

Combining Momentary and Retrospective Self-Reflection in a Mobile Photo-Based Journaling Application

Pelin Karaturhan
KUAR Research Center for Creative Industries, KARMA Mixed Reality Lab, Koç University, İstanbul/Turkey
pkaraturhan13@ku.edu.tr

Ecem Arıkan
Koç University, İstanbul/Turkey
earikan16@ku.edu.tr

Pelin Durak
Koç University, İstanbul/Turkey
pdurak15@ku.edu.tr

Asım Evren Yantaç
KUAR Research Center for Creative Industries, KARMA Mixed Reality Lab, Koç University, İstanbul/Turkey
eyantac@ku.edu.tr

Kemal Kuşçu
Department of Medicine, Koç University, İstanbul/Turkey
kkuscu@ku.edu.tr

ABSTRACT

The concept of self-reflection is investigated in a wide range of fields, from Psychology to HCI. Different fields use different methods to trigger reflection, such as visualizing accumulated personal quantitative data, personal photos, journaling, or asking reflective questions about experiences. This study combines photo-based journaling, reflective questions and data visualization for triggering momentary and retrospective self-reflection. We prototyped a photo-based journaling app and conducted a 5-week field study (N=13) to observe in-the-wild experiences. Following, we conducted an evaluation workshop (N=9) to explore strategies for motivating reflective question answering and retrospective self-reflection. Our approach encourages momentary and retrospective self-reflection, but the question-answering process could be burdensome and retrospective self-reflection should be incentivized. For that, we compiled design strategies for both kinds of self-reflection. We contribute to the HCI literature with strategies for unifying momentary and retrospective self-reflection in photo-based journaling.

CCS CONCEPTS

• **Human-centered computing** → Human computer interaction (HCI); Empirical studies in HCI.

KEYWORDS

Self-reflection, reflection, momentary self-reflection, retrospective self-reflection, journaling, photos, photo-based journaling, everyday experiences

ACM Reference Format:
Pelin Karaturhan, Ecem Arıkan, Pelin Durak, Asım Evren Yantaç, and Kemal Kuşçu. 2022. Combining Momentary and Retrospective Self-Reflection in a Mobile Photo-Based Journaling Application. In *Nordic Human-Computer Interaction Conference (NordiCHI '22), October 08–12, 2022, Aarhus, Denmark.* ACM, New York, NY, USA, 12 pages. https://doi.org/10.1145/3546155.3546676



This work is licensed under a Creative Commons Attribution International 4.0 License.

NordiCHI '22, October 08–12, 2022, Aarhus, Denmark
© 2022 Copyright held by the owner/author(s).
ACM ISBN 978-1-4503-9699-8/22/10.
https://doi.org/10.1145/3546155.3546676

1 INTRODUCTION

"The unexamined life is not worth living." Socrates

Introspective examination of one's own life has been prevalent since the very beginning of philosophical thought. There is a good reason for this. Engaging in reflective thinking can increase self-awareness and self-knowledge, resulting in better well-being. We can better understand ourselves and make more meaningful decisions in our daily lives, from setting achievable goals to finding friends who share similar interests with us through reflecting. The concept of reflection has been investigated in Philosophy, Cognitive and Developmental Psychology, Education, and Professional Development [6, 24]. Self-reflection (or reflection) gained popularity in HCI literature through its vital role in the Personal Informatics (PI) approach, which focuses on an individual's collected personal data.

In today's fast-paced world, encouraging people to reflect, especially on everyday experiences, can be a challenging task to overcome. Recording our daily experiences evolved from keeping detailed diaries to sharing photos on social media, often with little to no description. The potential of social media shares as records of our daily experiences gained attention both in academic research and industry. HCI investigated the potential use of social media data for self-reflection. Similarly, social media companies developed features that remind their users about their past shares, the most well-known examples being Facebook and Instagram's services.

However, most of these services assume 'a picture is worth a thousand words', whereas retrospectively engaging with reflection may require more than just seeing photos from our pasts. In personal informatics (PI), self-reflection occurs through a retrospective examination of previously collected data, generally through information visualizations to derive insights [31]. These visualizations allow users to make sense of complex information and see patterns. HCI also investigated the value of photos for retrospective self-reflection. Photos are proven to preserve everyday experiences, gain value over time, and are perceived as easy to capture and record



Figure 1: Research-through-design process.

[10, 37]. Although revisiting past personal experiences through reminders is also valuable [26], visualizing their personal experiences captured through photos may enable users to reflect better.

The data is the main challenge to supporting photos with visualizations of everyday experiences. Although deriving some context from images is possible, it does not allow a generable visual language. When we turn to Psychology and Education, we see their approach to reflective thinking is more focused on the momentary experience of thinking rather than on examining past data. One widely applied method is journaling, where individuals write about their emotions, thoughts, and experiences, creating a reflective moment. Writing activity may be more beneficial when accompanied by questions that trigger reflective thinking [45]. Educational research uses question probes (reflective questions) in schools and professional learning contexts for momentary reflection. Reflective journaling has been briefly investigated for learning [32] and professional development [3] contexts in HCI literature. However, reflective journaling methods for personal life experiences are an under-explored research area.

In this work, we encourage users to extend the data of their daily experience photographs with reflective questions and present their data through visualizations. We are interested in combining photo-taking habits with journaling to trigger momentary self-reflection and offering visualizations for retrospective self-reflection. In particular, we have two research questions;

(RQ1) How can we combine everyday photo-taking and journaling into a (self)-reflective thinking activity?

(RQ2) How can we visualize qualitative journal data to enable retrospective self-reflection in photo-based journaling?

We started by designing and developing a mobile application to address these questions. To answer RQ1, we integrated reflective questions into the mobile app using Karaturhan et al.'s reflective questioning framework [27]. To answer RQ2, we conducted a design study with eight designers and designed a visualization to work with Karaturhan et al.'s framework. After developing the mobile photo-based journaling tool, we conducted an in-the-wild user study, where 13 participants used the photo-journaling application for five weeks. This study confirmed that reflective questions encouraged the users to think more deeply about their experiences, and visualizations acted as thought triggers for retrospective self-reflection. However, the participants found the question answering and log creation process burdensome and did not visit their past logs often. We conducted another generative workshop with study participants, designers, and developers and devised strategies to address this problem (N=9).

Overall, here we report the findings of this research-through-design process [56], including (1) concept development, (2) design studies for visualization, (3) in-the-wild user studies with the prototype, and (4) a workshop evaluating the user insights (Figure 1). This work contributes to the literature by suggesting a multi-dimensional self-reflection system combining momentary (with photos, journaling, and reflective questions) and retrospective (with revisiting journal logs and visualizations) self-reflection. We also offer strategies for future work focusing on multi-dimensional systems for the HCI community to extend our work in the field.

2 BACKGROUND

We would like first to clarify the distinction between the concepts of reflection and self-reflection. Cambridge Dictionary defines reflection as *"serious and careful thought"*[1], and self-reflection as *"the activity of thinking about your own feelings and behavior, and the reasons that may lie behind them."*[2] Self-reflection, having a narrower focus, borrows a lot from reflection literature. Additionally, two concepts are often used interchangeably. Therefore, this section discusses background literature on reflection and self-reflection since research on reflection is wider.

2.1 Self-Reflection in Education and Psychology

As the function of reflection fundamentally is to make us think, reflection and self-reflection play a critical part in Education, Professional Development, Counseling, and Coaching. Journaling, expressive writing, and reflective writing are popular tools to trigger reflection. Questions and probes can accompany the writing activity; these reflective questions and probes intend to imitate the dialogue between a teacher and student or a therapist and a patient [43]. Previous work has pointed out the benefit of guided journals compared to free writing for reflection [45].

With or without guiding questions, journals and reflective writing are proven practical tools for reflection in Education and Psychology. In Education, reflective writing is proven to enhance student learning [36], self-knowledge [15], college preparation [44], and professional learning for educators [12]. Outside of the education field, expressive and reflective writing has been used in a wide range of areas. For example, to improve adolescent well-being [53], for families with deep traumas [30], in behavioral therapy of depressed college students [23], and to mitigate depression and PTSD symptoms of women with a history of childhood sexual abuse [38].

[1]https://dictionary.cambridge.org/dictionary/english/reflection
[2]https://dictionary.cambridge.org/dictionary/english/self-reflection.

Evidence from Education and Psychology emphasizes the critical role of writing for reflection, especially when accompanied by reflective questions or probes. However, these tools have a minimal reflection in HCI literature, even though Fleck and Fitzpatrick highlighted the potential of reflective questions for reflection [20]. HCI explored bullet journals and their role in self-tracking, meaning-making and reflection [4, 52], but they focus more on crafting and less on writing. As one of the very few examples, Mols et al. [43] highlighted dialogue-driven reflection as one of the strategies for everyday life reflection. As a recent development in the domain, Karaturhan et al. suggested a framework of reflective questions to help users reflect on their experiences [28]. However, they did not implement their questioning framework in any working system.

2.2 Reflection in HCI: Quantified Self, Visualizations and Authorship

With the Quantified-Self Movement gaining interest, reflection is established as a step to achieve behavior change through tracking and understanding quantitative personal information [31]. Since then, literature has examined best practices to help self-trackers better reflect on their data [6, 7, 20] and application of reflection to more specific cases such as diabetes [39] and eating disorders [14] with the help of new technology.

Due to the vast amount of data collected, systems needed ways to present the data insightfully [31]. HCI started to make use of information visualization methods for a wide range of quantitative personal data, from physical activity [13, 17, 18], to water usage [21], and from computer usage [29] to food waste and recycling [51]. Previous work also aimed to understand the role of visualization in better self-reflection on multiple streams of personal data [11].

As mentioned above, reflection gained more interest in HCI with quantified-self movement and initial forms of tools collecting data through sensors and trackers. Users were not active during the creation of "journal entries." Among other personal data, calorie intake is essential for a healthy lifestyle and helps manage certain disorders. Since food consumption cannot be detected easily through sensors and algorithms and requires active user authorship, HCI literature investigated food journaling in-depth. Work on food journaling focused on increasing system proactivity for ease of use [35, 46, 55], helping users better reflect on their data, and even cultural differences in food journaling apps [34]. We believe that HCI's interest in food journaling apps could be very well adapted to daily journaling in the future, based on the qualitative nature of everyday experiences and the potential of self-reflection for better well-being.

2.3 Shifts in Perception: Everyday Life

For some years, HCI moved from treating reflection as a step towards behavior change to accepting it as an essential part of our everyday lives [41]. With this, research started to focus on the reflective potential of experiences from our daily lives, such as social media shares [47] and photo galleries [37]. Concurrently, a stream of research focusing on everyday life reflection is also emerged [40, 41, 43]. The literature is now exploring ways to visually support reflection on everyday life in novel ways, such as using memes [50] or user-generated visual compositions [27].

Personal journals keep records of our daily experiences much like sensors keeping record of our step count. Hence, researchers interested in lived experiences use methods such as diary studies and experience sampling that asks research participants to record their daily lives. Realizing the potential, diaries and experience sampling tools for reflection is briefly investigated in previous work [2, 22].

Other than that, there is little work in HCI literature focusing on journaling everyday experiences for reflection. Echo, a mobile journaling application that allows users to record their experiences and add additional information, is an outstanding example for this purpose, in terms of its everyday focus and its distinction between logging an experience and retrospectively looking back [26]. Echo requires a title and a happiness rating, leaving descriptions, photos, videos, and voice recordings optional. It presents its users with previous entries based on time and allows them to reflect again. Our work has three main departures from Echo. First, Echo treats the journaling activity as simply recording experiences while we consider the journaling activity as a reflective activity. Second, Echo only collects data related to emotions while we collect the emotional, sensory, and intellectual significance of each experience. Third, Echo is not photo-based and does not use visualizations, whereas we present a photo-journal accompanied with experience visualizations.

2.4 Photos in Digital Journals and Social Media

Digital photography have been a big part of our daily lives for years, due to the increased ubiquity through smartphone cameras. As a result, people record more of their mundane, everyday experiences through photographs [25]. Among the many photos taken through smartphones, valuable photographs may be shared on social media, printed out, or displayed in a public setting such as the home. Shared images, especially on social media, go through various filters, such as one's concerns about online impressions [19], privacy concerns or aesthetic value while unshared photographs piling on digital photo libraries may never be reviewed again [33] and may not be retrieved easily [54]. However, photographs capturing everyday experiences are valuable for reflection and can bring surprise and pleasure [25]. As a result, HCI literature has been investigating the role of photographs through various perspectives such as remembering personal pasts [49], location based reminiscence [37], presenting previously shared social media images for reminiscence [47].

With the digitalization of journals, data other than written entries have started to be integrated into digital journals, gaining interest in the field. Examples include voice recordings, photographs, location tags, weather information, and timestamps. Among these, photos have been observed to be prioritized by users. While exploring digital journaling practices, Elsden et al. discovered that user-generated content paired with photographs evoked a sense of curation and ownership, which journal keepers value [16]. A similar inclination is observed in personal informatics and lifelogging systems. For instance, when creating a time capsule for future reminiscence, families preferred to include photos more than anything else, as participants valued their potential to help remember [48]. McGookin also explored how photos from the past are considered

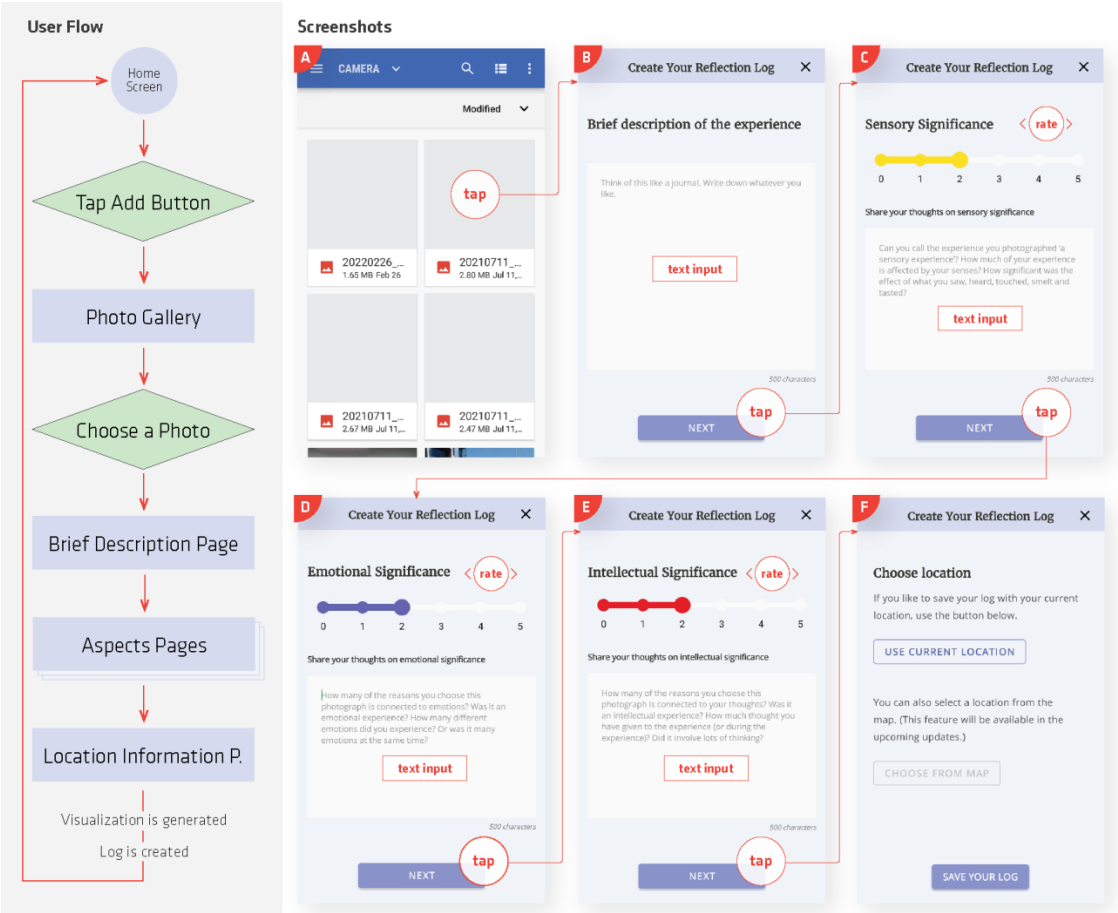

Figure 2: User flow and prototype screenshots for creating a journal log.

valuable for reminiscence with the Reveal app [37]. From another perspective, photographs paired with small annotations are very successful in diary studies at capturing everyday life experiences, as they are easy to capture [10]. Building on this body highlighting the importance of photos for journaling and retrospective reflection, we put photographs on the center to create a multimodal self-reflection application.

3 CONCEPT DEVELOPMENT AND PROTOTYPING: REFLECTION THROUGH PHOTO JOURNALING

As mentioned in the introduction, we aim to explore the combined potential of photos and journaling both for momentary and retrospective reflection on everyday experiences, with the following research questions in mind; 'How can we combine everyday photo-taking and journaling into a (self)-reflective thinking activity?' and 'How can we visualize qualitative journal data to enable retrospective self-reflection in photo-based journaling?' We designed and developed a mobile photo-based personal journaling application to address these questions and collect user feedback. Below, we explain the concept, visualization design, and prototype.

3.1 Concept Development

Experience Design. As the introduction explains, recording everyday experiences in today's world generally means sharing photos on social media. We are all very used to visual feeds and galleries, both from social media applications and native gallery applications of our smartphones. We base our design decisions on this familiarity by creating a prototype visually similar to social photo sharing applications. More specifically, we aimed for a sense of familiarity through a home page showing previously uploaded photos in a grid view (2 3A), much like our photo galleries, and a detail view screen that has the image on top and the description below (2 3B), similar to vastly used visual social media application Instagram. On top of these, we created a survey-like structure for presenting reflective questions (Figure 2) to resemble online questionnaire softwares like Google Forms, which most users are already familiar with. After multiple rounds of design iterations within the research team, we finalized the experience design and interfaces. Our design affords five main functions; (1) importing a photo to the application (1 2A), (2) creating journal logs for the photo with reflective questions (Figure 1B,C,D,E,F), (3) overviewing previous logs in a grid view (2 3A), (4) viewing visualizations generated based on users' logs (2 3A), and (5) viewing previous logs in detail (2 3B).

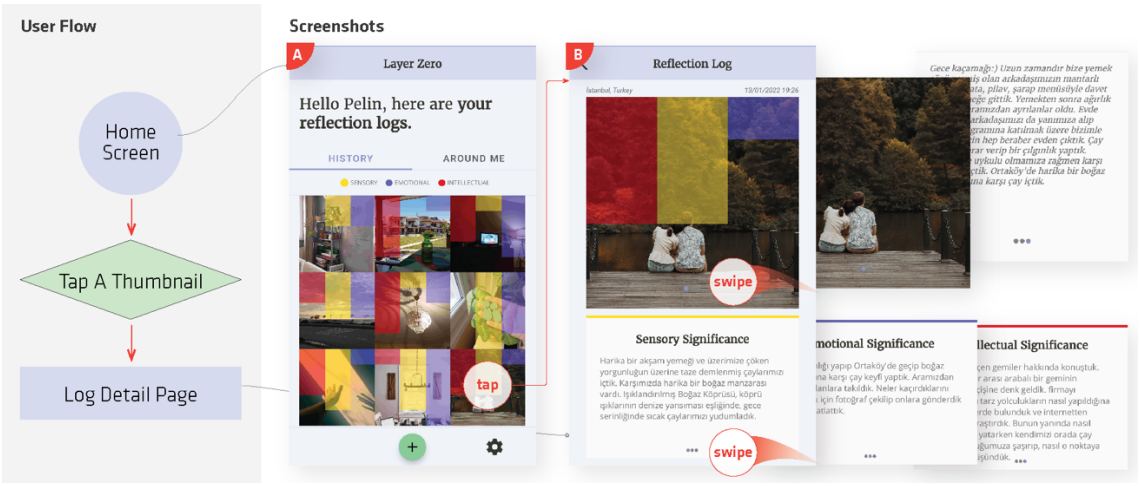

Figure 3: User flow and prototype screenshots for reviewing previous logs.

Question Selection. We implemented Karaturhan et al.'s reflective questioning approach, where each experience is evaluated in three dimensions: sensory, emotional, and intellectual. We transformed these dimensions into reflective questions by asking the users to share the significance of the recorded experience for each category (i.e., Share your thoughts on intellectual significance) through the user interface. Our motivation for choosing this framework is threefold. First, it focuses on everyday life experiences compared to a specific domain like learning. Second, it has been tested and found beneficial for photographed experiences, just as we aim to do here. Third, these questions already categorized the daily experiences, unlike other options such as a general expressive writing prompt or prompts from cognitive behavioral therapy or positive psychology. This existing categorization is helpful from a visualization perspective, as explained in the next part.

Visualization Parameters. Data visualizations should have a common denominator, and such commonality is hard to establish in everyday experiences [27]. However, Karaturhan et al.'s approach already provides a dimensional system. Therefore, we decided to use these three dimensions when visualizing each experience. We asked the users to rate each parameter's significance when answering questions on a 0-5 scale, 0 being the least significant. We conducted a workshop with designers to generate a suitable visualization method based on the three dimensions of Karaturhan et al.'s framework, which we explain in detail in 3.2.

Visualization Placement. Aligned with the common practice in the photo-based applications, where the grid view consists of photos, we explored and evaluated different visualization strategies that would work with photos in a grid view. For visualizations to work together to reveal patterns, we decided to place them on top of photos, which visually reminds photo filters.

3.2 Designing for Log Visualizations

Implementing a visualization on top of the uploaded image allows users to visually track and compare the significance of each dimension (intellectual, sensory, emotional) among their logs to derive insights. For the design of the visualizations, we announced an open call through social media that explained our aim. We recruited seven designers: six female and one male (four interaction designers, two visual designers, and one HCI designer). A total of 11 different visualizations with variations within them were submitted. We organized a follow-up meeting with these eight designers to inform them about all visualizations before distributing the survey for selection. The designers briefly explained their visualizations and discussed each visualization. After the meeting, we distributed an online evaluation survey where we asked them to rate each visualization set for *aesthetics, comprehensibility, level of detail, originality, creativity, and technical feasibility (adapted from* [24]*)* on a -5 to 5 Likert scale [1]. We selected one based on technological implementation ease among the three visualization sets with the highest overall score. The detail of the visualization is presented in 2 3. The designer of the visualization decided on the colors. Each column represents a dimension (emotional, sensory, intellectual) and fills its designated space proportional to the value attributed to the importance of that dimension. The yellow color represents the sensory dimension, purple represents the emotional dimension, and red represents the intellectual dimension. We choose not to interfere with the choice of color since the association of the colors with the concepts is highly personal.

3.3 Prototype

Below we are summarizing a generic user experience of the prototype:

- Onboarding. After signing up for the application, the users undergo an onboarding (training session) to learn about the application's aim and the dimensions. After onboarding, the users are directed to the home screen, which is empty upon registration. The plus button at the bottom of the screen can be used for log creation (Figure 3A).
- Creating Journal Logs. Log creation flow follows a step-by-step approach and starts with the plus button. After clicking the plus button, the app opens the photo library and the

user selects a photo to upload. Following, the user is asked to describe the photographed experience with a text input field. They can tap on the 'next' button to proceed. Following, pages asking for sensory, emotional and intellectual significance of the experience comes respectively. In each of these pages, users rate the significance of that dimension with a Likert scale out of 5 through tapping or swiping. They can also write about that dimension in the text input area. They can tap on the 'Next' button to proceed when they are done. Lastly, the application asks for location information. Users share their locations with the application by clicking a button. Upon completion, users are directed to the home page. Figure 2 summarizes the entire flow.

- Home Screen. After the log creation, users can reach the previous logs from the home screen. Home screen shows the logs by placing the photo with the visualization in a thumbnail grid (Figure 3A). Home screen allows an overview of the ratings over time as uploaded photos accumulate.
- Visualizations. Users can view the visualizations together with photos in the home screen (Figure 3A). They can also individually see the visualizations in the detail view (Figure 3B).
- Detail Screen. The detail screen aims to give the users a more focused self-reflection opportunity. In this view, there are two components: photo and annotations. The photo component comprises three parts: the photo with visualization, the original photo, and the brief description, which the user can reach with a left swipe action. The annotations component comprises three parts: notes about the sensory, emotional, and intellectual dimensions, also reached with a left swipe action. Figure 3 summarizes the entire flow.

4 STUDY 1: IN-THE-WILD USER STUDY

To observe users' interactions with the prototype, we conducted an in-the-wild user study where participants used the mobile application for five weeks. The study was conducted under the ethical committee approval from Koç University Committee on Human Research with the protocol number 2021.273.IRB3.120.

4.1 Study Procedure

The study comprised three tasks: (1) four-week user study: The users downloaded the mobile application to their smartphones and used it for four weeks. Reminder notifications were sent to the participants through the application during the study; (2) Scale: Participants filled the System Usability Scale [9] at the end of the study; (3) Semi-structured exit interview: We conducted semi-structured interviews with all participants to understand and discuss their experiences with the prototype.

After the participants were recruited, one of the authors organized online orientation meetings through video conferencing. A scheduling sheet was shared with participants. Each session took around 15 minutes and participants attended the meetings in groups or individually. An email including the online meeting link, an online informed consent form, instructions for downloading the mobile application form, a guide to the application and an instruction video for downloading the app was sent to the participants before the meeting. During the meeting, the author explained the user study, answered the participants' questions, and guided them through the application setup if there were any problems. Participants who did not manage to attend the meetings received the instructions through email.

4.2 Participants

We recruited 16 participants, three of whom were excluded from the study since they did not attend the exit interviews. Our participants, three male and 10 female, were recruited through two channels: (1) social media and (2) emailing to a voluntary participant pool of our research lab. The participants needed to have Android smartphones, and sufficient English to participate in the study. Participants' ages ranged from 16 to 34 with a mean of 24.9 and a standard deviation of 4.8 (Table 1). Participants recruited through social media announcements were compensated with a 3-month movie streaming platform membership, a 3-month meditation app membership, or a theatre ticket, based on their preference.

4.3 Analysis

We followed thematic analysis to analyze the data from the semi-structured interviews [8]. We did not analyze the users' input as we did not want them to sacrifice their privacy when creating their input. In the onboarding sessions, we informed our participants that we would not use their information other than providing examples for an academic paper, and if so, we would anonymize their data. We first transcribed the interviews. The first author read the transcripts first, to become familiarized with the data. After creating an initial coding schema, another author also coded the data based on the schema. After a discussion session with the authors, the final codebook was created. Two authors coded the data individually and disagreements were resolved through discussions to reach consensus. The analysis resulted in four themes explained below.

4.4 Findings

Over the course of five weeks, participants created an average of 5 logs, and a total of 71 logs are created. For details you can refer to Table 1.

4.4.1 System Usability Scale. Average usability score is 81.15, corresponding to a A grade[3]. Out of 13 participants, nine rated the usability of our system above 80.8 out of 100, which also corresponds to A grade.

4.4.2 Dimensional approach creates a space for self-reflection. Out of 13 participants, seven stated that encountering the dimensions made them "think", and they found this beneficial: "It's good that it's thought provoking because I want it anyway. I'm trying to understand how I feel in different places, so it's good to be asked the right questions." (P1). Thinking about their experiences helped them investigate different aspects of their experiences and reveal the often-overlooked details; "Actually, there are five senses, but in daily life, people don't think to share what they feel in terms of senses and which of the five senses is affecting them. It makes us think a little bit there. what did I do here; I just saw and touched but had no experience with any other sense." (P11). Creating a moment

[3]https://measuringu.com/interpret-sus-score/

Table 1: Participants of the in-the-wild study.

Participant Number	Age	Gender	Occupation	Number of inputs
P1	30	Female	Designer	5
P2	16	Male	High School Student	3
P3	25	Female	Designer	4
P4	23	Female	Architect	4
P5	22	Male	University Student	3
P6	22	Female	University Student	13
P7	28	Female	Product Manager	5
P8	25	Female	Research Assistant	5
P9	20	Female	University Student	10
P10	30	Female	Architect	2
P11	34	Male	Occupational Safety Specialist	3
P12	23	Female	Interior Architect & Student	8
P13	26	Female	PhD. Student	6

of pause to think also increased the perceived value of mundane experiences: "(With the dimensional approach) We can stop and take a different perspective on things that we don't think about or give any importance in the flow of daily life." (P10). We suggest that this level of thinking and consideration shares qualities with reflective description definition, introduced to the HCI literature by Fleck et al. as the first level of reflective thinking [20].

Beyond thinking, four participants reached a form of awareness or understanding about themselves: *"Especially when evaluating the intellectual side, I questioned myself: What if I don't reflect my experiences too much?"* (P11). For instance, P13 questioned their sharing habits and preferences: *"I noticed this; I always put more emotionally high experiences, it made me realize it."*. We identify these statements as the second level of reflective thinking: dialogic reflection.

Three participants explicitly stated a shift in perspective. P9 explained how they started thinking according to the three dimensions starting from the moment of capturing the image. *"From the moment I thought that I was going to upload that photo, I started to think about how I feel at that moment, and when I entered the application, I entered those states in a more comfortable way."* At least in the short-term, P2 stated that they started a shift in their overall thought processes: *"In fact, now my way of thinking has started to turn into it, as if I have the app in my head, I now think with the app."*. The shift in perspective is aligned with the third level of reflective thinking: transformative reflection.

To sum up, most of our participants are engaged in various levels of reflective thinking through their interactions with questions related to three dimensions (emotional, sensory, intellectual) we provided.

4.4.3 The process is appreciated, but sometimes perceived as burdensome. Our participants experienced various frustrations during the log creation process. When creating a log, the user made the participants go through each dimension step-by-step, though answering questions was not mandatory. This structure was not well-received by the participants. Four suggested changing this into a more user-led process, where users could choose which dimension to reflect: "*When it asks me for three phases, I force myself to think if there is something in all three phases. For example, if it's an emotional thing, it would be better for me if I could just click on it and write only it (emotional significance), if filling out the others wasn't like an obligation, it would be better for me." (P3).* When participants did not have immediate answers to the questions, they experienced feelings of inadequacy: *"I might want to skip those three things (dimension questions) because it made me feel as if something like this had to happen (different dimensions in every experience) and I was missing out." (P1).* This sense of inadequacy was sometimes combined with the sense of responsibility to give 'right' answers. *"I gave a very similar answer to the other one, did I answer that wrong, should I say something else?" (P12)* A sense of responsibility was also present in the participants since they felt their input was the determinant of their contribution to our study. All the perceptions mentioned above resulted in a high level of stress for participants.

When creating a log, the meaning of the dimensions was not easy to comprehend. Participants had hard times differentiating the categories from each other. Sometimes it was hard for them to decide which aspects of the experience belonged where. *"I also thought, for example, 'Now I wonder whether this is emotional or sensory, it goes both ways, should I write it on both sides?' It was not easy for me to group them." (P12).* We distributed a PDF guide and provided some inspiration in the input boxes (1 2). Participants expressed the explanations as being somewhat useful. However, only one participant stated that he made use of the guide.

All in all, uploading an image and answering three open ended questions, which required significant thinking, made the entire log creation process lengthy. Participants stated that thinking about questions was hard and took time.

"You remember everything about the experience when you write the initial description and you break up the experience step by step with questions about dimensions. For example, the sensory dimension takes me to think in detail about the sensory moment of that day. It made my brain work harder, it had a positive effect on me. But even though I thought a lot, I couldn't write as much as I thought because I felt lazy." (P5)

Our findings identified the benefits observed from answering questions about experience dimensions. However, new strategies

should be explored to make the answering experience easier and more appealing.

4.4.4 Visualizations act as reflective triggers, but there is a need for more incentive for retrospective self-reflection. The visualizations are generated based on the users' ratings for the significance of each dimension in their log. Due to their similarity with filters used on top of the photos, we referred to them as *'filters'* during the interviews. Filters created excitement and contributed to the motivation for looking back to the logs, a critical act for retrospective self-reflection.

The colorful visual aspect of photo filters was interesting for the participants. After the initial attraction, participants easily grasped the meaning of the filters and enjoyed seeing their experience through the filters. *"I like that the points appear in levels. It was good feedback that the colors appear one by one in the history." (P5)*

Seeing the filters helped the users to remember their experiences, and different aspects of their experiences, without a need to read the log input. Two participants also stated that filters may help them avoid the details of unpleasant experiences when they don't want to face them: *"It was a nice filter to avoid getting into the mood of that photo, if we were feeling sad at that time." (P2).*

For a group of participants, filters meant more than just remembering and thinking on the experience. They used the filters for various purposes. First, three participants used the filters for comparing different experiences. This opportunity arose from seeing the filters on top of the photographs, in a gallery view. *"Finally, when I looked at all the pictures at the same time, I loved being able to see the proportions of all of them. I really liked it there." (P6)* Second, one participant (P4) used the filters to track her experiences in a timeline: *"When I logged consecutively, I could see the change on a day-to-day basis. He was useful. On a day-to-day basis, for example, within a week after the first entry, I had the opportunity to see what I felt on the first day and how my mood was on the second day."* Third, the filters also helped (P4) to compare different aspects in the logged experience: "You can see what you're feeling that day, you can see which of the three categories is more intense.".

In addition to filters bringing about benefits in deriving insights, the placement of the grid of previous logs as the main screen of the app caused participants to be subjected to the filters and the images whenever they opened the application. This allowed for a moment of self-reflection and reminiscence each time they used the app. *"I put the first log I put in an excited way. It was a happy moment for me. Then I took a picture of it and posted it. When I saw that log while I was filling out the next ones, it made me happy to remember that moment and to experience that feeling." (P3*)

Although participants did not frequently look back to their logs during the 5 weeks, they explained that in the future they would. The initial expectation before starting to look back was the accumulation of memories. Time was another factor; two participants stated that looking back would be more meaningful after a certain time. *"If I had looked at it six months later maybe there would have been more memories accumulated there." (P12)* This also applied to painful memories, where time would help cool off certain feelings. *"In some entries, I may not want to go back and experience that moment again, or it may take some time before I want to look at it." (P7)*

Our findings reveal that although filters and home page with grid view enabled participants' retrospective inspection, new functions should be introduced to increase motivation for revisiting and retrospective self-reflection. When asked about their expectations from the app to revisit their past logs, being able to group logs, having filters or categories for easier searching stood out. "As far as I understand, these are just like a gallery, no history, no categorization. Maybe there can be a view like a category or a filter. When the gallery is a more crowded, I can search by mood: 'what did I share when I was feeling bad?' " *(P3*) Participants also suggested implementing a map and a calendar to easily track their logs.

4.4.5 Keeping the motivation high is vital for long-term use. Participants lacked the motivation for using the app regularly. As explained above, the process of creating a log was long and required an additional effort. Participants were not satisfied with the outcome of such an effort. They expected a more sophisticated outcome, or a reward. They expected the system to present them with an analysis from their input.

"I think I would like to create more entries if the app showed the average of my photos in graphs or tables, provided me with summaries like 'this is how you felt this month, or what you experienced last week'." (P9)

For some, the dullness of their daily life or busy work schedule kept them from creating logs: "We are always at home during the pandemic, there is a constant work-home routine, so it was not very effective." (P10). The perceived length of the process resulting on participants' selectiveness in terms of what experiences to record also resulted in a lack of motivation to use the app. However, participants came up with strategies to increase motivation. Their suggestions generally circled around the idea of the app presenting some sort of output. They pointed out to a need for summaries, or analyses provided by the app.

". . .To see the average of my photos, to see summaries such as 'you felt like this this month' or 'you experienced this last week'. . . .such as graphs or tables. . . .I would like to create more logs because it would turn into a kind of personal tracking." (P9)

5 STUDY 2: IDEATION WORKSHOP

We prepared an ideation workshop to develop solutions to address potential strategies for encouraging answering reflective questions and revisiting the app for self-reflection.

5.1 Procedure

We conducted an online workshop using Miro and Zoom softwares, structured in three parts: introduction, ideation and discussion. Two authors conducted the workshop as facilitators. To begin, the first author made a presentation explaining the aim of the study, how the application worked, and two main frictions detected in the in-the-wild user study (lack of motivation to answer the reflective questions for everyday experiences and lack of motivation to revisit past logs). The presentation lasted around 30 minutes. We asked the participants to develop new feature ideas to overcome two frictions. Following this, the participants ideated for 10 minutes using the sticky notes in Miro for the first friction. Then each presented their ideas to the group for 3-4 minutes, followed by a group discussion for 15 minutes. The same process was repeated for the second

friction. This workshop lasted around two hours. All participants gave consent to use the material they produced in the workshop.

5.2 Participants

To reach diverse strategies, we wanted to design a workshop which included not just designers but also users and developers. We contacted the previous study participants to participate in the workshop through email. We contacted six participants from Study 1, who created more than five logs during the user study, since we believe they would have more insight for the app. Two participants agreed to participate. We also invited five HCI designers, one mobile app developer, and one visual artist. A total of nine participants joined the workshop. All participants were compensated with a 3-month movie platform membership.

5.3 Findings

Participants came up with functionalities to address two main frictions; (i) lack of motivation to answer the reflective questions for everyday experiences and (ii) lack of motivation to revisit past logs. We categorized the ideas based on similarities in function to overcome the frictions.

5.3.1 Strategies for Encouraging Momentary Self-Reflection. The insights from in-the-wild study revealed participants were concerned to give a correct answer, the process of answering the questions on dimensions was rather lengthy and it was not always easy to understand what the dimensions stood for.

Language and Level of Detail. The workshop participants suggested that the language used in the application should be more informal and daily to make the question answering process more natural, rather than it being like an exam that requires correct answers. One suggested strategy was to integrate verbal communication to give the feeling of having a conversation. Regarding using a non-formal language, using more than one question for each category was suggested. Multiple questions for each category can create sub-categories that are easier to understand or respond to. Additionally, it can decrease the perceived length, especially if combined with a conversation-like structure. Having multiple questions investigating the sub-categories can also make the answers more tangible and descriptive, increasing the data users provide. For instance, when inquiring about the intellectual significance, the system could ask about the sub-categories ('Is this experience significant occupationally?', Is this experience significant from a lifelong learning perspective?') or direct more descriptive questions such as "What were your exact thoughts while you were taking that photo?".

Gamification. Various gamification strategies were proposed in the workshop. Goal setting and rewards are approached from a perspective that celebrates the length of the input. Rewards can be given both based on the number of the entries and the number of words used in a single log. Many gamification strategies could be explored in the future especially with the help of other technologies. For instance, one suggestion was to present the users with significance values determined by AI and to ask them to correct the values if they are predicted falsely.

Expanding the Time to Reflect. Answering the dimensional questions takes time. The expected amount of time may be too much to give up. Workshop participants suggested expanding the time to reflect; answers should not be required immediately but the user could take some time to come back and record their experience, for instance 24 hours. It could also extend 24 hours and the system proactively bring a previously uploaded photograph to the user and ask the reflective questions.

5.3.2 Strategies for Encouraging Retrospective Self-Reflection. One of the negative aspects identified in in-the-wild study was participants' lack of revisiting their previous logs. In the workshop, several strategies were suggested to encourage retrospective self-reflection.

Reminders. One of the suggested strategies was to remind users their past experiences. Participants suggested that setting up reminders both in and outside the app would increase retrospective self-reflection. Participants suggested different reminders: quantity-based, time-based, quality-based, and location-based. Quantity-based reminders would be triggered when users reach a specified number of posts. For instance, the app could remind users about past logs after 100 posts. Time-based reminders are the ones we see often; the app reminds the logs from a certain time ago; for instance, one year, one month or one week ago. Reminders can also be location based. Systems could remind users about their logs recorded in the same location. Lastly, quality-based reminders could be implemented. The system could pick the log to be highlighted based on certain qualities such as the longest input, or the most emotional log.

Contextual Summaries. Reminders highlight single logs whereas summaries compile similar logs. Contextual summaries collect logs based on their content and present them to the user as a summary. The summaries can be based on location or time; for instance, logs from a certain week or location can be presented to the user to reflect upon. Further, they can be based on certain qualities, just like reminders. Examples given by the workshop participants included logs most time spent creating, and the most emotional logs of the past month.

Visual Summaries. Another way of reminding participants about past logs is via visual summaries. These use visualizations to summarize the user's past activity and could be time-set to the end of the week, month or year. Visualizations can show the number of logs created and their content via colors and shapes. One participant highlighted how the grid view disables a cumulative overview by allowing only nine logs to be seen in the screen. Zooming out the grid view to enable users to see many logs at once may also act as a more cumulative, time-based visual summary, in our case. Furthermore, visual summaries can be gamified. For instance, the content of the log can be kept hidden while the user wanders around just the values (in our case) or individual experience visualizations. The contents can be made accessible only upon request, adding mystery to the experience.

Feedback. The system's feedback is one step further from reminders and summaries. In this case, workshop participants suggested that the system should be able to analyze the input and present the user with insights based on their data. The insights aim to present the user with information that is hard to reach by just looking at past logs. For instance, rather than presenting the user with a summary of the most emotional posts last month, the system should analyze the input and provide the user with the most felt

emotions last month. Two other examples were to present the user with their inclinations (people tend to get emotional past midnight) or present the repeated words (for example, in the past month, you said depressed 10 times). One participant suggested that system could produce predictions based on past data; for instance, "You had a very energetic and happy week, you can keep up the good mood if you keep moving next week.".

6 DISCUSSION

In this section, we revisit our findings from the in-the-wild study and the ideation workshop, discuss and share implications for the HCI literature.

6.1 Providing new perspectives for guiding users into how to investigate their own experiences

We discovered how the dimensional (sensory, emotional, and intellectual) question structure allowed users to take multiple new perspectives on their everyday experiences when using a photo-journaling application. Findings point out a more one-dimensional thinking structure for the participants before the study; participants shared with us that they mostly focused on their emotions related to experiences. When introduced to sensory and intellectual dimensions, it was first hard and puzzling to answer for the most. However, this challenge opened up space for momentary self-reflection. Retrospectively, too, having 3 different perspectives on a single experience allowed users to make comparisons within an experience. It also allowed participants to compare one dimension among different experiences. Our employment of sensory, emotional, and intellectual dimensions based on the earlier study of Karaturhan et. al., is just an example of reflective questions that can be implemented to everyday experiences. HCI community can explore more questions and compare the effects. However, we can say that multiple questions each focusing on different aspects of an experience contributes to self-reflection.

It should be noted that the feedback we gathered is from a 5-week study. The HCI community should also investigate longitudinal results of question answering. Long term effects of encountering the same questions can be demotivating for participants. As we briefly explored in our study, users lose motivation if they perceive the process as too long or challenging. Same may apply to the repetition of similar processes. When we discussed this with designers in the.workshop, it was a strong suggestion that gamification and asking about dimension in a more natural and flexible conversations can be beneficial for keeping up the motivation in the long term These ideas will be further discussed below

6.2 Fostering everyday self-reflection through flexible conversations

Journaling is used in specific application areas such as learning, professional development or restricted to specific use cases such as food consumption or journaling. Each of these instances can be easy to reflect on since there are clear aims. However, this is not the case for everyday experiences. Our findings indicate that recording everyday experiences requires a different approach since everyday life does not always bear significant experiences such as visiting a new city. Previous work explored how mundane memories and photographs become significant over time [25, 42]. However, we discovered certain stress factors that get in the way of recording for participants: perceived length, felt responsibility to give the right answer, and having hard time understanding the meta-level dimensions (such as emotional, sensory, intellectual).

Both user feedback and workshop findings point out to a better structured question-answering where emotional, intellectual, and sensory dimensions are infused to smaller and more tangible questions, and a conversational interaction where users can engage in reflective thinking in small chunks, rather than needing to analyze a rather mundane experience from a meta-level perspective. These conversations can also be content-aware, building on the information derived from the uploaded photo or daily habits, as suggested in the workshop. Voice based interaction is another suggestion by the designers. To our knowledge, this conversational interaction is also pointed out by [43], but to be implemented. In addition to their contribution, we suggest that (i) questions should be derived from meta-categories (such as emotional, sensory, intellectual), (ii) conversation should have a personal, friendly tone. HCI community can use emerging technologies such as machine learning, artificial intelligence, and conversational agents to develop reflective question asking systems with conversational interfaces.

6.3 Teaching first, asking later

Our findings show that users may not be able to motivate themselves and see the value of recording daily experiences until they look at their input retrospectively. Without motivation, users may not be able to create the necessary input at the first place. Therefore, it is important for users not just to understand the value of momentary self-reflection, but also understand the benefits of retrospective inspection. This is also closely connected to users' personality and already existing reflective practices. Our studies showed that people who already think about their life tend to enjoy our application more. On the other hand, another group of participants were eager to simplify and automate the process more. Everyday life self-reflection apps could reach a broader audience if they also aim to teach and show the benefits of self-reflection. Therefore, when trying to encourage users to practice self-reflection on everyday experiences, applications need to act as guides that show the value of self-reflection in a friendly, helpful way.

6.4 Combining visualizations with smart feedback on everyday experiences

Seeing the significance of each dimension on their everyday experiences through visual representation helped users remember and opened up space for self-reflection through comparisons within and among their logs. However, to engage in retrospective self-reflection, users needed more. Participant feedback and workshop suggestions were towards reminders, summaries, and analyses for accumulated logs. This implies an intrinsic need for pattern recognition, as literature recognizes [5]. Suggested parameters are temporality, context, location, and emotions.

Workshop participants' suggestions to use filters as a gamification material and providing these summaries through visualizations

point to new directions in terms of visualizing journaling data. Visualizations that have a breakdown or ambiguity effect to foster self-reflection should be explored in the future work. Systems recognizing patterns in everyday experiences can foster self-awareness and knowledge through self-reflection. Meaningful patterns in everyday experiences, methods to analyze input from everyday experiences, and new feedback strategies should be further investigated in the future work.

7 CONCLUSION

This work combines momentary and retrospective self-reflection strategies, namely reflective questions, and data visualizations in a photo-based journaling app to help users reflect on their everyday experiences. Our design was created in a research through process with the involvement of designers and users. We conducted an in-the-wild study to evaluate the experiences of 13 participants with the prototype. Results show that users benefited from our approach both for momentary and retrospective self-reflection, and there were opportunities to develop better reflection support systems. Then we conducted a workshop with study participants and HCI designers to develop application features that support momentary and retrospective self-reflection through question asking and visualizations. Our work presents strategies to better prepare systems for self-reflection for everyday life experiences through photo-journaling. We provide a base for future research to explore the value and the effect of self-reflection practices on everyday experiences in HCI.

REFERENCES

[1] Likert, R. 1932. A technique for the measurement of attitudes. *Archives of Psychology.* (1932), *22 140,* 55.

[2] Alexandra, Y. 2015. The Role of Accidental Self-Reflection in Wearable Camera Research. *Proceedings of the 17th International Conference on Human-Computer Interaction with Mobile Devices and Services Adjunct.* https://doi.org/10.1145/2786567

[3] Avrahami, D. *et al.* 2020. Celebrating Everyday Success: Improving Engagement and Motivation using a System for Recording Daily Highlights. *In Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems (CHI '20).* Association for Computing Machinery, New York, NY, USA, 1–13. https://doi.org/10.1145/3313831.3376369

[4] Ayobi, A. *et al.* 2018. Flexible and mindful self-tracking: Design implications from paper bullet journals. *In Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI '18).* Association for Computing Machinery, New York, NY, USA, Paper 28, 1–14. https://doi.org/10.1145/3173574.3173602

[5] Barton, S. 1994. Chaos, Self-Organization, and Psychology. *American Psychologist.* 49, 1 (1994), 5–14. https://doi.org/10.1037/0003-066X.49.1.5

[6] Baumer, E.P.S. *et al.* 2014. Reviewing Reflection: On the Use of Reflection in Interactive System Design. *In Proceedings of the 2014 conference on Designing interactive systems (DIS '14).* Association for Computing Machinery, New York, NY, USA, 93–102. https://doi.org/10.1145/2598510.2598598

[7] Bentvelzen, M. *et al.* 2021. The technology-mediated reflection model: Barriers and assistance in data-driven reflection. *In Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems (CHI '21).* Association for Computing Machinery, New York, NY, USA, Article 246, 1–12. https://doi.org/10.1145/3411764.3445505

[8] Braun, V. and Clarke, V. 2006. Using thematic analysis in psychology. *Qualitative Research in Psychology.* 3, 2 (2006), 77–101. https://doi.org/10.1191/1478088706qp063oa

[9] Brooke, J. 2020. SUS: A "Quick and Dirty" Usability Scale. *Usability Evaluation In Industry.* July (2020), 207–212. https://doi.org/10.1201/9781498710411-35

[10] Carter, S. and Mankoff, J. 2005. When participants do the capturing: the role of media in diary studies. *In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '05).* Association for Computing Machinery, New York, NY, USA, 899–908. https://doi.org/10.1145/1054972.1055098

[11] Choe, E.K. *et al.* 2017. Understanding self-reflection: How people reflect on personal data through visual data exploration. *In Proceedings of the 11th EAI International Conference on Pervasive Computing Technologies for Healthcare (PervasiveHealth '17).* Association for Computing Machinery, New York, NY, USA, 173–182. https://doi.org/10.1145/3154862.3154881

[12] Clarke, M. 2004. Reflection: Journals and Reflective Questions: a Strategy for Professional Learning. *Australian Journal of Teacher Education.* 29, 2 (2004). https://doi.org/10.14221/ajte.2004v29n2.2

[13] Consolvo, S. *et al.* 2008. Flowers or a robot army? encouraging awareness & activity with personal, mobile displays. *In Proceedings of the 10th international conference on Ubiquitous computing (UbiComp '08).* Association for Computing Machinery, New York, NY, USA, 54–63. https://doi.org/10.1145/1409635.1409644

[14] Devakumar, A. *et al.* 2021. A review on strategies for data collection, reflection, and communication in eating disorder apps. *In Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems (CHI '21).* Association for Computing Machinery, New York, NY, USA, Article 547, 1–19. https://doi.org/10.1145/3411764.3445670

[15] Dunlap, J.C. 2006. Using guided reflective journaling activities to capture students' changing perceptions. *TechTrends.* 50, 6 (2006), 20–26. https://doi.org/10.1007/s11528-006-7614-x

[16] Elsden, C. *et al.* 2016. It's just my history, isn't it?: Understanding smart journaling practices. *In Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems (CHI '16).* Association for Computing Machinery, New York, NY, USA, 2819–2831. https://doi.org/10.1145/2858036.2858103

[17] Epstein, D. *et al.* 2014. Taming Data Complexity in Lifelogs: Exploring Visual Cuts of Personal Informatics Data. *In Proceedings of the 2014 conference on Designing interactive systems (DIS '14).* Association for Computing Machinery, New York, NY, USA, 667–676. https://doi.org/10.1145/2598510.2598558

[18] Fan, C. *et al.* 2012. A spark of activity: Exploring informative art as visualization for physical activity. *In Proceedings of the 2012 ACM Conference on Ubiquitous Computing (UbiComp '12).* Association for Computing Machinery, New York, NY, USA, 81–84. https://doi.org/10.1145/2370216.2370229

[19] Farnham, S.D. and Churchill, E.F. 2011. Faceted identity, faceted lives: Social and technical issues with being yourself online. *In Proceedings of the ACM 2011 conference on Computer supported cooperative work (CSCW '11).* Association for Computing Machinery, New York, NY, USA, 359–368. https://doi.org/10.1145/1958824.1958880

[20] Fleck, R. and Fitzpatrick, G. 2010. Reflecting on reflection: framing a design landscape. *In Proceedings of the 22nd Conference of the Computer-Human Interaction Special Interest Group of Australia on Computer-Human Interaction (OZCHI '10).* Association for Computing Machinery, New York, NY, USA, 216–223. https://doi.org/10.1145/1952222.1952269

[21] Froehlich, J. *et al.* 2012. The design and evaluation of prototype eco-feedback displays for fixture-level water usage data. *In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '12).* Association for Computing Machinery, New York, NY, USA, 2367–2376. https://doi.org/10.1145/2207676.2208397

[22] Ghosh, S. *et al.* 2020. Towards improving emotion self-report collection using self-reflection. *In Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems (CHI EA '20).* Association for Computing Machinery, New York, NY, USA, 1–8. https://doi.org/10.1145/3334480.3383019

[23] Gortner, E.M. *et al.* 2006. Benefits of Expressive Writing in Lowering Rumination and Depressive Symptoms. *Behavior Therapy.* 37, 3 (2006), 292–303. https://doi.org/10.1016/j.beth.2006.01.004

[24] Guilford, J.P. 1967. Creativity: Yesterday, Today and Tomorrow. *The Journal of Creative Behavior.* 1, 1 (Jan. 1967), 3–14. https://doi.org/10.1002/j.2162-6057.1967.tb00002.x

[25] van House, N.A. 2011. Personal photography, digital technologies and the uses of the visual. *Visual Studies.* 26, 2 (2011), 125–134. https://doi.org/10.1080/1472586X.2011.571888

[26] Isaacs, E. *et al.* 2013. Echoes from the past: How technology mediated reflection improves well-being. *In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '13).* Association for Computing Machinery, New York, NY, USA, 1071–1080. https://doi.org/10.1145/2470654.2466137 .

[27] Jung, H. 2020. In Search of Forms for Evocative and Generative Reflection: Exploratory Studies and a Design Proposal. *In Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems (CHI '20).* Association for Computing Machinery, New York, NY, USA, 1–13. https://doi.org/10.1145/3313831.3376231

[28] Karaturhan, P. *et al.* 2021. Layer zero: An approach for deepening self-reflection on instagram shares. *In: Meiselwitz, G. (eds) Social Computing and Social Media: Applications in Marketing, Learning, and Health. HCII 2021. Lecture Notes in Computer Science(), vol 12775.* Springer, Cham. https://doi.org/10.1007/978-3-030-77685-5_27

[29] Kim, Y.H. *et al.* 2016. TimeAware: Leveraging framing effects to enhance personal productivity. *In Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems (CHI '16).* Association for Computing Machinery, New York, NY, USA, 272–283. https://doi.org/10.1145/2858036.2858428

[30] Lange, A. 1996. Using writing assignments with families managing legacies of extreme traumas. *Journal of Family Therapy.* 18, 4 (1996), 375–388. https://doi.org/10.1111/j.1467-6427.1996.tb00058.x

[31] Li, I. *et al.* 2010. A stage-based model of personal informatics systems. *In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '10).* Association for Computing Machinery, New York, NY, USA, 557–566. https://doi.org/10.1145/1753326.1753409

[32] Limueco, J.M. and Prudente, M.S. 2020. Improving Students' Reflections in Physics Class Using Video-based Journals. *In Proceedings of the 2020 11th International Conference on E-Education, E-Business, E-Management, and E-Learning (IC4E 2020).* Association for Computing Machinery, New York, NY, USA, 218–222. https://doi.org/10.1145/3377571.3377591

[33] Lindley, S. *et al.* 2008. Collocated social practices surrounding photos. *In CHI '08 Extended Abstracts on Human Factors in Computing Systems (CHI EA '08).* Association for Computing Machinery, New York, NY, USA, 3921–3924. https://doi.org/10.1145/1358628.1358957

[34] Lu, X. *et al.* 2021. How Cultural Norms Influence Persuasive Design: A Study on Chinese Food Journaling Apps. *In Designing Interactive Systems Conference 2021 (DIS '21).* Association for Computing Machinery, New York, NY, USA, 619–637. https://doi.org/10.1145/3461778.3462142 .

[35] M. Silva, L. and A. Epstein, D. 2021. Investigating Preferred Food Description Practices in Digital Food Journaling. *In Designing Interactive Systems Conference 2021 (DIS '21).* Association for Computing Machinery, New York, NY, USA, 589–605. https://doi.org/10.1145/3461778.3462145

[36] Mair, C. 2012. Using technology for enhancing reflective writing, metacognition and learning. *Journal of Further and Higher Education.* 36, 2 (2012), 147–167. https://doi.org/10.1080/0309877X.2011.590583

[37] McGookin, D. 2019. Reveal: Investigating proactive location-based reminiscing with personal digital photo repositories. *In Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems (CHI '19).* Association for Computing Machinery, New York, NY, USA, Paper 435, 1–14. https://doi.org/10.1145/3290605.3300665

[38] Meston, C.M. *et al.* 2013. Effects of expressive writing on sexual dysfunction, depression, and PTSD in women with a history of childhood sexual abuse: Results from a randomized clinical trial. *Journal of Sexual Medicine.* 10, 9 (2013), 2177–2189. https://doi.org/10.1111/jsm.12247

[39] Mitchell, E.G. *et al.* 2021. From reflection to action: Combining machine learning with expert knowledge for nutrition goal recommendations. *In Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems (CHI '21).* Association for Computing Machinery, New York, NY, USA, Article 206, 1–17. https://doi.org/10.1145/3411764.3445555

[40] Mols, I. *et al.* 2017. Balance, Cogito and Dott: Exploring Media Modalities for Everyday-life Reflection. *In Proceedings of the Eleventh International Conference on Tangible, Embedded, and Embodied Interaction (TEI '17).* Association for Computing Machinery, New York, NY, USA, 427–433. https://doi.org/10.1145/3024969.3025069

[41] Mols, I. *et al.* 2016. Informing Design for Reflection. *In Proceedings of the 9th Nordic Conference on Human-Computer Interaction (NordiCHI '16).* Association for Computing Machinery, New York, NY, USA, Article 21, 1–10. https://doi.org/10.1145/2971485.2971494

[42] Mols, I. *et al.* 2014. Making memories: A cultural probe study into the remembering of everyday life. *In Proceedings of the 8th Nordic Conference on Human-Computer Interaction: Fun, Fast, Foundational (NordiCHI '14).* Association for Computing Machinery, New York, NY, USA, 256–265. https://doi.org/10.1145/2639189.2639209

[43] Mols, I. *et al.* 2016. Technologies for Everyday Life Reflection: Illustrating a Design Space. *Proceedings of the Tenth International Conference on Tangible, Embedded, and Embodied Interaction (TEI '16).* Association for Computing Machinery, New York, NY, USA, 53–61. https://doi.org/10.1145/2839462.2839466

[44] Moore, S.E. *et al.* 2011. Social work students and self-care: A model assignment for teaching. *Journal of Social Work Education.* 47, 3, 545–553. https://doi.org/10.5175/JSWE.2011.201000004

[45] Moussa-Inaty, J. 2015. Reflective writing through the use of guiding questions. *International Journal of Teaching and Learning in Higher Education.* 27, 1, 104–113.

[46] Oh, H. *et al.* 2018. Multimodal food journaling. HealthMedia 2018 - *Proceedings of the 3rd International Workshop on Multimedia for Personal Health and Health Care, co-located with MM 2018.* 39–47. https://doi.org/10.1145/3264996.3265000

[47] Peesapati, S.T. *et al.* 2010. Pensieve: Supporting everyday reminiscence. *In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '10).* Association for Computing Machinery, New York, NY, USA, 2027–2036. https://doi.org/10.1145/1753326.1753635

[48] Petrelli, D. *et al.* 2009. Making history: Intentional capture of future memories. *In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '09).* Association for Computing Machinery, New York, NY, USA, 1723–1732. https://doi.org/10.1145/1518701.1518966

[49] Sellen, A.J. *et al.* 2007. Do life-logging technologies support memory for the past? an experimental study using sensecam. *In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '07).* Association for Computing Machinery, New York, NY, USA, 81–90. https://doi.org/10.1145/1240624.1240636

[50] Terzimehić, N. *et al.* 2021. MEMEories: Internet Memes as Means for Daily Journaling. In *Proceedings of the 2021 ACM Designing Interactive Systems Conference: Nowhere and Everywhere (DIS '21).* Association for Computing Machinery, New York, NY, USA, 538–548. https://doi.org/10.1145/3461778.3462080

[51] Thieme, A. *et al.* 2012. "we've bin watching you" - Designing for reflection and social persuasion to promote sustainable lifestyles. *In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '12).* Association for Computing Machinery, New York, NY, USA, 2337–2346. https://doi.org/10.1145/2207676.2208394

[52] Tholander, J. and Normark, M. 2020. Crafting Personal Information - Resistance, Imperfection, and Self-Creation in Bullet Journaling. *In Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems (CHI '20).* Association for Computing Machinery, New York, NY, USA, 1–13. https://doi.org/10.1145/3313831.3376410

[53] Utley, A. and Garza, Y. 2011. The therapeutic use of journaling with adolescents. *Journal of Creativity in Mental Health.* 6, 1 (2011), 29–41. https://doi.org/10.1080/15401383.2011.557312

[54] Whittaker, S. *et al.* 2010. Easy on that trigger dad: A study of long term family photo retrieval. *Pers Ubiquit Comput* **14,** 31–43. https://doi.org/10.1007/s00779-009-0218-7

[55] Ye, X. *et al.* 2016. Assisting food journaling with automatic eating detection. *In Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems (CHI EA '16).* Association for Computing Machinery, New York, NY, USA, 3255–3262. https://doi.org/10.1145/2851581.2892426

[56] Zimmerman, J. *et al.* 2007. Research through design as a method for interaction design research in HCI. *In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '07).* Association for Computing Machinery, New York, NY, USA, 493–502. https://doi.org/10.1145/1240624.1240704