Informing Design for Reflection: an Overview of Current Everyday Practices

Ine Mols[1,2]
i.mols@tue.nl
[1]Eindhoven University of Technology
Dept. of Industrial Design
Eindhoven, the Netherlands

Elise van den Hoven[2,1,3,4]
elise.vandenhoven@uts.edu.au
University of Technology Sydney
[2]Faculty of Engineering and
Information Technology
Sydney, Australia

Berry Eggen[1,2]
j.h.eggen@tue.nl
[3]ARC Centre of Excellence in
Cognition and its Disorders

[4]DJCAD, University of Dundee
Dundee, UK

ABSTRACT
There is an increasing interest in HCI in designing to support reflection in users. In this paper, we specifically focus on everyday life reflection, covering and connecting a broad range of topics from someone's life rather than focusing on a very specific aspect. Although many systems aim to support reflection, few are based on an overview of how people currently integrate reflection in everyday life. In this paper, we aim to contribute to this gap through a questionnaire on everyday life reflection practices combining both qualitative and quantitative questions. Findings provide insights in the broad range of people that engage with reflection in different ways. We aim to inform design through four considerations: rumination, timing, initiative and social context.

Author Keywords
Reflection; Reflective Design; Online Questionnaire; SRIS; Design for Reflection; Everyday Life; Autobiographical Memory

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous;

INTRODUCTION
People go about large parts of their everyday life in an automatic mode. The familiarity, repetition and sense of habit is what makes our everyday life what it is [9]. People can have a tendency to go on autopilot, especially in stress-full times and in our fast paced society, taking their everyday lives for granted. However, in retrospect people value many different memories from their past mundane experiences [25]. People tend to underestimate how interesting it is to remember everyday life experiences [36] and, as a consequence, they create little media of everyday experiences to support remembering them.

Reflection on everyday life has the potential to uncover these values. For instance, by uncovering slow change, appreciating small differences and gaining insights in personal habits. Additionally, stimulating reflection can have benefits for well-being, decision making or personal insight and can help appreciate everyday life. Increasingly, technologies are used to stimulate or support such reflections, such mediated reflection can create connections between past, present and future experiences of everyday life.

HCI & Reflection
Reflection is an upcoming theme within HCI work and there are different strands of work in which reflection takes place. An important distinction to be made is whether the reflection is done by designers as part of the design process or by the users on or through a system. Baumer [3] distinguishes three different areas: personal informatics, reflective design and slow technology. Personal informatics is driven by data and often focuses the reflection by the user on the user himself/herself and his/her behavior. Slow technology also stimulates reflection by the user, but is more often oriented towards the system, technology or interaction. Reflective design, as described by [30], includes multiple forms of reflection by both designer and user. Although we acknowledge the importance of reflection as part of the design process we focus on systems that support reflection in users. Beyond data driven, such support systems can use a variety of reflection drives and roles [26] in everyday life reflection. An overview of related systems with similar aims is presented in the related work section of this paper.

Research Gap
We build upon the elaborate work in design for reflection and differentiate in two important ways. First, we focus on *everyday life* reflection rather than more subject specific reflection. In many existing concepts, a very specific subject is reflected upon, for instance energy usage [35], movement or professional development [28]. In stead, we focus on a more open and broader view of reflection in which many different elements of one's life can be considered and connected. We will elaborate on our scope

 NordiCHI '16, October 23-27, 2016, Gothenburg, Sweden ISBN 978-1-4503-4763-1/16/10…$15.00 DOI:
http://dx.doi.org/10.1145/2971485.2971494

of reflection in the related work section. Secondly, we found there to be a lack of empirical work on current reflection practices to inform our design process. With the study in this paper, we hope to contribute to closing this gap by exploring when, where and how people currently engage with reflection.

RELATED WORK

Despite its widespread use, the term reflection often lacks a thorough definition in HCI work [3, 10]. We base our definition on a combination of reflection theory and a more psychological perspective on remembering.

The life review model [32] describes reflection as "*remembering plus further analysis*". Such analysis can consist fo evaluation or explanation through processes such as abstraction, comparison and categorization [32]. We combine these process aspects with the type of insight we strive for, inspired by Mezirows theory [23]. Specifically, we build upon Mezirow's definition of *critical self-reflection* as "reassessing our own orientation to perceiving, knowing, believing, feeling and acting" [23, p.13]. Together, these bring us to our definition of everyday life reflection as: "*Considering and analyzing past, present and future experiences in order to reassess our thoughts, beliefs, feelings and actions regarding our everyday life."*. This definition emphasizes the role of autobiographical memory (AM). Reflection is strongly related to several of the basic functions of AM, people reflect to shape, determine and confirm who they are (identity function [4] and use reflection to make directive choices in their lives [4]. In both processes, memories of past events are crucial but reflection is not only focused on the past, it includes present and future events as well. Processes of remembering the past and imagining the future are even highly similar [29]. As such, in discussing reflection we include all considerations of past, present as well as future events and experiences.

Benefits of Reflection

Reflection can be beneficial by giving insights within different areas such as education, design or health [2]. Rather than 'only' insight, the foreseen benefit in much work on personal informatics is *action*. The line of reasoning suggests that showing users data about themselves will lead them to do something, presumably something different from and better than what they are already doing [18]. Overall, reflection is seen as being beneficial for one's wellbeing. Within the scope of everyday life reflection, both of these types of benefits are important. Reflecting on aspects of everyday life can provide self-insight as well as support a broad range of actions. In addition, positive reflection can contribute to the appreciation of everyday life.

Design for Reflection

Reflection takes time and for many people it does not come naturally, they usually need a reason to reflect or, at least, encouragement to do so [10]. People can use different tools or methods to support reflection. Ever since the spread of literacy in the seventeenth century, diaries have been used as means of self-exploration, self-expression and self-construction [27]. Similar practices have recently moved online through blogs [27] and social media accounts, often enriched with visual media. Besides writing, conversations have taken an important role in supporting reflection through history, often as part of specific professional relations such as teacher-student or therapist-client. Beyond diary writing or conversations, HCI has been increasingly engaged with exploring how interactive systems can take a role in supporting reflection. In this section, we focus on concepts within HCI that aim to support reflection in users. Broad overviews of different ways of supporting reflection are given elsewhere, by domain [2], sorted by level of reflection [10] or by adopted reflection strategy [26]. Here, we focus on systems that come closest to supporting everyday life reflection as we define it, including a higher degree of openness in what is reflected upon.

Mediated Reflection with Diaries

Within this scope, several design interventions have explored redesigns of a traditional diary. [24] explored the application of persuasive strategies to lower the threshold of (traditional) diary writing. In addition to the threshold effects, their evaluation showed a difference in the effect of the diary between reporting and reflecting writers [24]. Similarly, different effects for recorders and reflectors were found in an evaluation of Echoes [14], a mobile application which combines text, photos and emotional ratings. Other digital diaries, such as the Affective Diary [31], combine multiple media types enabled by the use of smartphones. Affective diary includes reflections prompted by abstract representations such as color [31]. The process of choosing abstract representations supports reflection [26] and suits reflecting on everyday life as it contains a high degree of openness. In addition, the ambiguity of media can become a trigger for reflection [11]. Such ambiguous triggers were also explored in History Tablecloth [12] visualizing traces of use and in MindPool [21] visualizing brain waves. Although these visualizations use more specific sources of information, the ambiguity still supports the openness of everyday life reflection.

Mediated Reflection with Sensecam

Several projects have explored the potential of Sensecam, a wearable lifelogging device, to capture everyday life. The medium is especially suitable to explore everyday life, because the media created throughout the day includes many mundane activities and is captured in a for the user unaware way. [6] explored ways of interacting with the content to reduce the quantity and create a storyline and founts these interactions to support introspection and remembrance. Elements that participants seemed to have forgotten sparked enthusiasm and reflection [6]. Reflecting on elements that normally remain unnoticed or are easily forgotten is one of the potential benefits of using automatically recorded media to support reflection.

Providing multiple perspectives through multiple recordings can stimulate additional reflection on representing oneself to others [19]. Most studies review material shortly after it is created, however, especially concerning the evolving value of everyday life experiences, longitudinal effects should be considered. For example, reviewing Sensecam images after 18 months added value by supporting reinterpretations of the past and uncovering incremental changes [20].

Combined, these systems illustrate a direction in HCI to support reflection through expression and by triggers captured in various media (textual, photo or multimodal). These systems show a higher degree of openness than many data-driven systems. Although the media involved might be limited in terms of timeframe, reflections often include relations with past and future events.

Measures for Reflection

To evaluate reflection support systems, it is interesting to consider what measures for success could be used. This challenge is sometimes addressed by focusing on measuring the effect of reflection rather than reflection itself (for example by assessing the interventions effect on wellbeing [14]). To measure reflection itself, coding schemes and questionnaires are the most common approaches.

In areas dealing with written reflection, such as journals or student reports, entries are often coded to assess the level of reflection. For example, [16] developed a seven category coding scheme ranging from habitual action (non reflective) to premise reflection (similar to Mezirow's 'critical reflection [23]). Entries in Echo, a reflective journaling application, were similarly coded for the level of emotional depth [14]. Coding is a suitable approach to assessing written instances but provides little insight in someone's overall attitude towards reflection.

Questionnaires can provide more insights into such attitudes. [17] developed a questionnaire for an educational context measuring four levels of reflection (habitual action, understanding, reflection and critical reflection). Although the questionnaire's statements go more towards a general attitude, it is still limited to the attitude concerning a specific course. Other questionnaires on overall reflective attitude experienced problems in distinguishing reflection and rumination (a more negative, problem focused and often repetitive meta-cognitive process), which the Rumination and Reflection questionnaire aimed to resolve [34]. Similarly, [13] developed the Self Reflection and Insight Scale (SRIS), which measures different elements related to reflection and which is more applicable to measure a general attitude.

METHOD

For this study, we choose to conduct an online survey combining quantitative and qualitative questions, with multiple choice (MC), checklists (C) and open questions (OQ). The survey could elicit more honest responses and grant greater anonymity in comparison to focus groups or interviews [15], which was found to be worthwhile because the subject of reflection can potentially be sensitive. This approach allowed us to gather a broad range of data on everyday reflection practices. The questions focused on conditions for and characteristics of reflection rather than the subject of reflection. We were less interested in what people reflected on, but more interested in the conditions this reflection occurs in. In this paper we will discuss the findings based on demographic information, the SRIS scale (see below) and the following questions:

- How often do you have a moment of reflection in your everyday life? (MC, see table 2)
- Are you satisfied with this frequency? (MC)
- Has there been a certain period in your life when you experienced a higher need for reflection? When and why? (OC)
- When does reflection most often occur? (MC)
- What are the causes for reflection? Which things regularly trigger you to reflect? (C, see table 1)
- Please choose which applies most: I consciously choose to reflect, Reflection just happens to me or both apply equally (MC)
- Do you reflect individually or with others? (MC, see table 3)
- Which characteristics apply? (C, see table 4)
- Please specify the answers given to the previous question on characteristics (OC)
- In what way do you think a product or system could support reflection for you? (OC)

All questions were evaluated during a pilot with 8 participants. After the pilot, minor adjustments to the phrasing of questions were made. To guarantee anonymity, the data collected during the pilot is not included in the analysis presented here. Completion of the questionnaire took approximately 10 to 20 minutes; participants did not receive any financial compensation for participating.

Self Reflection and Insight Scale

As explained above, there are several different ways to measure reflection; we considered the Self Reflection and Insight Scale (SRIS [13]) to be most suitable to measure the general attitude towards reflection in everyday life. The questionnaire includes two main measures: Insight and Self-Reflection. However, originally the Self-Reflection measure was further sub-divided into "Engagement in Reflection" and "Need for Reflection", these sub-measures were later combined. The SRIS requires responses to statements on a six-point Likert scale (strongly disagree to strongly agree). Statements include "I am very interested in examining what I think about" (need for reflection) and "I frequently examine my feelings" (engagement with reflection). Because, both in psychology and design it is often believed that there can be a great difference between motive and acts (see e.g. [13, 34]), both measures were separated in this study. Therefore, similar to [36], the

current study followed Grant et al's original design, however only using the reflection subset without insight, which have been shown to be independent measures [22].

Vocabulary & Definition

Our questionnaire started with the SRIS statements. Before presenting the SRIS statements, our focus on reflection was intentionally not discussed. In the invitation and introduction we referred to "thinking about everyday life" rather than reflection as we were cautious of how people might interpret the term. Because SRIS uses different phrasing to describe reflective behavior, we considered it best not to mention 'reflection' before. After the SRIS-questionnaire, we used a simplified definition to explain our scope of reflection as: "*thinking about your thought, feelings, actions or experiences*". In addition we included the following explanation: *We do not only refer to elaborate reflection or "hard thinking" but include small moments of considering as well*. These statements were used to guide the multiple choice and open-ended questions.

Analysis

Due to the diversity in questions, the data was analyzed in multiple ways. The SRIS data were statistically analyzed for within group differences using ANOVA. The multiple-choices questions are summarized across all participants. Finally, we analyzed the open-ended survey questions through thematic analysis for which we adhere to Braun and Clarke's [5] approach. We adopt an inductive approach to the coding process. However, we also recognize that our view is shaped by our theoretical knowledge and models of reflection. Answers were coded on a semantic level, which is most suitable for the open-ended survey questions as they do not provide the richness of data required for latent thematic analysis. We present the prevalence between brackets (for example (3)) at the level of data item (e.g. per participant) rather than how many segments are coded with a certain theme [5]. Because of the different scope of each question and the more focused nature of survey responses in relation to interview data, answers were analyzed on a per-question bases (similar to [15]).

RESULTS

After introducing the population of our sample we will first discuss the results of the SRIS questionnaire and findings related to demographics. After that, we will discuss our findings thematically, combining both multiple choice and open questions.

Participants

Participants were a convenience sample of 66 community members who were recruited through requests on several online forums and through snowball sampling. Of the 66 responses, 1 was excluded for being incomplete, resulting in 65 participants. Of these participants, 38 were female and 27 male. This sample included a broad age range, from 19 to 76, with the average age being 44 (SD = 15,7). Overall, the sample was fairly highly educated: 45% obtained a university degree and 38% completed higher degree vocational education. 11% of the population completed secondary education and 6% intermediate vocational education.

Need for and Engagement with Reflection

Both SRIS-Need and SRIS-Engagement use 6 items, ranked on a five-point scale, which are summed for a final score. The average score for SRIS-Need was found to be 23,37 (*SD* = 4.11). For SRIS-Engagement the average was 22,99 (*SD* = 4.5). Before doing the further analysis, the data were screened for violations of the assumptions of normality. Distribution of both measures is shown in figure 1. Both SRIS-E and SRIS-N scores were negatively skewed (SRIS-E skewness = -.97 and SRIS-N skewness = -.98). For both values outliers below 14 were eliminated from the SRIS data set. As a result, 61 participants are included in the analysis of the demographics. With this data set, we reviewed SW-test for normality for SRIS-N (SW = .973, df = 60, p = .21) and SRIS-E (SW = .977, df = 60, p = .32). These results gave no reason to reject the assumptions of normality.

SRIS Demographics

In accordance with previous work [8, 13] we found no significant differences between male and female participants for SRIS-Engagement ($t(60) = 5.43$, $p < .05$). For SRIS-need we found the scores for women to be slightly higher compared to men ($t(60) = 1.83$, $p < .05$).

A one way ANOVA for differences in level of education showed no significant effect for SRIS-E ($F(2,59) = 0.06$, p = .05). There seemed to be a light trend for SRIS-N to increase with level of education, with higher education showing a higher need for reflection, but the difference was not significant ($F(2,59) = 0.80$, p = .05). A one way ANOVA for differences between age showed no significant effect for SRIS-E ($F(2,59) = 0.83$, p = .05) or SRIS-N ($F(2,59) = 0.80$, p = .05).

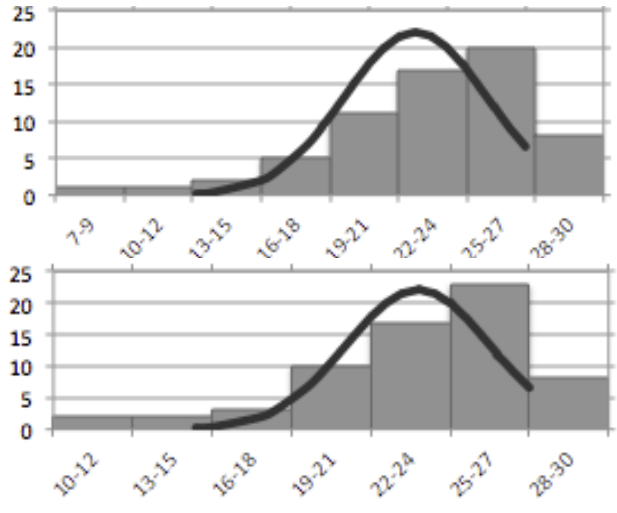

Figure 1: Top: SRIS-E (incl. outliers) Bottom: SRIS-N (incl. outliers)

Reasons for Reflection

There is a wide variety of reasons to engage with reflection or occasions that can trigger reflection. We will discuss causes for reflection on two different levels. First, we will discuss the circumstances that stimulate or require reflection on a "major" scale, referring to different life time periods [7]. Secondly, we will look at a 'minor' or short-term scale which causes for reflection were seen.

Major Scale: Life Time Periods

As mentioned above, the quantitative analysis of the SRIS scores showed no significant difference between age groups. The qualitative data provided additional insight in certain life time periods with a higher need for reflection. Here, we present the findings based on a thematic analysis of the responses to the question "*Was there a period in your life when you experienced a higher need for reflection?*" Coding the response to this question showed a few specific life time periods. These included: *as part of education* (3), *as a parent* (3) and *when getting older* (1). Instead of referring to a specific period, the majority of answers were coded to refer to a transition between periods rather than a period in itself. Most prevalent changes were:

- *Relationship changes* (8): Most people referred to relationship problems, endings or periods of temporary separation. Only one person included a period of positive transition: falling in love.
- *Educational Transitions* (6): These entries included a variety of transitions regarding study such as the moment of choosing a course or direction, finishing school or quitting before graduating.
- *Becoming a parent* (5): Five participants referred to the period of childbirth and having children as a period of large change and increased reflection.

Less prevalent transitional themes related to illness & death (3), career (2) or moving house (1). Other themes related less to transitions or periods, but rather to recurring life circumstances. These themes included:

- Stress or business (13): Most often referring to work related stress. Such as:
  "I find that there is not a certain period, but rather there are certain periods. When work and family are both busy I think it is worth reflecting on separate events." [P21]
  "in stressful periods, to find out where it is coming from and how to reduce stress." [P26]
  In addition one participant mentioned reflecting in periods that were either very busy or very calm.
- Intense emotions (6): these answers most often related to negative emotions such as frustration or anger, even including extreme emotions such as (long-term) depression.
- Personal struggle (4): although personal struggles might coincide or overlap with the experience of intense emotions, these answers did not specify such emotions but referred more abstract to personal struggle or circumstances, often related to insecurities or periods of doubt.
- Decisions (2): the life transitions mentioned before sometimes included decisions. Others referred more generally to moments in life when (large) decisions have to be made.

Several participants referred specifically to periods in which multiple of these themes overlapped. For example, P58 explained:

"Between 2 and 4 years back, my need for reflection was at its highest. In this period I broke up with my ex-girlfriend of 4 years, moved to a new apartment, which was bad and too expensive, quit before finishing university and got a job, which was below my education level." [P58]

To no surprise those times with many changes are periods with a high need for reflection.

Minor Scale: Causes for Reflection

We were interested in how conscious reflection is and whether people deliberately choose to reflect. 39% indicated that reflection just "happens to them" while 12% indicated they "consciously choose to reflect". Almost half of all participants (49%) indicated that both apply equally. A wide variety of circumstances can be the motive or trigger for reflection. To the question "*What are the causes for reflection?*" the majority indicated at least three different causes, which can be found in Table 1. These results show that very few people have a fixed moment for reflection and a relatively small number of people is triggered by future events. Rather, (present) feelings, actions or events are frequent triggers for reflection. Other reasons for example included "seeing a friend I have not seen in a while" or "when I am tired".

Causes for reflection	Nr.	Percentage
my feelings	48	75%
something that is said to me	42	65%
my actions	39	60%
something that happens to me	38	59%
something that I see or hear	31	48%
something that is about to happen	15	23%
I have a fixed moment for reflection	5	8%
Other	8	12%
I don't know	1	2%

Table 1: Overview of causes for reflection with responses both in absolute numbers and percentages of all respondents.

Characteristics

To design for reflection, the characteristics and circumstances of reflection scenarios are most interesting to consider. Specifically, we address the frequency and timing of reflection, social context and characteristics related to reflective habits or rituals.

Frequency & Timing

Most people reported reflecting several times a day (45%) or several times a week (23%). See Table 2 for the full spread. These self-reported frequencies of reflection (ranging from several times a day to once a month or less) show a moderately strong positive correlation with the SRIS-Engagement scores with $r(63) = .64$, $p < .05$. This provides additional support for SRIS-Engagement as a reliable measure for engagement with reflection. Only very few people indicated at the previous question to have a fixed moment for reflection (8%), still, the majority of people could indicate a time of day when reflection most often occurs. For 28% of the people, this was at night, with another 20% most often reflecting in the evening. The morning (9%) and afternoon (3%) were less common. For 37% of participants reflection occurs too irregular to pinpoint a time of day. This was especially prevalent among people who indicated reflecting several times a day.

Social Context

Reflection is a cognitive process often considered to be highly individual. However, our results show a variety of reflective partners as well. A relatively small number of people indicated they only reflected individually (15%). Most people indicated reflecting both alone and with someone else. As Table 3 shows, a partner or friend is the most common companion (55% and 48% respectively). Other reflective partners included professional help (2), boss (1), children (1) and any other person (1).

Frequency of Reflection	Nr.	Percentage
several times a day	29	45%
several times a week	15	23%
once a day	12	18%
once a week	3	4%
once a month or less	2	3%
several times a month	2	3%
I don't know	2	3%

Table 2: Responses to the question: How often do you have a moment of reflection in your everyday life?

Social Context	Nr.	Percentage
alone	57	88%
with partner	36	55%
with a friend	31	48%
with a colleague	26	40%
with a family member	21	32%
with a group of friends	10	15%
other	5	8%

Table 3: Overview of whom is reflected with.

Habits & Rituals

We enquired about a number of other habits and rituals concerning reflection. These were based on characteristics found in literature or habits that have been used as a basis for design. More specifically, we wanted to know whether the characteristics listed in Table 4 applied. This list is not 'complete' but contains a number of assumptions we thought would regularly apply for reflection in everyday life. Multiple answers could be given, the full overview can be found in Table 4. Here, we discuss some of the participants' additional explanations to these habits:

- *Walk / run / bike:* these were most often indicated as activity during which reflection took place. Such activities were described both as deliberate choice to reflect but also as a circumstance that allowed for reflection to emerge, for example, because it does not require a lot of concentration.
- *Writing*: these practices included both manual and digital writing. Several participants also indicated *social* writing when reflecting:
  "I write my thoughts and reflections in a (privacy-protected) social medium and ask my friends to tell me their opinion." [P1]
  "I always write emails when I'm reflecting. Usually this is an unedited word vomit to my close friends. This always happens at night in bed and is usually followed by a morning email containing the words: 'I'm fine again, thanks'" [P9]
- *Location:* Within the home the most mentioned location is in bed, or other relaxing locations such as bath, sofa or comfortable seat.
- *Music*: only a few participants included explanation regarding listening to music while reflecting, most referred to a preference for classical music.

Characteristics of Reflection	Nr	Perc.
I reflect during a walk / run / bike-ride	38	59%
I write when I reflect	19	29%
I reflect on a fixed place within my house	18	28%
I listen to music while reflecting	16	25%
I reflect on a specific location outside of my house	7	11%
I have another routine	6	9%
none of the above	12	19%

Table 4: Overview of characteristics of reflection. Multiple answers could be given.

- *Conversation:* Although not part of the list, social practices and conversations were recurring here.
  "Moreover the other strategy is talking while reflecting. Talking helps me create order in my thoughts. Not only because of what others say, but also because I have to think about how to put my thoughts in words." [P28]
  "Generally with friends where we talk about personal issues/desires/motivations in a fairly objective manner. Also we ask each other confronting questions about certain behavior." [P31]
  In some cases both individual and social reflection were combined: participants expressed the need to reflect individually at first, before discussing such reflections with someone else.
- *Religion*: Two participants expressed a connection between religion and reflection. They mentioned church as a location for reflection [P3] or prayer as an important related habit [P29].

Similarly to the timing of reflection, several participants indicated that there was no fixed routine:

"I do not plan to reflect; so it happens mostly at moments that there is "nothing else to do." [P57]

This is in line with the often given answer that reflection can just "happen to you" rather than being a deliberate choice.

Desires for Change and Support

The majority of participants are content with their frequency of reflection (69%). Others would prefer to change, with a similar amount of people expressing a desire to reflect more often (9%) or less often (11%). All who desire to reflect less often reflect once a day or more. People preferring to reflect more often showed a wider spread, from several times a month to once a day.

We ended the survey with an explanation of our intention to design reflection support systems and prompted for suggestions on what such a system might provide. Several people (12) indicated having no desire for system supported reflection. Either because they didn't know how such a system could support them or because they do not feel the need for support:

"I cannot imagine a product or system being of any help for me. I've learned to reflect since it is a vital part of my work, in a very personal and effective way. I don't really need systems or products" [P9].

Others actively reject the idea of system-supported reflection:

"Sometimes it is best to put away all products and just be silent and without any electronics." [P10].

The most mentioned type of support to be provided by a system were triggers, mentioned by 16 participants. These varied in direction; from being mere reminder to being more explicit in supporting reflection:

"An app that provides random reflection questions. This would help to sometimes step outside the mindset or ideas you currently have" [P9]

Others suggested inspiration from different sources such as suggesting other subjects or including quotes from philosophers. One participant suggested a system that could provide inspiration from the personal past, as this helps to but things into perspective:

"By showing periods in life that happened and have passed before. Things usually seem longer in the future than in the past and things in the past are much easier to put in perspective" [P12]

Similar to [26] these suggestions for triggers differ in the level or specificity: the reminders provide *opportunity triggers*, the questions are often used as *direction triggers* and inspiration provides more direct *content triggers*.

Finally, systems were suggested to help by being more positive (3), by making reflection more conscious (3), by ruling out distraction (3) or by helping to stop reflecting (3). Although the reflection characteristics had shown that reflection was often social, the system suggestions were all focused on individual reflection except one. P18 suggested

"*An anonymous reflection database from which I can compare my thoughts with others. <…> Or having a anonymous platform to reflect with others. Knowing how others would reflect without harming your image, because you do not know them.*" [P18]

Again, this suggestion highlights the importance of social context in reflection.

DISCUSSION

The survey provided a wide variety of findings. We will start with discussing the limitations of the adopted method and consequences of the chosen approach, including the definition of reflection, sample and SRIS questionnaire. Secondly, we discuss the interpretations of our results regarding potential target groups. We end the paper with the interpretations of our insights clustered in four important considerations for designing for reflection.

Limitations

The survey was conducted in English, which resulted in language challenges for some participants, as English was a secondary language for nearly all participants. Especially, the negative statements included in the SRIS (for example "I don't often think about my thoughts.") caused confusion to answer on a disagree-agree scale. For the open questions, some answers were given in the participants' native language, which were translated for inclusion in the paper. Overall, no severe problems with the English language were seen in the answers. However, the secondary language enlarges the challenges to convey our view on reflection.

We were afraid that participants might only consider elaborate moments of reflection, which is why we included a statement on smaller moments of 'considering thoughts'. The high frequency in self-reported reflection suggests that respondents adopted this definition. Both for participants and researchers, it remains very difficult to determine when a meta-cognitive process should or should not be considered reflection. We consider the language challenges and the uncertainty of understanding the scope as the biggest disadvantage of the chosen method.

Interest & Demographics

Participants were recruited through an open call, which generally attracts more people who are interested in the subject. Although the call did not include the term reflection, the description still stated the research was on 'thinking about everyday life'. We expect this to be one of the causes for the relatively high SRIS scores. In previous studies (for example [13]) SRIS scores were found to be normally distributed. In our case, the sample had a few negative outliers. However, rather than exceptions, these could be considered representations of a larger group of people with lower need and engagement with reflection. We argue that these people are underrepresented in our sample because of the open call. Previous studies were based on student populations and did not rely on an open call, resulting in a wider spread of participants' interest in reflection. Overall, the misbalance in our participants has not devalued our insights for design. In our approach to design for reflection, we aim to design for empowerment. In other words, we aim to support people who want to reflect rather than persuade people with no need for reflection. Therefor our insights are suitable to inform our designs, despite the limitations of our sample.

Demographics & Target Group

One of the aims of using the SRIS was to objectively identity target groups with a higher need for reflection. However, the analysis of the SRIS scores for different demographics did not show a clear group with higher needs. No significant differences for age or education were found. In contrast to earlier research, SRIS-Need was found to be slightly higher for women. Together, these differences do not justify prioritizing a target group based on demographics. Rather, the qualitative insights on life time periods, transitions and life characteristics showed the dynamic nature of the need for reflection, which will be more important for design than selecting target users based on demographics. We will elaborate on this dynamic need in the design consideration regarding the timing of reflection.

Designing for Reflection

The overview of everyday reflective practices can inform the design of reflection support systems. We will discuss four themes, which are important to consider. More specifically, we will first consider the risks of *reflection & rumination*. After that, we discuss themes that are more closely related to systems in terms of *timing*, *initiative* and *social practice*.

Reflection and Rumination

Although distinguishable theoretically, constructive forms of reflection and worrying or rumination are in practice often both referred to as reflection. SRIS is designed with the intention to differentiate between both [13]. However, in the open questions, some participants focused more on rumination, describing processes of worrying or stressful thoughts that show a negative spiral. This might be a reason for a part of the people to express a desire to reflect *less* often. Design concepts for reflection support systems often assume positive effects and aim to increase its frequency or intensity, sometimes neglecting potential negative effects of reflection [1]. We emphasize that considering the potentially worrying effects of reflection and rumination is important. New design opportunities can be found in supporting people to *stop* reflecting, to reflect *less* or to specifically support *constructive* reflection avoiding rumination.

Timing

As we described in the findings section, the causes and timing of reflection can be discussed on two different levels. Both of these are relevant to consider when designing to support everyday life reflection. Concerning the occurrence of reflection in different life time periods, we expected to find a higher need for reflection in life time periods with high degrees of transition. For example, in ages 18-25 with changes in study, living environment and often relationship or social contacts. Although not evident from the SRIS scores and demographics, the related open questions show themes that result to such periods with high prevalence of personal life changes and education. Life circumstances play a large part in the need for reflection. This also applies to the smaller time scale, which shows that on a weekly or daily bases circumstances determine the timing of reflection. Currently, reflection systems rely on fixed moments (for example, MirrorMirror [26]) or random timing (for example, Echoes [14]). Based on our findings such triggers could be improved by being more intelligent or more open. A design challenge for intelligent systems could be found in recognizing the causes for reflection, including emotions, conversations and actions. However, these characteristics differ highly between persons and between different moments. Developing 'sensitive' triggers will therefor be very complex. Potentially, systems with a higher degree of openness [26] and will allow for more flexible timing to adjust to personal preferences.

Initiative

System-triggered reflection (e.g. Echo, [14]) can be difficult to incorporate in everyday life. However, results also show that reflection is not always a choice and occurs irregularly throughout the day. Some participants rejected the idea of systems 'forcing' a structure or timing for reflection while others expressed appreciating reminders. In addition to the flexible timing mentioned above, this requires flexibility in

terms of initiative. System initiative (such as active triggers or reminders) should be balanced with user initiative. More context-aware systems that provide triggers at more appropriate times would support this. Another opportunity lies in systems providing more peripheral triggers [1] that are only perceived when welcome. In this way, initiative from system and user is more balanced.

Social Context

Throughout our findings, the theme of social reflection was recurring. However, currently, very few systems support reflection as a social practice, but focus on individual cognitive processes instead. Rather than designing for the individual 'by default', designers of reflection support systems should make a deliberate choice for individual or social reflection. One approach to the design of the system could be to take the 'role' of a reflective partner [26]. Alternatively, designers could also consider how systems might mediate or support social reflection practices. Lovers' Box [33] stimulates reflective communication between romantic partners in different ways: people can create messages for their partner (dialogue mediated by the system), they can talk with an artist to create these message (reflection about the system) and they can reflect together triggered by the system. In such ways, systems can support the reflective conversations that are already part of many people's reflective practices.

CONCLUSION

As part of a user centered design process, we have enquired about current practices to provide inspiration, insight and support for designing novel reflective systems. In this paper, we have summarized the findings from an online survey illustrating how a broad variety of people demonstrates a need for and engagement with reflection. Although the majority of participants is content with their current frequency of reflection, the described reflective practices provide ample opportunity for design to support these complex processes. In designing such support systems, designers should consider the risk of rumination, the timing of reflection, the balance of system and user initiative and the preferred social context. With these insights, we hope to contribute to the design of reflective systems which are better integrated into everyday life.

ACKNOWLEDGEMENTS

This research was supported by STW VIDI grant number 016.128.303 of The Netherlands Organization for Scientific Research (NWO), awarded to Elise van den Hoven. This research was approved by the UTS Human Research Ethics Expedited Review Committee under UTS HREC REF NO. ETH15-0026. We would like to thank all the participants for their willingness to participant and their contribution.

REFERENCES

1. Saskia Bakker, Elise van den Hoven, Berry Eggen. 2015. Peripheral interaction: characteristics and considerations. *Personal and Ubiquitous Computing* 19.1. 239-254.
2. Eric P. S. Baumer, Vera Khovanskaya, Mark Matthews, Lindsay Reynolds, Victoria Schwanda Sosik, Geri Gay. 2014. Reviewing Reflection: On the Use of Reflection in Interactive System Design. In *Proc. of the 2014 conference on Designing interactive systems* 93-102. ACM.
3. Eric P.S. Baumer. 2015. Reflective Informatics: Conceptual Dimensions for Designing Technologies of Reflection. In *Proc. of the 33rd Annual ACM Conference on Human Factors in Computing Systems*. 585-594. ACM.
4. Susan Bluck. 2010. Autobiographical memory: Exploring its functions in everyday life. *Memory*, *11*(2), 113-123.
5. Virginia Braun and Victoria Clarke. 2006 Using thematic analysis in psychology. Qualitative Research in Psychology, 3 (2). 77-101. ISSN 1478-0887
6. Daragh Byrne & Gareth J.F. Jones (2009). Creating stories for reflection from multimodal lifelog content: an initial investigation. CHI Workshop on Designing for Reflection on Experience. Retrieved March 23rd 2016.http://doras.dcu.ie/16136/1/Creating_Stories_for_Reflection_from_Multimodal_Lifelog_Content_An_initial_Investigation.pdf
7. Martin A. Conway and Christopher W. Pleydell-Pearce. 2000 The construction of autobiographical memories in the self-memory system. *Psychological review* 107.2 261.
8. Alexander T. Creed & David C. Funder. 1998. The two faces of private self-consciousness: Self report, peer-report, and behavioral correlates. *European Journal of Personality,* 12(6), 411-431.
9. Rita Felski. 1999. The invention of Everyday life. New Formations, vol. 39, Winter 1999, 15-31.
10. Rowanne Fleck and Geraldine Fitzpatrick. 2010. Reflecting on Reflection: Framing a Design Landscape. In Proc. of the 22nd Conference of the Computer-Human Interaction Special Interest Group of Australia on Computer-Human Interaction. 216-223. ACM.
11. William W. Gaver, Jacob Beaver & Steve Benford, (2003). Ambiguity as a resource for design. In *Proc. of the SIGCHI conference on Human factors in computing systems*. 233-240 ACM.
12. Wiliam Gaver, John Bowers, Andy Boucher, Andy Law, Sarah Pennington and Nicholas Villar 2006. The history tablecloth: illuminating domestic activity. In *Proc. of the 6th conference on Designing Interactive systems* 199-208. ACM.
13. Anthony M. Grant, John Franklin and Peter Langford. 2002. The self-reflection and insight scale: A new measure of private self-consciousness. *Social Behavior and Personality: an international journal*, *30*(8), 821-835.

14. Ellen Isaacs, Artie Konrad, Alan Walendowski, Thomas Lennig, Victoria Hollis and Steve Whittaker. 2013. Echoes From the Past: How Technology Mediated Reflection Improves Well-Being In *Proc. of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 1071-1080). ACM.
15. Kristin M. Jackson & Wiliam M. K. Trochim 2002. Concept mapping as an alternative approach for the analysis of open-ended survey responses. *Organizational Research Methods*, *5*(4), 307-336.
16. David Kember 1999 Determining the level of reflective thinking from students' written journals using a coding scheme based on the work of Mezirow. *International Journal of Lifelong Education*, *18*(1), 18-30.
17. David Kember, Doris Y. P. Leung, Alice Jones, Alice Yuen Loke, Jan McKay , Kit Sinclair , Harrison Tse , Celia Webb , Frances Kam Yuet Wong , Marian Wong & Ella Yeung 2000. Development of a questionnaire to measure the level of reflective thinking. *Assessment & evaluation in higher education*, *25*(4), 381-395.
18. Ian Li, Anind Dey and Jodi Forlizzi. 2010 A Stage-Based Model of Personal Informatics Systems In *Proc. of the SIGCHI Conference on Human Factors in Computing Systems*. 557-566. ACM.
19. Siân E. Lindley, Dave Randall, Maxine Glancy, Nicola Smyth, Richard Harper. 2009. Reflecting on Oneself and on Others: Multiple Perspectives via SenseCam. In *CHI 2009 workshop on Designing for Reflection on Experience*.
20. Siân E. Lindley, Maxine Glancy, Richard Harper, Dave Randall, Nicola Smyth. 2011. “Oh and how things just don't change, the more things stay the same”: Reflections on SenseCam images 18 months after capture. *International Journal of Human-Computer Studies*, *69*(5), 311-323.
21. Kiel Long & John Vines 2013. Mind pool: encouraging self-reflection through ambiguous bio-feedback. In *CHI'13 Extended Abstracts on Human Factors in Computing Systems*. 2975-2978. ACM.
22. Jennifer A. Lyke. 2009. Insight, but not self-reflection, is related to subjective well-being. *Personality and Individual Differences*, *46*(1), 66-70.
23. Jack Mezirow. 1990. How Critical Reflection Triggers Transformative Learning. *Fostering critical reflection in adulthood*, Jack Mezirow and Associates. Jossey-Bass. 1-20.
24. Ine Mols, Panos Markopoulos. 2012. Dear Diary: A Design Exploration on Motivating Reflective Diary Writing. *Persuasive Technology*, 29.
25. Ine Mols, Elise van den Hoven and Berry Eggen. 2014. Making memories: A cultural probe study into the remembering of everyday life. In *Proc. of the 8th Nordic Conference on Human-Computer Interaction*. 256-265. ACM.
26. Ine Mols, Elise van den Hoven and Berry Eggen. 2016. Technologies for Everyday Life Reflection: Illustrating a Design Space. In *Proc. of the Tenth International Conference on Tangible, Embedded, and Embodied Interaction* 53-61. ACM.
27. Catherine O’Sullivan. 2004. Diaries, On-line Diaries, and the Future Loss to Archives; or, Blogs and the Blogging Bloggers Who Blog Them. The American Archivist Vol. 68 (Spring/Summer 2005). 53-73.
28. Lily Orland-Barak. 2005. Portfolios as evidence of reflective practice: What remains ‘untold’. Educational research. 47, 1: 25-44.
29. Daniel L. Schacter and Donna Rose Addis. 2007. The cognitive neuroscience of constructive memory: remembering the past and imagining the future. Phil. Trans. R. Soc. B. 362, 773-786.
30. Phoebe Sengers, Kirsten Boehner, Shay David & Joseph J. Kaye, (2005). Reflective design. In *Proceedings of the 4th decennial conference on Critical computing: between sense and sensibility* (pp. 49-58). ACM.
31. Anna Ståhl and Kristina Höök. 2008. Reflecting on the design process of the Affective Diary. In *Proceedings of the 5th Nordic conference on Human-computer interaction: building bridges*. 559-564. ACM.
32. Ursula M. Staudinger. 2001. Life Reflection: A social-cognitive analysis of life review. Review of General Psychology. Vol 5 (2) 148-160.
33. Anja Thieme, JayneWallace, JamesThomas, Ko Le Chen, Nicole Kramer and Patrick Olivier. 2010 Lovers' box: Designing for reflection within romantic relationships. *International Journal of Human-Computer Studies*, *69*(5), 283-297.
34. Paul D. Trapnell, Jennifer D. Campbell 1999 Private self-consciousness and the five-factor model of personality: distinguishing rumination from reflection. *Journal of personality and social psychology*, *76*(2), 284.
35. Nina Valkanova, Sergi Jorda, Martin Tomitsch and Andrew Vande Moere. 2013. Reveal-it!: the impact of a social visualization projection on public awareness and discourse. In Proc. of the SIGCHI Conference on Human Factors in Computing Systems 3461-3470
36. Xu Xu. 2011. Self-Reflection, insight, and individual differences in various language tasks. *The Psychological Record*, *61*(1), 41.
37. Ting Zhang, Tami Kim, Alison Wood Brooks, Francesca Gino and Michael I. Norton. 2014. A "Present" for the Future: The Unexpected Value of Rediscovery. Psychological Science. Vol. 25 no. 10 1851-186