bedtime. Based on the reported data, we modified each figurine to primarily reflect screen time usage before going to sleep, with sleep quality considered as a secondary variable. The data considering sleep routines from the previous night was intended to capture exposure to screens other than phones (eg. mentioning watching a moving, playing video games) that wouldn't be reflected in the screenshot they provided, while sleep disruptions was included as a control variable. Figure 2 illustrates how the figurine was modified based on the participants' reported data. These adjustments were aimed at visually representing the relationship between screen time (blue light exposure) before sleep and sleep quality. By the time participants arrived at the study space, their figurine had already been modified. Participants were encouraged to interact with their figurine throughout the day, in any way they preferred.

Figure 2: Figurine changes over the period of 3 days, based on participants self-reported data.

3.6 Designing with Slow Technology Qualities

This study attempted to implement three of the design qualities outlined by Odom, Stolterman and Chen (2021), explicit slowness, ongoingness, and pre-interaction. Among the eight slow technology design qualities, we selected those based on their relevance to our study context and feasibility within the scope of the intervention. These qualities were most compatible with the goals of encouraging reflection, creating temporal distance, and fostering ongoing engagement with the artifact. Other qualities were deemed less applicable due to the individualized nature of the intervention and resource limitations.

1. *Pre-Interaction:* We chose voice messages as the method for pre-interaction because it served two key purposes. First, the articulation of their experiences primes participants to be more aware of their screen time exposure before sleep. Second, it allowed us to collect the necessary data for modifying the figurine.
2. *Explicit Slowness*: The figurine's transformation was intentionally delayed. Rather than allowing immediate feedback, we introduced a delay between reporting and seeing changes to encourage anticipation and reflection. The decision to place the figurine in a shared study space further reinforced this pacing, as participants had to physically visit the space to see the updates, without knowing exactly when they had occurred.
3. *Ongoingness*: The artifact (figurine) evolves continuously, reflecting changes on screen time exposure before sleep and sleep quality over the days. This ensured that the experience was not a one-time interaction but rather an ongoing engagement with gradual and cumulative changes. The decision to implement ongoingness in this way was based on the idea that behavioral awareness and reflection develop over time rather than in isolated moments.

3.7 Ethical Considerations

This study was designed with a strong commitment to ethical research practices, ensuring that participants' rights, privacy, and well-being were always protected. A protocol of informed consent was established, ensuring that participants were fully briefed on the study's goals, their involvement, and their rights before participation, and that consent remained valid throughout the study.

Every participant had the freedom to decide whether or not they wanted to participate, and participation was completely voluntary. They were also informed that they could withdraw from the study at any time without consequences. During a detailed briefing session, we walked participants through the study's objectives and answered any questions they had. We took extra care to protect privacy and anonymity since the study focused on personal topics like screen usage and sleep habits. This was key to creating a safe space where participants felt comfortable sharing honest and open reflections.

To make the process as smooth as possible, we set up private WhatsApp groups with each participant for daily message reflections. Only the relevant participant and two members of the research team had access to these groups, ensuring confidentiality was maintained at all

times. While the study was low risk, we made it clear that participants could skip any questions or activities they were not comfortable with no pressure, no consequences.

After the study, we held a debriefing session to address any further questions or concerns at the end of the interview. This was also an opportunity for participants to share their experiences and feedback in more detail. We wanted to make sure everyone felt comfortable and did not face any inconveniences throughout the entire process.

3.8 Data Collection and Processing

3.8.1 Daily Reflections and Figurine Modifications

As previously described in the study design section, we mainly collected data from daily reflections shared as WhatsApp voice messages and screenshots of participants' screen time from the previous day. These inputs were analyzed daily to better understand participants' screen habits and sleep quality, as described in their reflections. Based on this ongoing analysis, we made adjustments to the figurine to reflect each participant's evolving behaviors and experiences. These changes were guided purely by the qualitative interpretation of the data. After three consecutive days of daily reflections, we conducted semi-structured interviews with each participant, lasting about 25 minutes. Participants shared deeper insights about their experiences while giving us a more comprehensive understanding of how they engaged with the figurine and how it impacted their awareness of screen time in these interviews.

3.8.2 Semi-structured Interviews

Following the three-day interaction with the figurine, the participants took part in a semi-structured interview. The interviews aimed to explore their experiences with the figurine and investigate the impact of the implemented slow technology qualities. An interview guide was designed to serve as a framework during the interview process. Four interviews were conducted in person and one online via Teams and lasted approximately 25 minutes. The interviews started by collecting demographic information (age, gender, occupation), followed by questions focusing on i) the overall experience (e.g. How did you interact with it? Can you share one or two memorable interactions?), and ii) the experience of the implemented slow design qualities (e.g. How did you experience the delay between sending the voice message and seeing the figurine's transformation after arriving in the lab and not directly?).

3.9 Data Analysis

To address the research question, a qualitative approach was used to analyze the data collected through participant reflections and interactions with the figurine. The analysis followed a hybrid thematic analysis method, combining both deductive and inductive approaches (Braun & Clarke, 2006). Below is the sequence we followed:

1. Data Collection: We gathered data through interviews, reflections, and observational notes from participants during the study period.

2. Transcription and Anonymization: All data were transcribed and anonymized to remove personal identifiers, ensuring participant confidentiality. Basic demographic details such as age, gender, and occupation were recorded to provide context.
3. Initial Coding: Each researcher independently coded the transcripts using MAXQDA software and manual techniques.
4. Deductive Coding – Theory-Driven Themes: We applied theory-led codes based on three predefined slow technology design qualities: Explicit Slowness, Ongoingness, Pre-Interaction. These were used to guide the analysis and interpret participant experiences through a design lens.
5. Inductive Coding – Data-Driven Themes: In parallel, we performed open coding to allow themes to emerge directly from the data. These inductive codes captured participants reflections and patterns that were not directly tied to the slow tech framework.
6. Review & Consolidation of Themes: After initial coding, both researchers compared findings and collaboratively reviewed and refined the themes. We resolved any discrepancies through discussion to ensure consistency and reliability (Nowell et al., 2017).
7. Final Themes: This process resulted in seven final themes, including both theory-driven and organically emerging themes. For example, 'Reflection & Behavioral Awareness' emerged inductively as participants described emotional responses and behavioral adjustments.

The collected qualitative data was analyzed using thematic analysis. This approach was chosen to identify patterns and insights in participants' reflections, in line with the exploratory nature of the study. A hybrid inductive-deductive method was applied, described below.

3.9.1 Thematic Analysis

We followed a structured thematic analysis process as outlined by Braun & Clarke (2006). The first step in the analysis process was to familiarize both researchers with the data by reading through transcripts and notes. Then we independently generated initial codes, capturing recurring patterns related to screen exposure, sleep habits, and engagement with the figurine. While we worked separately, we followed the same methodological steps to ensure consistency and reliability (Nowell et al., 2017).

After completing independent coding, we came together to discuss and compare our findings. We critically reviewed each other's codes and worked collaboratively to refine them. This process led to the identification of seven overarching themes and their sub-themes which captured key insights into participants' reflections on screen usage and sleep quality. To support the coding and organization of themes, we used both manual methods and the MAXQDA software[1].

We employed a hybrid approach to thematic analysis using both deductive and inductive methods. The deductive aspect of slow technology design was guided by three predefined qualities. They are Explicit Slowness, Ongoingness, and Pre-Interaction. These theoretical

[1] https://www.maxqda.com/

frameworks allowed us to examine participants' experiences through a structured lens. The inductive approach allowed for new themes to emerge organically from the data, ensuring an exploratory and open-ended process (Braun & Clarke, 2006).

Each researcher coded the data independently and compared the results later in order to enhance the reliability of our findings. We discussed, reviewed, and refined any discrepancies in coding until we came to a mutual agreement on the final themes.

4. Results

This chapter is structured to present firstly results related to the three slow technology design qualities applied (sections 4.1, 4.2, 4.3) and secondly, themes that emerged from participants' reflections, not directly tied to the design theory (sections 4.4, 4.5, 4.6, 4.7).

4.1 Pre-interaction

The pre-interaction in this study's context was expressed through the act of sending the voice message in the morning. This action occurring before participants directly engage with the figurine prompts their curiosity, anticipation and reflections. The participants expressed excitement in the morning when they had to report their data followed by curiosity and anticipation. They were curious how their figurine would look like each day and how the content of their voice message would affect it.

> *"Yeah, the second I woke up, I had the figurine on my mind like…And that's why I actually reported my data so quickly because I was already thinking of it when I was waking up and the whole day I anticipated like how the figurine might look…because you send it in and you're like, oh, I wonder what this voice message or if I say like this how it could actually affect it?" (P03)*

Two of the participants (P03, P05) also thought about possible scenarios on reporting "false" data to capture changes, but they did not act upon that.

> *"I never did anything to, like subvert or like lie or deceive. But I kept wondering in my head, what if I had lied about like today's results? So what if I like said something completely differently?" (P03)*

Beyond curiosity, the act of reporting itself fostered self-reflection. Participants described that by sending voice messages in the morning, it led them to reflection and awareness of their behavior, sometimes extending these thoughts starting from the night before. P04 noted that the process of reporting encouraged reflection in the evening, prompting them to think about what they will report about their bedtime routine and whether it aligned with how they really wanted to spend their time before going to bed. Similarly, P05 mentioned that they became more self-conscious, being more aware of their behaviors and question whether they should adjust them.

Additionally, arriving in the study space evoked moments of anticipation and speculation for P04 and P05. P05 mentioned that while they might continue with their day after reporting

and not think much about it, approaching the university often reminded them of the figurine, resurfacing curiosity about its appearance. This anticipation was sometimes shared with other participants, as group discussions emerged when participants met on their way to the university.

> *"When I just before I came to the lab I would. I think coincidentally there was always either (name) or (name) with me when I came to the lab. So I wonder how dirty…or I wonder how my figure is going to look today." (P05)*

> *"meet in the morning and then went to the lab together and then just briefly like talk about it and we'll be like, oh, we'll see you on the mini mes. I wonder how they're looking like." (P04)*

4.2 Explicit Slowness

The quality of explicit slowness had a different effect among participants. P05 appreciated the restricted access to the figurine in the study space, experience the delayed changes as a quality that kept them engaged. On the other hand, P03 and P04 expressed impatience and frustration in the delayed feedback. P03 noted that their experience contrasted with their expectations shaped by fast technology, where feedback is immediate. They described feeling frustrated by the waiting period, as it contradicted with their usual expectation of instant results.

> *"It was just more frustrating because I normally have like low patience so I kind of have the mentality I want to know now. Especially with the like fast technology, you keep going like, oh, immediately when I wake up, I'm gonna find out how the figurine looks or. Oh, immediately when I wake up and after I report it. Soon I'll get the results, but it's not, that's not the case. You'll find out when you arrive, which is like in like a couple of hours for me." (P03)*

P04 described how the delay became more perceivable on the second day. On the first day, they visited the study space shortly after waking up, minimizing the waiting time. However, on the second day, other commitments delayed their visit, making the wait feel much longer and more frustrating.

> *"It didn't feel like a big thing the first day, but because I went to lab pretty quickly after waking up. But the second day I had like a meeting someplace else, and then I had like errands to run and then I came to the lab in the afternoon. And that was different or a little bit like difficult almost because in the morning I was sending my message and I was like excited to see what would change. And then it was like hours and hours later, and I didn't know. So I did get a little bit impatient, like wanting to know what would have changed. But I knew I wouldn't know until the afternoon." (P04)*

Moreover, P02 expressed a preference as well over immediate feedback and felt a strong sense of entitlement to immediate access, expressing frustration that they couldn't view the changes whenever they wanted to.

> *"I mean, yeah, the fact that I had to wait to see the changes was was a little bit..like it's I don't know how to describe it, it felt..It didn't feel right. I felt like I had a right to see it at any time." (P02)*

4.3 Ongoingness

In this study, the concept of "ongoingness" captures the idea that the transformation of the figurine was a gradual and continuous process rather than a sudden or isolated event. As a result of this slow process, participants were able to understand how their behaviors have developed over time rather than being reset every day. After watching the figurine deteriorate bit by bit, they began to correlate their actions with the visible changes. Due to the figurine's worsening condition, it served as a physical reminder that habits accumulate over time, challenging the common belief that every day is a new beginning. A participant stated: *"Over the three days, today it has stains all over, and then I think it's even a bit more torn. And the stage just kept getting worse. So it is very visible."* (P05).

However, while participants became more aware of their bedtime behaviors, their daily voice recordings did not reveal explicit behavioral changes during the three-day period. But, in the final interview after the third day, one participant reflected on a possible shift, "Maybe subconsciously, that's why I went to bed on time yesterday and had a very good sleep." (P06). This suggests that the reflections encouraged by the figurine may influence future behavioral changes beyond the study period.

This ongoing transformation didn't just make participants more aware of the figurine's changes, it also shifted how they thought about their behavior. The gradual transformation of the figurine illustrates how past actions have lasting effects, as opposed to starting over every day. As one participant shared, "*Yeah, I think because it doesn't feel like every day is a blank slate anymore now.*" (P04). Participants were able to gain a broader understanding of their habits by observing how their actions were interconnected over time rather than isolated to specific moments.

But the figurine's changes did more than just raise awareness. They also sparked curiosity and kept participants engaged. People found themselves looking forward to seeing the figurine each day by wondering how their previous choices might have affected its condition. One participant described this anticipation: "*The whole changing aspect of it was very interesting to see. I was actually hyped to go to bed and wake up to see what the figurine looked like the next day*." (P03). This sense of curiosity not only made the gradual changes more interesting but also helped reinforce the idea that habits accumulate over time. Participants waited to see the figurine each day, wondering how their previous choices might have affected its current state. This ongoing transformation sparked a deeper reflection on their actions, highlighting how their behavior was continuously shaping the figurine's condition, rather than resetting each day.

4.4 Personal Attachment & Projection of Self

The participants developed a strong personal attachment to the figurine, often seeing it as something more than an object and an extension of themselves. This personal connection was collectively expressed by all participants by referring to the figurine using pronouns like “her” and described it as a “mini me” or a twin. Individually, the participants expressed this connection in different ways through their interactions. P02 saw the figurine as a reflection of themselves, adjusting its posture and clothing to match their own feelings and behaviors:

> *“I was also feeling a bit hot, so I rolled up his sleeves and like, I guess that's still how he looks right now and I rolled up his sleeves before I rolled up my own, which was weird, and I noticed that though it was weird. I'm like, why am I rolling up his sleeves when I'm the one who's feeling hot. And then I rolled up my sleeves.” (P02)*

For P04 the connection with the figurine led to feelings of responsibility and empathy towards the figurine. They described moments of guilt when the figurine appeared disheveled, interpreting it because of their own unhealthy habits, such as poor sleep. The figurine became a visual representation of self-care, reinforcing their awareness of personal behaviors.

> *“Because now when I reflect, I know that the day I slept, the least I felt like I saw the biggest change in how she looked. So now I'm thinking 'cause I didn't sleep well this figurine has suffered and like she looks all disheveled and like her, her clothing is torn or something. So on one side, it's like an empathetic thing. I'm like, oh, no, I did something bad to her” (P04)*

Moreover, P03 while identified the figurine as a reflection of self, expressed their desire to be able to personalize the figurine to resemble more themselves.

4.5 Reflection and Behavioral Awareness

The concept of Reflection & Behavioral Awareness in this study captures how participants engaged in self-reflection regarding their screen time and sleep habits, their energy levels, and potential behavioral changes. The slow, ongoing transformation of the figurine acted as a mirror by encouraging some participants to become aware of their daily routines and reconsider their digital habits before bedtime. As a result of the figurine, one participant was encouraged to think differently about their screen time and sleep habits. In contrast to direct numerical tracking, the figurine's evolving state offered a more abstract yet powerful reflection of their behavior. It is described as a meaningful but non-overwhelming process that gently reminds of habits without causing undue stress. As one participant noted,

> "It *was reflective, it has got me thinking about my habits in a way that I usually don't, but it didn't feel too heavy or depressing, which was nice because just looking at screen time can sometimes be a little bit saddening."* (P04)

Beyond self-reflection, the figurine also acted as a visual cue. It helps participants to recognize the effects of their habits on their energy levels. Some participants made explicit connections between their fatigue and their digital behaviors by observing how excessive screen exposure before sleep influenced their well-being. One participant described how the figurine's condition mirrored their state, stating, "For example*, I could see that I was really tired yesterday, and the figurine was lying like a dead person, which reflected that I had a really bad sleep and was very tired the next day"* (P06). Similarly, another participant linked their fluctuating energy levels to screen time, saying, "*I mean it's sort of crossed my mind, not that it's a direct reflection of my screen time, but that my feeling not so energetic and feeling a little bit disheveled each day is... I know that is a reflection or a result of me having so much screen time*" (P02).

Two participants were able to adapt their behavior as a result of these reflections. After seeing the figurine slowly transform, they began to reconsider their bedtime routines, resulting in conscious efforts to improve sleep quality and reduce screen time. One participant reflected on how this awareness influenced their actions, stating, "*Yes, I did feel like I should improve my sleep. I sleep not quite much. But it definitely made me think that, OK, I should. So subconsciously I did that yesterday, I had a very good sleep yesterday.*" (P06). Another participant described a shift in mindset, saying, "*It made me think that I should reduce my screen time. It didn't have a huge impact on my mind, but it definitely made me think that I should work on my habits*" (P06). The figurine's evolving state also led to preemptive adjustments in behavior. As one participant noted, "*I just knew I wasn't going to get a good sleep every day, so I set myself to keep screen time lower since I wasn't going to be able to manage my sleep well*" (P04). However, it is important to note that while some participants engaged in deep reflection on their screen time habits, others exhibited only limited reflection, and one participant even did not explicitly reflect on his behavior on screen time.

4.6 Interaction & Engagement with figurine

Participants utilized diverse methods to interact with the figurine for creating their experiential outcomes through personal experiences as well as social contacts. The figurine became more than a static object. It facilitated self-reflection, curiosity, and conversations about personal habits through the figurine, self-reporting and interactions with the researchers. Participants observed, manipulated, and discussed its changes as its appearance evolved by incorporating it into their everyday routines.

The figurine functioned as more than a social tool because it provoked useful social exchanges which led participants to compare their items with others. They observed the differences between their personal figurines and the ones carried by others, which made them think about their own habits. The participants used the figurine as a central point to start collective conversations about their sleeping behaviors beyond individual experiences. The participants of the study reported satisfaction with the practice of exchanging updates with their peers. *"When people would come by, I would tell them about it because it felt like a fun little update to give people like, 'Hey, look how my figurine is looking today!".* The social element demonstrated that this figurine expanded its influence by facilitating collective discussions about personal well-being.

Participants had mixed feelings about the figurine, from fascination and amusement to worry about its state of decay. Some started to feel attached to it and kept it near them in their workspace, others saw it as a reflection of themselves and their well-being. "*When I found her, I usually took her to wherever I was working and just set her on the window next to me*" said one participant, indicating a deeper personal connection. The figure also encouraged engaging interaction with people adjusting its pose and appearance. At the same time its gradual changes made people try to figure out the logic behind it by asking themselves how their behavior was affecting its form.

The physical presence of the figurine was important for participant engagement. Many touched it, adjusted its clothes and examined its daily changes. Some even saw it as a judging presence which affected their behavior. One participant said,

> *"Whenever I find myself on, for example Facebook or whatever like something which I which is distracting me from my work, I would physically just like turn him towards me, giving me this expression of like "bro, what are you doing right now? Go back to work" and I was feel that's that expression in my soul and I would like basically to be judging myself but like to him he is the one judging me."*

These interactions show the figurine wasn't just a passive object but also an active prompt for self-monitoring. And because it was fragile, participants had to take care of it by feeling responsible and attentive.

4.7 Sense-making & Speculation

The participants used their sense-making and speculations based on observations of the figurine throughout the study. Participants first experienced shock at the altered appearance of the figurine before attempting to link their daily actions with its changed form. One participant expressed their surprise upon noticing unexpected changes, stating,

> *"The first day was surprise. I think I had a normal night… I was surprised to see, Why is my figurine? Why does my figurine have stains and like torn sleeves, so that was surprising" (P05)*

As they continued interacting with the figurine, they started forming explanations for its evolving state with another participant noting, "I tried to make that connection that it just generally reflected how my today's state would be like." (P05). During the study, certain participants noted unexpected irregularities between their assumptions about the figurine and its evolving state, causing them to feel unsure about the process. Participants presented findings that conflicted with the deteriorating state of their figurine. One participant described their confusion, stating,

> *"But then came like the second day where I actually did like take 7 hours of sleep. And where I did mention like, Oh yeah, I feel good and yeah, yeah. But then the issue became of like him, his still getting like, worn with, like chalk stains" (P03).*

This ambiguity sparked curiosity about the figurine's underlying logic, with another participant reflecting on their desire to fully understand how it functioned.

> *"I think that's like the only issue ahead was just wanting to understand it more and I of course I imagined this as like a real product and then I thought, oh, if this was like a product that I bought for myself to like monitor myself, I would probably be reading all about like the technical specifications and everything. But maybe it was good that I didn't" (P04).*

The uncertainty surrounding the figurine's transformation process encouraged speculation, keeping participants engaged and prompting ongoing reflection on their habits.

5. Discussion

This thesis aimed to investigate how slow technology design qualities can be applied to personal informatics to encourage sustained reflection on daily behaviors, particularly screen exposure before sleep. To achieve this, we developed a low-fidelity, tangible artifact, a figurine, whose appearance was manually modified based on participants' self-reported data over a three-day period. The design incorporated three slow technology qualities: explicit slowness (deliberate delays in feedback and unpredictability), ongoingness (gradual, cumulative transformation), and pre-interaction (the morning ritual of sending voice messages).

The results showed that the act of reporting data in the morning sparked both anticipation and self-reflection, with participants eagerly speculating about how the figurine would change. The gradual deterioration of the figurine served as a visual narrative of habit accumulation, effectively reminding participants that daily behaviors have lasting consequences. However, responses to the delayed feedback were primarily characterized by impatience and frustration. Three participants expressed a preference over immediate feedback, while one appreciated the slowness in the figurine's changes. Moreover, the artifact became more than just an object, with participants developing a personal connection and engaging in social interactions with others discussing their habits through the figurine. Overall, although the study design was intended to foster reflective engagement with personal data, our results indicate that reflective responses, particularly regarding screen time, varied considerably among participants.

5.1 Slow Design Qualities

Our design intentionally leveraged the period before direct engagement by incorporating a daily audio recording task, priming users for subsequent interaction with the figurine. This phase is conceptualized as a critical preparatory period where the user's attention is reoriented toward a broader range of experiences beyond immediate interaction (Odom, Stolterman & Chen, 2021). In our case, the morning voice messages generated a phase of anticipation, an initial period of tension and reflection, that set the stage for subsequent engagement with the figurine. Participants described feeling a sense of curiosity and mental readiness as soon as they recorded their data, suggesting that this pre-interaction phase contributed to a richer, layered reflective experience. However, it should be noted that the pre-interaction here was incorporated through audio journaling, a technique that by itself has been explored to prompt

reflection (Hislop, Arber, Meadows, & Venn, 2005; Van Koningsbruggen, Shalawadi, Hornecker, & Echtler, 2022). The reflective moments observed may be partly attributed to the specific modality of audio journaling, which supports self-reflection through the spontaneous verbalization of thoughts and emotions. This raises the question if a different pre-interaction activity had been employed, the reflective outcomes might have been different. In overall, while our findings suggest that the pre-interaction framework can prime users for a reflective experience, the modality chosen (audio journaling) may also play a crucial role in shaping the nature and depth of reflection. Future research should compare various pre-interaction strategies to disentangle these effects and better understand how contribute to reflective engagement in personal informatics.

We implemented explicit slowness by introducing a deliberate delay between participants' data submissions and their observation of changes in the figurine. Explicit slowness refers to the design choices that intentionally limit user control over the artifact's pacing, allowing to operate on its own time to foster cycles of anticipation and release (Odom, Stolterman & Chen, 2021). This was achieved by positioning the artifact in a specific location (study space), creating a necessary temporal gap between the participants' input and their subsequent viewing of the figurine. However, the participants' responses to this design choice were predominantly negative: three out of five participants expressed frustration and impatience with the delayed feedback. Similar reactions were observed in other slow technology artifacts, where participants initially anticipated immediate feedback after their run and felt confused or dissatisfied when the feedback was intentionally delayed (Menheere et al., 2021). This reaction highlights a key challenge in employing explicit slowness. While the intention is to encourage reflection and engagement over time, participants may experience the lack of immediate feedback as a barrier rather than a benefit, especially when accustomed to fast technologies. Moreover, for slow interactions to successfully foster reflection, the delayed feedback should be intentionally designed and perceived as meaningful (Hallnäs & Redström, 2001). These findings suggest that the design and implementation of slowness need to be carefully balanced to align with users' expectations and capacities for delayed feedback, ensuring that the intended reflective qualities are meaningfully perceived.

One of the key findings of this study is that ongoingness played a central role in fostering reflection. A gradual transformation of the figurine allowed participants to perceive behavioral accumulations over time as opposed to conventional self-tracking tools that reset daily. This design challenges the notion that every day is a fresh start, instead emphasizing continuity. These findings align with Bentvelzen et al.'s (2022) work on temporal perspectives in reflection which highlights how past actions shape present awareness. Even though their study presented self-reflection in a retrospective context, our findings suggest that ongoing transformation can sustain engagement by encouraging users to anticipate the figurine's state daily.

Closely related to this, the study also suggests that reflection and behavioral awareness were encouraged through the figurine’s transformation. Participants became more aware of their screen time and sleep habits after visualizing their changes over time. When compared to self-tracking tools that give numerical feedback, the figurine presented behavior accumulation more slowly and visibly. These findings support previous research in HCI on reflection

(Bentvelzen et al., 2022), which emphasizes the importance of temporal perspectives in fostering awareness. However, while prior studies mainly focused on retrospective self-reflection, our results indicate that ongoing transformation may act as an active motivator, prompting participants to anticipate and interpret daily changes.

Although these insights are promising, caution is advised when interpreting the results. This study doesn't prove that gradual change of the figurine was enough to sustain behavior change. It is possible that participants' engagement was influenced by external factors, such as the novelty of the figurine or their general curiosity as to how it works. There should be further research conducted to determine whether similar engagement patterns persist over a longer period and in different contexts.

5.2 Engagement, Reflection & Social Interaction

The results suggest that the figurine has turned it into an active tool for self-reflection and social exchange from passive object, influencing participants' engagement and experience. Participants engaged with it in various ways, from manipulating the figurine's appearance to discussing its changes with others. Based on prior research, responsiveness and agency enhance user engagement in interactive artifacts (Bentvelzen et al., 2022). Further, the figurine's ability to provoke curiosity and foster discussion demonstrates that physical artifacts may have an impact that extends beyond the individual to collective discussion about personal well-being.

However, while the figurine facilitated engagement, it is important to consider that this may not have been solely due to its interactive nature. Some participants expressed a sense of attachment to the figurine by viewing it as an expression of their well-being. This finding resonates with research on emotional attachment to objects (Hancock et al., 2017), where physical artifacts serve as extensions of one’s identity. Moreover, the personal attachment participants formed with the figurine appeared to enhance engagement for some and self-reflection for others, as they perceived it as an extension of themselves. However, this close identification may also carry a risk. People often distance themselves from objects that reflect identities or associations they find undesirable, therefore potentially there could be a decrease in interaction when the figurine embodies traits they did not wish to confront (Wheeler & Bechler, 2020). Engagement with the figurine may also have been driven by external factors such as novelty, rather than its' inherent bond. It is also unclear whether engagement would maintain over the long term since this study primarily examined short -term interactions. As a future research area, it would be beneficial to examine the long-term effects of such interactions, as well as whether the figurine's role as a social catalyst would endure beyond the novelty period.

As well, this study highlights how sense-making and speculation shape participants’ engagement. After being initially surprised by the figurine's transformation, participants tried to link their behaviors with those transformations of the figurine. It is in line with previous findings on curiosity and engagement, which suggest that surprise and uncertainty can be powerful motivators of maintaining interactions. Despite this, not all participants formed accurate connections between their behaviors and the changes in the figurine, highlighting the potential limitations of feedback which were open to interpretation.

Even though speculation encouraged curiosity and reflection, it also led to frustration and confusion for some participants, particularly when they struggled to discern the figurine's underlying logic. It seems that some people tracked their behaviors attentively, while others enjoyed the ambiguity. Future research should investigate whether providing clearer explanations would enhance or diminish participants' curiosity and reflection.

6. Limitations

6.1 Methodological Reflections

There are several limitations included in the methodology while this study provides valuable insights into the role of slow technology and reflective engagement through the figurine. First, the sample size of five participants was too small to generalize the findings, although convenient and targeted at a specific target group of HCI & UX students. There is limited diversity in the sample, which could affect how individuals interact with slow technology due to the homogeneity of the sample (mainly male participants and a single female participant). Furthermore, the use of convenience sampling means that the participants may not represent the broader population, thereby affecting the generalizability of the results.

As the study was conducted over only three consecutive days, it might not be sufficient to understand long-term behavioral pattern changes or maintained engagement. Participants' interactions with the figurine were influenced by novelty effects, as they were primarily engaging with the artifact for a limited time. It is possible that participants' curiosity about the figurine and its transformation could have waned with continued exposure, which was not captured within this brief study duration. Therefore, the lack of a long-term follow-up to observe sustained behavior change or reflection diminishes the study's capacity to conclude about the durability of these effects.

Moreover, the design choice of using audio journaling as a pre-interaction phase introduces a limitation. The mode of audio journaling enables self-reflection through verbalization. When comparing with the other pre-interaction strategies, it may have shaped participants' engagement differently. Future research could explore alternative approaches including written journaling or visual prompts to compare how different strategies might affect reflective engagement.

6.2 Limitations of study results

The results of this study suggest that ongoingness and interaction with the figurine foster reflection, but there are limitations in the way these findings can be interpreted. Participants' engagement was not solely based on the figurine's gradual transformation but was also influenced by external factors such as novelty and social interaction. It is important to note that the novelty of the figurine may have contributed greatly to participants' curiosity and initial engagement, raising questions about whether the same level of engagement would persist over a longer period or in a different context.

Even though the study explored the effects of explicit slowness in fostering reflection, participant reactions to delayed feedback were mixed. While some found it beneficial for

sustained engagement, others expressed frustration with the lack of immediate feedback, revealing a potential barrier to the success of slow technology. The challenge lies in striking a balance between creating slowness that encourages reflection and ensuring it does not lead to negative emotional responses such as impatience or frustration.

Additionally, it was always ambiguous the sense-making process, where participants linked their behaviors to the figurine's transformations. For example, some participants couldn't interpret the figurines' underlying logic accurately. This uncertainty in feedback interpretation highlights a limitation in the clarity of the feedback provided by the figurine. It suggests that there should be clearer explanations or guidance to enhance engagement and reflection all the time.

7. Future Work

While our work provides initial insights, there is still much to explore in understanding how slowness can shape self-tracking experiences and encourage deeper reflection. One key area is understanding how to facilitate users' transition from fast, instant-feedback systems to slower, more reflective interactions. People are used to seeing their self-tracking data immediately, therefore a sudden shift to slow technology may feel frustrating or unappealing. Future studies could explore ways to introduce slowness more gradually, offer flexible pacing based on user preferences, or use design elements that help people see slow interactions as meaningful rather than restrictive. We chose to implement explicit slowness, where the pacing of interaction was fixed and beyond users' control. However, an alternative approach could involve implicit slowness, which allows users to modulate the pace of interaction while still encouraging slower engagement. This study focused on only three of the eight slow technology design qualities, but future research should explore the remaining five.

Another important area is studying slow technology over longer time periods. In this study, participants interacted with the system for only three days, so we don't know how their experiences might have changed over weeks or months. Would they become more comfortable with the slow approach, or would they lose interest? Longer-term studies could help answer these questions and provide insights into how slow personal informatics systems can be designed for sustained engagement and reflection.

Finally, our results suggest that social interaction played an important role in shaping participants' experiences. Unlike many slow technology designs that focus on individual reflection, this study demonstrated how social elements, such as discussing figurine changes with peers and making connections with their behavior, can enhance engagement and encourage shared reflection. Future research could explore how social elements influence reflection and whether incorporating them into slow technology designs makes them more engaging and meaningful.

8. Conclusion

This thesis explored how slow technology design qualities can be integrated into a tangible artefact to foster reflection on screen exposure before sleep. This study encouraged users to

engage more deeply with their screen time data by adopting explicit slowness, ongoingness and pre-interaction into a figurine-based intervention. The results highlighted that participant developed a strong personal connection with the figurine which facilitated self-reflection, behavioral awareness, and social interaction.

According to the research question, ongoingness is the most effective design quality when addressing slow technology design qualities since participants were able to engage with the gradual transformation of the figurine over time. Even though the impact of the pre-interaction is varied, it was also beneficial in fostering reflection through morning voice messages. However, explicit slowness was the least successfully implemented design quality as the delayed feedback was met with mixed responses, highlighting challenges in integrating this quality into personal informatics.

In this study, participants perceived their screen-time habits as an accumulation rather than isolated as a result of the gradual transformation of the figurine. This provided a new perspective on self-tracking beyond traditional data visualization. Pre-interaction in the form of daily voice messages contributed to building anticipation and fostering early-stage reflection. Nevertheless, explicit slowness and deliberately delayed feedback were met with a mixed response. Even though some participants appreciated the way it facilitated reflection others found it frustrating since their expectations of instant feedback were shaped by the rapid evaluation of digital interactions.

Acknowledgments

We would like to sincerely thank all the participants in this study for their time and engagement, without whom we wouldn't have been able to complete this thesis. A special thank you to our thesis supervisors, Pedro Sanches and Eirini Kaklopoulou, for your continuous support and guidance throughout the entire thesis. Your constructive feedback and thoughtful suggestions were essential in shaping the direction of this thesis and keeping us motivated. We would also like to express our gratitude to Rikard Harr, the coordinator of the thesis course, for providing clear guidance throughout the process, and to Anders Lundström for conducting the two seminars that helped us on scientific writing.

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Slow Technology Design Qualities (Odom, Stolterman, & Chen, 2021)

Implicit Slowness:	The pacing of an artifact is naturally slow, yet not strictly enforced. Users have the ability to control and accelerate the interaction if they choose to, but the artifact's design make such acceleration feel less intuitive or desirable. This creates an experience where the artifact remains available for engagement at any time while subtly encouraging a slower interaction.
Explicit Slowness:	The user has little to no control over the artifact's pace, which is predetermined by the designer. The artifact operates on its own timeline, making its behaviour feel unpredictable. This unpredictability can be intentionally used to create moments of anticipation and delayed interaction.
Ongoingness:	The continuous passage of time within a design artifact, manifesting in both explicit and implicit ways. Explicit ongoingness involves a never-ending cycle of behaviour, where interactions unfold over time without urgency - users can engage at their own pace, knowing another opportunity will arise. Implicit ongoingness refers to the gradual transformation of the artifact over time, shaping how it is perceived and experienced. While these changes may be subtle in the moment, they contribute to the evolving relationship between the user and the artifact.
Pre-interaction:	The time and space leading up to direct engagement with a design artifact. This phase sets the stage for the interaction by shaping expectations and building anticipation, even if the actual interaction itself is brief or minimal. It allows for meaningful experiences to occur before any interaction takes place.
Temporal Drift:	An artifact's behaviour shifts in and out of sync with the regular rhythms of daily life. Rather than adhering to conventional time structures like a 24-hour cycle, the artifact follows its own unique pacing. This quality relies on ongoingness, ensuring the artifact's behaviour unfolds continuously, and it connects to explicit slowness by emphasizing the artifact's autonomy in determining its own timing.
Temporal Modality:	The integration of various forms of time, both linear and non-linear, is a core aspect of the artifact's design. This can include traditional chronological time or alternative rhythms such as seasons, days, or years, each shaping distinct user experiences.
Temporal Interconnectedness:	Multiple temporal modalities are integrated into a design artifact, allowing different time frameworks to coexist and interact.
Temporal Granularity:	The ability of users to adjust the amount of time they navigate through when interacting with slow technology, particularly in digital media or data archives. This quality offers the user control over the pacing of the interaction allowing for flexibility in exploring large historical datasets.

Interview Guide:

Demographics:

- Age
- Gender
- Occupation

Questions:

1. General

- How would you describe your overall experience with the figurine over the past few days?
- How did you interact with it? Can you share one or two memorable interactions?
- Did the figurine prompt you to reflect on anything? If so, how?
- How did you interpret the changes in the figurine (e.g., clothing, hair, accessories, posture)?
- Did you ever find yourself anticipating any changes in the figurine based on what you reported?
- Did you ever try to influence how the figurine would look? If so, how?

2. Pre-Interaction

- Before arriving in the morning, did you ever think about what the figurine might look like that day?
- Did you feel curious or excited to see how it had changed? Why or why not?
- Did the fact that you had to wait until the next day to see the figurine's transformation make you more aware of your behavior at night?

3. Ongoingness

- Did you feel that the figurine's changes accumulated over time, or did it seem like it was resetting each day?
- Did the ongoing transformation make you think differently about how habits build up over time?
- Did the figurine's continuous changes keep you engaged throughout the study? Why or why not?

4. Explicit Slowness

- Did you ever feel like you had control over how the figurine changed?

- How did you feel about the fact that you couldn't directly influence the figurine's changes?
- How did you experience the delay between sending the voice message and seeing the figurine's transformation after arriving in the lab and not directly?

5. Feedback & Closing Questions

- Was there anything you didn't like or found confusing about the figurine?
- Is there anything else you'd like to share about your experience with the figurine?