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Figure 1: Rebulb displaying the daily question, "Recall a time in elementary school when you achieved a goal," which is framed by the theme of proud moments

Abstract

Accumulating a life history is a valuable resource for understanding self and reflecting on personal historical experience, which could be developed through diary writing. To facilitate the recording of past events in a diary, we designed and implemented Rebulb, a system that enables users to engage with reflective questions about proud moments and document memories evoked for accumulating one's life history. Our four-month field study with three participants showed that users intentionally and spontaneously recalled vague and wide memories during their daily activity and then concretized these memories by writing them down in a journal. The study also

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CCS Concepts

• Human-centered computing; • Human computer interaction (HCI);

Keywords

Diary, Life history, Self-journaling, Self-explorative retrospection

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1 INTRODUCTION

Writing one's life serves as a personal autobiography, offering more than just a record of life events. It provides opportunities for selfreflection and self-understanding [31] by encouraging individuals to reflect on and comprehend their personal growth, both internally and externally. Moreover, a personal autobiography can serve as a life history that could be utilized for clinical purposes, such as enhancing emotional well-being [58]. This autobiography comprises significant and memorable life events or experiences. One potential approach to creating an autobiography is through the accumulation of daily entries. A diary is an autobiographical record that documents an individual's daily events, characterized by its unstructured nature, which made users freely record their daily life events. Keeping a diary serves various purposes, such as reflecting on daily occurrences through self-assessment and understanding, planning, and finding enjoyment in the process of accumulating daily experiences.

In the field of human-computer interaction (HCI), research has actively explored ways to enrich diary content and offer new experiences through diaries. For instance, Hammerl, et al. [20] proposed a semi-automatic diary system utilizing smartphone sensors. Similarly, the Affective Diary [41] uses smartphones to provide hints for diary writing following bodily memory, adding a new dimension to the content and offering prompts to stimulate what to record. Additionally, new experiences with diaries include sharing them with others [30] or using internet memes as a tool for daily journaling [77]. These efforts enriched the diary with diverse content (e.g., social relation, location, activity, emotion). By capturing its multidimensional nature, the diary was utilized as a tool for sampling personal experiences in order to assess the author's mental state [21, 76, 78] or emotion [1, 75]. Moreover, not only individual diaries but also life histories composed of multiple diaries serve as valuable resources for understanding an individual's developmental background and environment [5, 61] by forming one's autobiography. However, various factors, such as simple forgetfulness [13], schedule conflicts, and negative emotions [6], hinder consistent diary writing. These obstacles can lead to temporal discontinuity in the accumulated entries. Also, because diaries typically focus on recording recent events rather than distant past experiences, it becomes challenging filling the temporal gap and maintaining a comprehensive record of one's life.

To address these issues, interaction for everyday remembering [14] can be used, which facilitates the retrieval of memories providing appropriate reminiscence cues [79], as well as supports memory retrieval such as a photo, music, and scent. According to van den Hoven and Eggen [80], external cues such as people, environments, and objects influence the reconstruction of memories, with objects holding particular potential for integration into design. Indeed, numerous HCI researchers have explored the intersection of reminiscence cues and object design, conducting various studies [9, 32, 51, 53] that demonstrate this potential. These prior research efforts suggest that if users can reminisce about past events and experiences through designed objects that provide reminiscence cues and concretize the evoked memories into a diary, it becomes possible to document entries that include previously forgotten memories based on the recalled content. This research background implies the need for research on methods to properly recall and document memories in order to accumulate a comprehensive life history and propose the following research spaces, as well as the need to explore users' experience and perception for utilizing devices designed to aid in recalling and documenting autobiographical memories. Accordingly, the research questions are as follows:

RQ1: How should devices be designed to help users recall and record memories to build a comprehensive life history?

To address these questions, we initially employed the research through design (RtD) method to develop a research product called Rebulb (3 1). Rebulb utilizes reflective questions to prompt users to recall memories related to "proud moments"¹ and assists them in documenting these memories as part of their life history. The device comprises a table-shaped unit that provides questions and a mobile app for diary writing (Figure 2). The development of Rebulb raises additional research questions:

RQ2: What experiences can Rebulb provide for users in the process of recalling and recording their past? Specifically, we want to investigate a) how users recall memories related to proud moments in their daily lives and b) how they perceive the process of documenting and accumulating these memories.

To answer these questions, we conducted a four-month in-field study with three participants. We evaluated the acceptability of memory recall framed by proud moments through the reflective questions provided by Rebulb and analyzed the experiences of writing past diaries in the present.

This research makes two key contributions. First, it introduces Rebulb, providing a detailed account of its design and decisionmaking process. It offers insights into enhancing awareness of past proud moments and integrating this design feature into everyday objects. Second, it presents findings from a four-month in-field study with Rebulb, shedding light on how participants recall their past proud moments in daily life and how journaling and accumulating these memories influences their current and future self-reflection. Additionally, it provides insights into the ambivalence of positive framing.

2 BACKGROUND AND RELATED WORK

The related work falls into 1) digital intervention for life journaling, 2) facilitating everyday remembering in HCI, and 3) positive framing for self-journaling and reminiscence.

2.1 Digital Intervention for Life Journaling

Diaries are widely utilized in the fields of HCI and design as a methodology for sampling users' qualitative experiences [54, 55, 62, 63]. Additionally, written diaries can function as life logs for users, potentially enhancing self-awareness and reflection. In this context, Elsden, et al. [12] emphasized the importance of using diaries not only for methodological purposes but also for life logging.

As life-logging tools, diaries have been the focus of various studies aimed at designing and evaluating life journaling systems that support users' motivation and self-reflection. These studies have

¹This includes moments of both major and minor accomplishments and satisfaction such as achieving small goals (e.g., reading or cooking, learning or trying a new tool, performing an act of kindness, receiving unexpected recognition).

included cases where customized tracking systems were developed, incorporating parameters [34] and visualizations [3] or recommending appropriate tools based on individual needs [36]. Furthermore, some researchers have designed and implemented various toolkits for capturing users' behaviors related to sleep [59, 65], food intake [11, 72], and exercise [10, 83], and they have evaluated these systems in terms of their effectiveness in fostering motivation and self-reflection. Furthermore, advancements in sensor and dataprocessing technologies have made it possible to track activities without user intervention, thereby enabling smart journaling [12]. Although sensors can automatically record multidimensional life log data (e.g., visited locations, physiological data, social interaction) [20], some cases have utilized the collected life logs as prompts to inspire users to manually create journal entries.

These HCI approaches could extend the purpose of life journaling beyond the mere documentation of personal life events [26], offering multidimensional opportunities by incorporating contextual information such as social interactions or their health status. Ren, et al. [66] demonstrated that visualizing daily physiological data collected from smartwatches facilitates a more user-driven, mindful, and exploratory approach to reflective journaling, as it encourages users to consider the broader context provided by their physiological states in their journal. Similarly, Apple's Journal app, released in 2023, supports users in creating journal entries by integrating contextual data from smartphone-tracked activities, such as music played, scheduled events, and physical exercise, allowing users to reflect on their social interactions and daily experiences.

Although these existing approaches enhance the richness of journal entries and reduce the barriers to journaling, various factors, such as lapses [13], scheduling conflicts, and emotional fluctuations [6], can hinder users from maintaining consistent journaling practices. This challenge is further exacerbated by the tendency of journals to focus primarily on recent events, making it difficult to retroactively fill gaps in past entries. Consequently, this disrupts the continuous accumulation of autobiographical memory over time. For this, our work seeks to find a way to encourage users to write down both recent and past events to resolve memory discontinuity and accumulate lifespan autobiographical memory.

2.2 Facilitating Everyday Remembering in HCI

Past events can be recalled if an appropriate reminiscence cue is provided, enabling the retrieval of contextual information linked to that cue. Leveraging this characteristic of memory, HCI researchers have conducted various studies aimed at aiding everyday remembering through different cues. These studies have utilized accumulated personal digital media, such as music-listening histories [22, 47, 51, 53], photos [7–9, 11, 27, 32, 43, 50], emails [17, 49], and social media [39, 84] as a reminiscence cue, which helps users recall memories they may not have thought of or may have forgotten, thus facilitating a flashback to those memories. Additionally, other memory-triggering cues, including previously visited locations [67, 85], significant monuments [14, 29], specific poses [41], and self-defining cue [69], have been commonly employed in these studies. These research examples showed the potential to recall forgotten past events through interactive devices. Furthermore, some studies have showcased the design of devices that aid in everyday remembering in the form of everyday objects (the artifacts designed for daily use [48], e.g., a photo frame, telescope). For example, Slide2Remember [32] presented past photographs along with music frequently listened to during the time the photos were taken, using a picture frame form. Chronoscope [9] allowed users to explore past photographs in the form of a telescope. Similarly, Olo Radio [53] used a radio form to play music from the past, helping users recall memories associated with that media. However, the process of recalling memories before recording them requires careful consideration. Negative experiences are often recalled more vividly and intensely than positive ones [4, 68], and the emotional state during recollection can trigger rumination [60], where one negative thought leads to another, exacerbating the negative impact. In this regard, the Slide2Remember[32], which was designed to facilitate reminiscence through past photos and music, highlighted the potential risks associated with the involuntary recollection of negative events. These potential issues stressed the need for providing methods that support users in managing negative thoughts that may be triggered during the process of recalling memories. Building on this, our research aims to explore and implement a way that could address potential risks associated with reminiscing, particularly in the context of assisting users with reflective journaling of their past experiences.

2.3 Positive Framing for Self-Journaling and Reminiscence

The research team led by Qu, et al. [60] addressed issues such as negative bias, overgeneralization, and reduced positivity in the context of episodic memory within HCI studies. They also denoted some strategies, including positive reframing, to help with the potential risky emotional process when users recall their past episodic memory. Moreover, positive framing is not only significant for reminiscence-to cope with the potential risk of Slide2Remember mentioned in previous section-but also for journaling. The selfjournaling process inevitably involves reminiscence, and although writing about past experiences could lead to better coping mechanisms, even when the events are negative or traumatic [57], it may still be influenced by the user's emotional state when recording negative memories [21]. Several efforts have been made to support this approach. For instance, MEMEories [77] developed a mobile application that assists users in journaling by selecting and editing internet memes that match their experiences, enabling them to process even negative events with the humor characteristic of memes. Similarly, Avrahami, et al. [2] developed a system for recording daily successes, which enhances awareness of the small, often overlooked achievements in everyday life, thereby fostering positive emotions and encouraging their documentation. In a slightly different context, Go, et al. [19] proposed a system that detects highly negative sentences or words in users' entries and reconstructs them into more positive alternatives, thereby generating additional positive emotions [23] and potentially improving self-control [35]. This strand of past research suggests the potential of incorporating a positive framing-such as humorous internet memes or success stories in the workplace-when recalling memories for journaling purposes. Based on this possibility presented

through a past attempt, our work modestly attempts to explore the utility of providing the reminiscence cue, which contains positive framing.

2.4 Summary and Reflection

Collectively, our literature review identified two key research gaps: (1) supporting users to recall past events and accumulating written reflections on those experiences; and (2) providing reminiscence cues that facilitate the framing of memories in a positive light. To address these gaps, this study explores two central questions: "How can we assist users in recalling and recording memories during their daily lives?" and "How can we apply a positive frame to users' memories of past events?" To investigate these questions, we designed Rebulb, a research product, and conducted a field study to examine how such a device can be designed to support memory recall and journaling in everyday contexts. Through this process, we aim to understand when and how users engage in memory recall and documentation, as well as their experiences with positively framed reminiscence cues.

3 REBULB DESIGN AND IMPLEMENTATION

3.1 Rebulb Design Features

Rebulb includes a table-shaped device that provides a reflective question framed by a proud moment as a reminiscence cue as well as a mobile application that enables users to record their memories evoked from the question. During the design process, we employed the RtD method [86]; we also decided to design and implement Rebulb as a research product [52], which posed the question, "How does one frame users' reminiscence experiences positively?" With a high-quality finish, the product was designed to be independently used in users' home environments without researcher intervention, enabling long-term usage. It was intended to blend naturally into users' everyday spaces, achieving a strong fit, to form an aesthetic that minimizes any sense of dissonance in deploying a research product, and to encourage users to willingly deploy it into their personal environments.

3.1.1 Table shape everyday self-journaling support device for home context. In designing Rebulb, we set the following key design goals (DGs): DG1) Rebulb should seamlessly integrate into the user's home environment without heterogeneity; DG2) Rebulb should assist users in becoming aware of and journaling their self-reflections of recalled memories; and DG3) Rebulb should be robust and maintainable enough for independent use over the extended field study period.

To achieve seamless integration into the home context (DG1), we adopted a design approach inspired by everyday objects, a strategy commonly used in previous studies [24, 53, 82]. This approach leverages the physical presence [44] of familiar objects, which can attract the user's attention and prompt awareness of the object's function [18] simply by being placed within their line of sight. One of our key challenges in this process was minimizing the disruption to the original form of the object when delivering reflective questions. Throughout this process, we explored several design strategies. Initially, we considered voice prompts to discreetly deliver reflective questions but found potential issues: automatic playback could feel intrusive, while manual activation might hinder unconscious recall. We then examined using a display, which introduced the challenge of seamless integration into everyday objects. To address this, we explored two approaches: incorporating objects with inherent visual display properties (e.g., mirrors, picture frames) and using a sliding mechanism to conceal the display when not in use. Ultimately, we decided to use a sliding mechanism for flexible design exploration rather than limiting the selection of everyday objects (e.g., mirrors, photo frames).

Following the initial design process, we explored which type of object could support users in reflecting on and journaling their responses to reflective questions (DG2). Through this exploration, we identified three potential object types: a fireplace, a speaker, and a table (Figure 3a, b, c), each enhancing self-awareness in distinct ways. The fireplace concept incorporated fire-related ASMR sounds and LED lighting to provide an emotional stimulus for reflection. The speaker concept leveraged prior research [51] suggesting that music can trigger memories tied to specific time periods, playing songs from the era relevant to the reflective question. Lastly, the table concept was chosen for its natural association with contemplation and writing, making it well-suited for encouraging users to reflect and document their memories. Among these options, we evaluated each against our design goals (DGs). While the fireplace and speaker effectively fostered a reflective atmosphere and offered reminiscence cues, our primary goal was to support the accumulation of life records. Given this focus, we selected the table, as it naturally facilitates both contemplation and journaling.

After selecting Rebulb's form as a table, we initiated a secondary ideation phase focused on the table form (Figure 3d). During this phase, we planned to modify existing commercially available tables so that we could create a prototype, with a particular emphasis on integrating Rebulb's functionality into the table design. Among the table design candidates, the final concept was selected based on its suitability for long-term field studies. The design allows participants to place and record items on the surface while minimizing disruption to their existing home environment by maintaining a compact size and offering color customization through adhesive sheets, in alignment with DG1. Additionally, considering ease of maintenance (DG3), the table features a modular structure with a detachable pipe-frame design, enabling easy access to electronic components.

The most thoroughly considered element of Rebulb's modular design is the sliding mechanism, which enables a motor-driven system to lift the display stably. Initially, a single motor (Figuer 3e.1) was attached to the display stand; however, this approach led to issues with vertical stability and generated noise when the motor's power was insufficient. To address these issues, we implemented a dual-motor (Figure 3e.2) configuration, positioning one motor on each side and adding a vertical guide (Figure3e.3) at the rear to ensure balanced movement. Additionally, both motors were connected to a single motor driver using wires of equal length, enabling synchronized operation. This process enabled us to finalize the shape of the Rebulb (Figure3f).

3.1.2 Recalling and archiving lifespan autobiography through reflective questions regarding a proud moment. Rebulb utilizes reflective questions as a tool to evoke memories and frame them positively.



Figure 2: On the left, the Rebulb display presents five life periods and contains memories of each period. On the right, the Rebulb mobile app presents proud moments titled "join the drama club" and derivative memories from this moment.

Reflective questions can prompt users to recall thoughts related to specific topics [28, 46]. Accordingly, Rebulb is designed with two main types of questions. First, it uses reflective questions to help users remember proud moments from their lives, whether significant or minor. These questions aim to bring back memories that may have been forgotten over time or compressed by outcomes or comparisons with others [2]. Subsequently, based on the proud moments recalled, Rebulb asks questions about related episodes (e.g., the triggers for starting the action, intermediate challenges encountered). This approach encourages participants to deeply reflect on their proud moments, thus framing these memories positively, and prompts them to recall additional related memories through follow-up questions. Rebulb supports comprehensive recollection by allowing users to categorize memories by life periods (e.g., teens, twenties) and generating prompts based on this temporal information. We developed 44 question templates (Table 1, Appendix A1), carefully avoiding sensitive topics such as health or financial circumstances while encouraging reflection on proud moments in a positive and nonintrusive way. By engaging with questions about past proud moments and documenting their responses, users accumulate autobiographical memories spanning both small and significant proud moments, as well as broader aspects of their life experiences.

3.2 Self-Journaling Sequence of Rebulb

Profile setting through Rebulb mobile: Once users create their account, they will be redirected to a page where they can configure their profile. At this stage, users have the option to segment their life into various periods according to their preferences. After dividing their life into these periods, users may optionally record specific places or individuals associated with each period. This information will be utilized to generate reflective questions. Finally, users can set the timing for viewing these questions through Rebulb and determine the number of daily questions they wish to receive.

Providing questions about the proud moment and derivate from the proud moment: When the designated time for viewing the question arrives, the hidden display of the Rebulb table slides up to present the day's reflective questions (see Figure 5a, a-1). The transformation of the Rebulb table's shape enables users to recognize and be aware of the daily question before they begin journaling. Additionally, if users tag their mobile device while the Rebulb display is showing the question, the device will automatically switch to the screen for journaling the corresponding question (see Figure 5b-c).

Journal the past event: Figures 5c-f illustrates the process of journaling past events. Initially, users enter a page where they can select the point in time for the memory they wish to record (Figure 5c). On this page, users can slide Figure 5c-1 to choose the desired memory timestamp. Subsequently, users register an icon representing the record, a title, associated people, and places, as well as photos of commemorative items (Figure 5d). In the following screen (Figure 5e), users could write a past journal entry. This can be done either by typing text directly on the page or by writing notes with a pen, which can then be photographed and uploaded (Figure 4).

Skimming recorded memory: Users can review their past records through the Rebulb mobile app with these records categorized by time periods. Additionally, the Rebulb table also allows users to visually inspect their records. When opening Rebulb via its button or mobile app (Figure 6a, a-1), icons representing memories from each period are displayed (Figure 6b, c). By touching these icons (Figure 6c.1), users can view the timeline leading up to the memorable moments (Figure 6d). Furthermore, by tapping on each record and tagging their mobile device, users can immediately access detailed information about the record on their phone.

3.3 Implementation.

3.3.1 Hardware. The Rebulb table hardware is constructed using a modular table frame, to which CNC-machined ABS plates are attached with fixed clips. The display, which moves vertically, is a 16-inch touch monitor that is controlled by two linear motors to adjust its position as needed, providing users with an extended horizontal view. The motor movements are managed by a microcontroller unit (Arduino Leonardo), which is connected to the Jetson Nano via USB. This setup allows the microcontroller unit to control keyboard and mouse inputs from the Jetson Nano as needed and

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Figure 3: Concept decision process of Rebulb



Figure 4: journaling diary using pen and paper and a direct journal through the Rebulb app

enables communication of motor movements and button detection signals between the microcontroller unit and the Jetson Nano.

3.3.2 Rebulb software. Both the Rebulb table and Rebulb Journal apps are built to be a progressive web app (PWA) using ReactJS. Depending on the screen size of the accessing device, users are redirected to the appropriate page for Rebulb table screen or the Rebulb journal app. Features requiring real-time connectivity between Rebulb and the Rebulb Journal app (e.g., connection status monitoring, remote opening and closing, notification time settings) are managed through the Google Realtime Database to facilitate real-time status updates. Information regarding life periods and

diaries is stored using Google Firestore and Google Cloud Storage services.

Generating question: The database contains a total of 44 question templates. Of these, 14 are related to proud moments, whereas 30 are questions templates evoking memories derived from these proud moments. Some templates have specific constraints, such as being applicable only when certain individuals or locations are registered, or when there are a minimum number of associated records. The process for generating daily questions using these templates is as follows: After midnight, a random decision is made based on weighted counts of registered types to determine whether the question will pertain to a proud moment or to a memory derived from



Figure 5: Journaling process of Rebulb

existing records. Subsequently, one template is randomly selected from the chosen category (i.e., questions about proud moments or derived memories), and its constraints are verified for validity. If valid, the template's marker is checked, and the question is then adapted into a suitable form (see Table 1.) This process is repeated according to the number of questions set by the user in the mobile app.

4 FIELD STUDY

To explore the experience of recalling and journaling memories through questions related to proud moments, we utilized the Rebulb in the homes of three participants over a four-month period. Our field study aimed to understand how participants engaged in recalling memories and writing diaries through Rebulb in their daily lives. Additionally, we sought to determine the impact of creating and accumulating past diary entries on self-understanding and self-awareness. Furthermore, we examined how framing questions around proud moments influenced the process of recalling past experiences.

4.1 Participants and Deployment

Participants: We recruited potential participants who were interested in writing diaries about their past experiences and accumulating their autobiographies through a Korean recruitment service, which included a study application containing questions about their journaling experiences and their reflections on their past life. Among the applicants who applied to our research, we selected the three participants based on the following criteria: 1) individuals who have experience with regularly keeping a diary; 2) individuals who have had enough time to self-reflect and are comfortable with this process; and 3) individuals without a history of mental illness (to ensure that recalling past experiences would not be harmful). The participants' details were as follows:

- **P1 (65, M):** A current writer who works primarily from his apartment. He has had a diverse career, including work as a carpenter, and regularly reflects on his future. He has published several books based on his experiences and writes privately on a personal blog about his daily thoughts, emotions, and intentions for the future.

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Figure 6: Exploring archived memory using Rebulb

Table 1: Markers contained in question template (see Appendix A1 for all question templates)

Marker	Description	Question Template	Completed Question
\$[period]	A period registered by the user	Reflect on a meaningful event during \$[period]	Reflect on a meaningful event during the "Lived in Washington" period
<pre>\$[proud_moment_title]</pre>	The title of the user's registered proud moment	Recall why you committed to \$[proud_moment_title]	Recall why you committed to "Join the drama club"
\$[proud_moment_type]	Type of the proud moment (e.g., education, hobby, relationships)	Is there a memorable event related to \$[proud_moment_type] during \$[period]?	Is there a memorable event related to "relationships" during the "Lived in Washington" period?
\$[related_person]	Person associated with the user's memories	Do you have any special memories related to \$[proud_moment_title] involving \$[related_person]?	Do you have any special memories related to "Join the drama club" involving "Finn"?
\$[related_place]	Place associated with the user's memories	Recall another anecdote related to \$[related_place]"	Recall another anecdote related to "Starlight Hall"
<pre>\$[derivated_memory_title]</pre>	Title of a memory derived from the proud moment	Recall events that occurred before \$[derivated_memory_title]	Recall events that occurred before "Interview"

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Figure 7: Three Rebulb tables deployed in participants' residences

Table 2: Each participant's life periods set by themselves and corresponding avatars used in their Rebulb display



- **P2 (30, F):** A nurse, who works from a personal office space. She sets plans and goals for her future daily and often writes about past regrets, reflections, and new goals in her diary using a pen.
- **P3 (42, F):** An insurance office worker. She primarily reflects on her emotions, the reasons behind them, and past decisions, and she writes about her experiences, thoughts, emotions, and realizations in her diary.

Although the small number of participants may limit the generalizability of the findings, our approach mirrors those of previous studies [17, 22, 51, 59] by focusing on the richness of individual experiences and qualitative data. Our goal was to gain an in-depth understanding of the complex and nuanced experiences of each participant.

Deployment: One day before the field study began, we visited the participants' homes to install the Rebulb table. Participants chose the installation locations: P1 placed it next to the living

room sofa, P2 set it up beside the bed, and P3 installed it in the corridor connecting the living room, kitchen, and bedroom (Figure 7). After setting up the Rebulb table, we installed the Rebulb journal app on each participant's mobile phone and created their accounts. During this process, participants divided their life stages (see Table 2), and we illustrated each life stage with specific avatars to be used in their Rebulb display (both mobile and device). Once account creation was complete, we conducted a demonstration session that included an overview of Rebulb's features. The demonstration lasted approximately 20 minutes, and participants uploaded 2-3 test entries to familiarize themselves with using Rebulb.

4.2 Data Collection and Analysis

Qualitative data: During the field study, we conducted four semistructured interviews each month, with each interview lasting approximately 45 minutes. The interviews focused on the overall use of Rebulb, including experiences related to recalling past events

Table 3:	Summary	interview	questions

Month	Main Interview contents
First Month	Overall initial user experience, areas of unfamiliarity, and aspects users would like to change.
Second Month	Changes in adaptation and evolving thoughts compared to the initial phase, as well as the experiences of recalling proud moments, including the timing of memory recollection and recording.
Third Month	The experience of reviewing accumulated data and whether or not users can readily recall the memories after extended use.
Fourth Month	Whether participants have sought out proud moments during their daily routines and if they have discovered any new aspects of themselves after participating in the experiment.

			Codes	Description
indings	Themes	C	Interacting with table in daily life	Response on how questions from the table and interactions with the table permeated the user's daily life.
5.1 Self-explorative deliberated and spontaneous retrospection for recognizing one's proud	Integration of Reflective Thinking into Daily Routines	C	Increase awareness on question	Response on how users consciously thought about the questions provided by Rebulb.
	Impact of Periods and Keywords for Deliberative Retrospecetion	¢ c	Impact of question	Response on how the template-based question generation
	Contextual Impact for Spontaneous Retrospection	He	Recalling answers	Response on how users thought about answers to the
5.2 Forming past diary by concretizing ambiguous memories though the personal	Cognitive Effort to Clarify Vague Memories		Assign deliberative	Response on how users allocated time for reflection and
	Re-evaluation of Past Events		Impact of objects and	recalled their past. Response on how users' objects or activities influenced
	Memory Distortion Cause from Personal Interpretation		activity on memory recall Reflection from collection	spontaneous memory recall. Response on how realizations and lessons learned from
5.3 Side effects of proud moment-framed questions on the reminiscing and acceptance of memories	Discovery of Overlooked Past Proud Moments	A C	of past memories	past memories have been reflected in the present self.
	Self-Comparisons with Past and	M/o	Evoking vague past mental image	Response on how the questions triggered fragmented and vague past memories.
	Reframing Negative Experiences	Ac	Re-evaluation of past with current perspective	Response on how users re-evaluated and accepted past events from their current perspective.
General findings	Recognizing tables and questions in everyday Routine	1 c	Positive / Negative distortion of memory	Response on how past memories were positively or negatively distorted depending on the user's current state.
	Recalling Answers to Questions in Everyday Routine	/ 2) Self-comparison	Response on how users compared their past self with their present self.
		~) Learning from Failure	Response on how lessons learned from negative past experiences had a positive impact on the user.

Figure 8: Overall process of qualitative data analysis

and writing past diaries, with a slightly different emphasis each month (see Table 3). Additionally, based on participants' previous responses, specific follow-up questions were tailored to individual participants. All interview content was transcribed and translated into English, terms were carefully selected to preserve the nuances of participants' experiences and emotions, and careful comparison was made with dictionary definitions and contextual references. Then, open codes were generated immediately after translating each interview. Two authors were involved in an iterative affinity diagramming process using these codes. We organized participants' statements into common themes as well as unique individual experiences to emphasize their personal perspectives rather than generalizations. Following the initial grouping, we enlisted three additional researchers, not involved in the field study or interviews, to independently evaluate the codes for triangulation and discuss any coinciding or conflicting statements. Commonly agreed-upon codes (n=12) were then selected. Through this process, we could

create thematic connections between the codes, and we derived 12 themes, which formulated three separate findings. Figure 8 shows our overall process of qualitative data analysis.

Quantitative data: Based on participants' diary log data, we were able to determine when users checked questions, the details related to past diaries (e.g., recording times, associated periods), and the number of individuals and places recorded. Using these log data, we identified patterns that supported or were meaningful in relation to users' interview responses. These patterns were then visualized and presented (see Figures 9 and 10).

5 FINDINGS

During the field study trial, a total of 213 past diary entries were recorded (P1: 87, P2: 56, P3: 70). These diary entries contain additional information, including 46 individuals (P1: 16, P2: 14, P3: 16) and 76 locations (P1: 27, P2: 39, P3: 10). Figure 9 illustrates



Figure 9: Usage log data over four months; this figure represents the order of the journaled period and how many journal entries, related persons, places, and monuments of each period were recorded.

the chronological distribution of the entries, indicating the number of records for each time period (represented by the bar graph below Figure 9) and the monthly distribution of entries (shown in the stacked bar graph labeled M1-M4 on the left side of each participant).

Participants received questions through Rebulb at the start of their day After receiving the question, P1, who did not go to work, immediately sat in front of Rebulb to reflect on the past and recorded their thoughts based on the question (Figure 10.a). When they couldn't think of anything to record, they continued with their daily activities while considering possible answers and then returned to Rebulb at the end of the day to complete their recording (Figure 10.b). P2 and P3, who went to work, mentioned that the physical presence of Rebulb caught their attention and made them aware of the question while they were getting ready to leave home. They mentioned that they often came up with answers during their commute (P2 on the bus, P3 on the subway). If no relevant memories came to mind, they would think of something during a break at work or on their way home. Additionally, through logs, we confirmed that they mostly recorded their answers on their way home (Figure 10.c, e) or before going to sleep (Figure 10.d, f).

The impact of Rebulb's scale and form on user experience: The Rebulb table seamlessly integrated into users' daily lives, influencing their self-awareness and journaling behaviors. Beyond serving as a research product for reflective prompts, its inherent functionality allowed diverse everyday use. Users engaged with it for writing (P1, P2), storing books and stationery (P1, P2, P3), or placing personal items like glasses and beverages before sleep (P2, P3). Notably, P3 utilized it in the living room for organizing essentials for the next day, while P1 used it as a secondary workspace when the primary family table was unavailable.

Despite P1's active use of a desk for writing as a writer, Rebulb's desk was not utilized as frequently. This was primarily due to two factors: (1) the redundancy of having an additional desk and (2) the compact size of Rebulb, which was designed to accommodate only simple notes or a smartphone during the design process. These limitations restricted the active use of Rebulb as a desk in P1's daily life. Even though, participants received reflective questions



Figure 10: Daily journaling time (gray rectangle) and question revealed time (circle) of three participants over four months

through Rebulb and naturally noticed them during their daily routines. P2 and P3 reported seeing the questions while preparing for work, whereas P1 mainly noticed them while watching TV or listening to music in the living room. P1 also mentioned that his attention was drawn to Rebulb when passing through the kitchen for a drink or while preparing meals, particularly when moving from the bedroom.

Rebulb's physical presence significantly facilitated awareness, as participants noted that merely seeing the table and displayed questions prompted reflection on their recording habits. This effect stemmed not only from its scale but also from its sliding mechanism, which alternated between revealing and concealing questions. P1 remarked, "When I missed recording in the morning, seeing the display in the raised position as I walked by reminded me that I hadn't recorded yet, which helped me remember to do it." Similarly, P3 initially questioned the necessity of a physical table for such a purpose, stating during a two-month follow-up interview, "I can do the same thing with an app, so I don't quite understand the purpose of the table." However, her perspective shifted during the field study when Rebulb's sliding mechanism malfunctioned, preventing the display from popping up. Coordinating Rebulb's repair schedule with the participant took one week, during which the device remained in the participant's home with the slide lowered. Although the participant could still view questions and write journal entries through the mobile app, they reported a decline in their recording activity during this period.. she commented, "I initially thought that using an app alone was sufficient and didn't see the need for an additional table. But during the period when the display wasn't popping up, I found myself rarely opening the app or recording anything. It made me realize that seeing the questions physically displayed in my daily environment had a much greater impact than I had expected."

This study aligns with previous research by demonstrating that a device with physical presence [44] can capture users' attention and prompt recall of its function [18]. However, insights from P3's experience suggest that mere physical presence is insufficient; instead, the persistent visibility of the information provided by the device plays a crucial role. This finding highlights the potential for further research on strategies for sustained information exposure through

physically present devices. Furthermore, the functionality and size of a table vary depending on user needs. While Rebulb was effective for storage, it was less suitable for tasks requiring workspace and cross-referencing information. Given these considerations, rather than introducing an additional table, an alternative design approach could involve a modular interface that can be attached to existing tables, enabling a sliding mechanism for question display.

5.1 Self-Explorative Deliberated and Spontaneous Retrospection for Recognizing One's Proud Moment

We identified that because the reflective questions provided by Rebulb didn't require immediate answers, participants often thought about their responses throughout their daily activities after receiving the questions in the morning. This indicates that participants reflected on the questions in various situations during their daily routines. Even P1, who typically wrote their responses right after receiving the question in the morning, agreed with this point, stating, "Surprisingly, washing dishes is a good time to focus. I do a lot of dishwashing at home, and since it's a time-consuming activity, as I focus on the sound of the water, my thoughts tend to drift toward the question. It's kind of like how some people say that showering is a good time to think or meditate." Similarly, participants mentioned that they often found themselves thinking about the answers during activities like commuting, taking breaks at work, walking, or exercising. This shows that Rebulb helped participants engage in self-explorative retrospection not only during "designated thinking times" but also during "unintentional moments."

Utilizing periods and keywords for deliberate retrospection: Regarding deliberate retrospection, all participants primarily used the questions and the life periods they had defined for themselves. They tried to recall memories by applying the keywords from the questions to the various periods of their lives. Regarding this, P1 said, "In the morning, when I see the keywords from the question in the living room, I sit down in front of Rebulb and think deeply. As I recall memories, like watching a film, the proper memory comes to mind. Then, I sort of draft it mentally and make adjustments." In addition to the question's keywords, participants applied these keywords to the periods of their lives they had defined, which helped them recall the past. In this context, P2 mentioned, "When I'm not in the middle of daily life and can focus entirely on the question, I think I can recall more deeply... (omit) ... I repeated the words from the question for each divided period of my life." Similarly, P3 stated, "I would recall and write down memories related to the keyword from the question, even if they didn't match the suggested time period. For example, if the keyword was volunteering, I would think of stories or experiences related to volunteering, even if they weren't from the period suggested by the question."

These findings align with previous studies [27, 71], demonstrating that users explore their answers based on the content of reflective questions. Specifically, it was observed that users engaged in self-explorative efforts to recall memories by referencing the keywords embedded in the reflective questions and the life periods they had defined.

Spontaneous retrospection triggered by casual activities: In the process of exploring answer of reflective questions, it is crucial to provide sufficient time and conducive environmental conditions to facilitate self-reflection [45]. Field studies of Rebulb revealed that participants not only engaged in designated reflection times but also spontaneously recalled memories during daily activities. They reported that memories were often triggered unexpectedly by ongoing activities or familiar objects in their environment. Regarding the connection to activities, P2 said, "Yeah, naturally, if I'm traveling now, memories of past trips come to mind. If I'm hiking, I think about previous hikes, and if I'm working out at the gym, I end up thinking about exercise." Additionally, both P2 and P3 mentioned that memories could be triggered by objects they owned. P2 commented, "I usually declutter old items quickly, so there's not much that brings back memories. However, I recently came across my official school records from elementary, middle, and high school. This discovery made me reminisce and consider writing down the awards I received back then." Similarly, P3 mentioned, "When I was organizing my things, I would come across something and think, 'Oh, I remember this,' and memories would come to mind. Interestingly, those items didn't trigger any thoughts before, but since I've been looking for things to write about, memories have started coming back." P3's remark suggests that a user's mindset could influence memory recall. Although the objects didn't previously trigger memories, Rebulb's questions helped her consciously reflect on memories, making it possible to rediscover them through these items. Rebulb's reflective questions not only aided in recalling proud moments but also heightened users' conscious awareness of them in daily life, helping to preserve small, easily forgotten achievements. Regarding this, P3 said, "There were moments that made me feel proud that day, so I wrote them down right away. Normally, I would forget them, but by being conscious of pride, I was able to recall and capture them." Similarly, P2 noted, "At first, I recorded big achievements, but as time passed and there was less to write about, I started finding and enjoying recording those small, fleeting moments of pride that would occasionally come to mind."

Overall, in line with previous studies' finding, we were able to see that confronting memory triggers helps individuals face memories and facilitates the recollection of past moments [51] and that reflection on oneself can occur in spontaneous and casual environments [38]. Additionally, Rebulb contributes to this by providing a framework (i.e., proud moments) that helps participants recall memories they may typically overlook in daily life, such as minor achievements or accomplishments related to objects.

5.2 Forming Past Diary by Concretizing Ambiguous Memories Though the Personal Interpretation

Triggering vague memories through personal recall: We confirmed that when participants involuntarily recalled the past, they often brought up vague and broad memories. Although this approach could yield a variety of potential writing materials, it also requires personal interpretation to concretize these memories into a past diary. All participants noted that when recalling memories from distant times, the memories were generally vague rather than detailed. P1 mentioned, "It's a downside that memories might be vague or exaggerated, and it's not as accurate as writing about something that happened today." Accordingly, all participants needed a process to refine these vague memories by clarifying the visual or mental images that arose. They made efforts to articulate these mental images and recall fragments of detailed memories. P3 stated, "Expressing the past scenes that came to mind in writing was not as easy as I expected. I tried hard to find appropriate expressions for the scenes that emerged while organizing the memories. By repeatedly writing and revising, I was able to think more deeply about the memories and clarify abstract recollections. Interpreting memories from a current perspective has the advantage of allowing a fresh evaluation of past events from a distance, but it could also lead to idealizing the past, which may pose issues regarding authenticity.

The impact of personal interpretation on vague memories: First, in the context of viewing past events from a new perspective, participants found that they were able to reevaluate past events or engage in self-reflection. P1 noted, "During the process of concretizing in writing, it seems like I viewed past events less emotionally. I questioned whether what I was writing was exaggerated, and I tried to understand the other person's perspective, which led to more detailed writing." Similarly, P3 mentioned, "Looking back now, it seems like there were emotional events that weren't significant at all. With older memories, I tend to view them more objectively. By stepping back, I can see both my own actions and those of others more clearly." However, the inclusion of personal interpretation when dealing with vague memories could lead to distortions, raising concerns about authenticity. All participants expressed concerns about this issue. P3 commented, "The initial image that comes to mind is difficult to express in writing, and as I described the scene, I realized that the image might not be accurate." Specifically, participants varied in their methods of filling in the vagueness with personal interpretation. P2 mentioned that they often idealized memories, saying, "Even if there are incorrect actions in my memories, I tend to idealize or omit them and write only the positive ones. Since these are memories, I prefer to make the good ones look even better and delete the less favorable ones for my current satisfaction." Similarly, P3 also noted idealization, stating, "It seems like I tend to evaluate memories more favorably. Naturally, I justify them according to my current standards, thinking, 'I learned a lesson, so that's enough!' There seems to be a

tendency to interpret things more positively." In contrast, P1 mentioned that although idealization is possible for events that can be rationalized, those that cannot tend to be distorted more negatively. "For ambiguous events that could be seen as either right or wrong, I still tend to idealize them in a way that benefits me. However, for ambiguous memories of giving up or failing, they seem to be distorted more negatively, with a focus on the lessons learned."

Recalled memories are often abstract and fragmented [15, 74]. a characteristic leveraged in HCI memory technologies [9, 51] that emphasize experiential reflection through reminiscence cues. However, Rebulb shifted this focus from revisiting memories to documenting them, highlighting the need to concretize vague recollections. Our findings reveal that personal interpretation plays a key role in this process, introducing varying degrees of idealization or distortion based on individual perspectives. While this raises questions about memory authenticity, it also suggests that interpretation and current mindset are integral to recording. This opens discussions on how subjective reinterpretation can be effectively utilized in the context of past diaries.

5.3 Side Effects of Proud Moment–Framed Questions on the Reminiscing and Acceptance of Memories

Discover overlooked past proud moments: We confirmed that the questions framed on proud moments helped participants recall positive memories hidden within past experiences. Our field study revealed that these positive-framed questions could evoke memories of positive moments, as well as associated memories (e.g., trial and error, related experiences), which could have both positive and negative impacts on participants. All participants mentioned that they were able to revive moments of achievement and joy that they had not previously acknowledged. For instance, P2 said, "I realized that I've done a lot more, both big and small, than I thought. I hadn't deeply considered it back then, but looking back now, I feel like I've lived well." Similarly, P3 noted, "At first, I thought I didn't have any good memories to write about, but as I reflected, I found many positive memories, even those derived from realizations and pride." Moreover, even when the memories derived from proud moments were negative, participants were able to accept them if they contained pathetic lessons learned or led to a sense of pride. P1 mentioned, "When writing about memories when I felt troubled, misunderstood, or upset, if I could find positive growth or rewrite a positive conclusion through reflecting on those negative experiences, it seemed acceptable to recall them, even if they were negative." Similarly, P3 remarked, "Even negative memories sometimes had aspects that allowed me to view them positively. For instance, I thought, 'I overcame that well' or 'It seemed difficult then, but looking back, it wasn't such a big deal.""

These findings align with previous research [16], which demonstrated that reflective questions facilitate self-reflection on specific topics. Our study extends this by showing that reflective questions focused on positive themes can prompt users to recall overlooked positive memories from their past.

Accumulating memories for fostering self-reflection and self-understanding: Furthermore, accumulating autobiographical memories related to proud moments not only helped participants recognize past proud moments and related memories they were

previously unaware of but also prompted reflections on areas for self-improvement, influencing their future plans. For instance, P2 noted, "I realized that many of my recorded moments were about hobbies or travel, but there weren't many related to academic achievements. I felt a bit regretful about not challenging myself more in that area. This made me think it would be beneficial to study for certifications or explore topics like investments or real estate." Similarly, P3 reflected, "When reviewing the categories of my proud moments, I noticed there were entries related to my career and spiritual growth, but content on interpersonal relationships was lacking. This made me realize I need to put more effort into that aspect moving forward." In contrast, P1, who has retired from active social life, mentioned that rather than focusing on future plans, they have shifted their attention to reflecting on their life as a whole, drawing lessons from the past and focusing on the present. P1 further added that if they were still engaged in professional life, they might have applied those lessons to future endeavors. However, given their current stage in life, they primarily use these reflections as a way to reminisce and find closure.

These findings were inline with prior research [27, 28], which demonstrated that reflective questions facilitate a deeper exploration of everyday moments by prompting users to observe past experiences from new perspectives. However, Rebulb also discovered that encouraging users to accumulate memories of past proud moments and review these records could assist them in identifying new goals and areas for personal growth. This process might supports transformative reflection [16], enabling users to connect these insights to meaningful changes in their lives.

Side effects of framing memories through proud-moment questions: However, we found that questions focused on proud moments could also induce some side effects. Specifically, issues arose when participants struggled to recall proud moments or when they compared their past positive states with their current ones (P2, P3). First, when participants were unable to recall positive memories to write about, they felt disappointed by the apparent lack of content. For instance, P3 mentioned in the three-month interview, "At first, it was fun and enjoyable, but then when I ran out of things to write about, I started thinking, 'Was it really that sparse? There don't seem to be many proud moments after all." Similarly, P2 said, "After writing for 2-3 months, I found there was nothing left to write about ... 'Have I really run out of material already?' I thought there would be a lot to write about at first, but after about two months, I felt like there was nothing left." Additionally, P2 and P3 noted that recalling past proud moments sometimes triggered comparisons with their current state. P2 commented, "A few years ago, I was reading books diligently and feeling proud, but now I just let them pile up, which feels pathetic. Comparing myself to my past self, I feel like I'm not living up to those standards anymore. It's like a reminder of past glory?" Similarly, P3 noted, "In the past, I had passion and energy, but now I make excuses related to age and haven't done the same things. Even if those memories were positive, they seem less relevant now. Writing about past achievements feels like boasting about old accomplishments rather than objective accomplishments."

This finding indicated how participants accept their memories, and the reception of memories is not simply about accepting positive ones and rejecting negative ones [70]. Even positive memories could have negative effects if they do not align with the current situation. At the same time, negative memories could be accepted if they involve learned lessons or overcoming challenges.

6 DISCUSSION AND DESIGN IMPLICATION

The findings of our field study showed that users recall memories associated with past proud moments during their daily lives and how they concretize these abstract memories for journaling. Additionally, we identified potential issues arising from the distortion of memories, as well as the side effects caused by the framing of proud moments. Based on these insights, we have opened up several points for discussion in designing a system that facilitates the recall and journaling of past experiences.

6.1 Supporting Self-Reflection and Journaling with Personalized Reminders and Prompts

Self-awareness refers to a user's ability to recognize their own abilities and states, which can then be used as triggers for behavioral change or motivation. Various methods have been employed to enhance self-awareness, such as using self-tracking and visualization tools [3, 34], reflective questions [28, 46], conversations with chatbots [33], and capturing personal reflective thoughts through meditation [42]. These examples primarily focus on how users can be provided with tools to enhance self-awareness. Moreover, it is also important to offer methods that help users secure and recognize appropriate times and spaces for self-reflection. Rashid and Seligman [64] suggested that in a modern society filled with digital distractions and external stressors, it has become increasingly difficult for individuals to find time for introspection. In this context, Rebulb utilizes a design strategy that prompts users with self-reflective questions without requiring immediate answers. This approach allows users to recall scattered and abstract memories from their past during daily activities, and later, when convenient, to concretize these thoughts by journaling them. Based on this, we identified a design space for an interface that naturally encourages self-reflection and the recording of thoughts during everyday life.

To facilitate natural self-reflection during daily activities, participants could be suggested personalized times to think about themselves (e.g., responding to Rebulb's question). Instead of using random notifications, a "Just In Time" approach [73] could be utilized. This is because the optimal times and places for self-reflection (e.g., during a walk, while doing chores, during meditation, or while taking a shower) can vary for each user [25].

Repetitive activities like walking or household chores create plastic time [40] allowing for self-reflection and memory recall. Leveraging this, Rebulb can seamlessly prompt introspection during these moments. Identifying optimal reflection times via smartphone sensors [37] enables context-aware prompts, such as "It's *a good time to think about [today_question]*." However, intrusive or frequent notifications may disrupt activities and reduce engagement [56]. One potential strategy is to encourage users to naturally associate reflective moments with their daily routines, based on the understanding that they often check the Rebulb table's questions throughout their day. For example, around the time when a user typically goes for a walk (based on schedule or health data), a prompt could appear on Rebulb's display, such as "It's almost time for your walk; the weather is nice today. How about thinking about

[today_question] while you're out?" This approach would guide users to seamlessly integrate reflection into the gaps of immersion that occur during their walk Additionally, engaging in casual activities such as walking or doing chores while reflecting on oneself can lead to broader, less organized thoughts that may later serve as material for past diary entries. However, because diaries are not written immediately after recalling thought, there is a risk that these thoughts may be forgotten over time. To address this, a method for jotting down brief keywords through text or voice recordings could be employed. Additionally, it is crucial to create an environment that supports diary writing when users are prepared to compose their entries. In Rebulb's design process, this consideration led to the development of a concept where a display with tabular questions pops up, encouraging users to sit and review the questions as they write. Expanding on this idea, adding a recording mode to Rebulb could be beneficial. This mode could provide not only the questions but also previously recorded keywords or examples from other users' responses, offering valuable references to assist in the diary-writing process.

6.2 Enhancing Users' Active Memory Exploration Through Inquiry-Based Prompts

Recalling the past can be beneficial for both self-improvement and enjoyment, as it allows individuals to learn from previous experiences. However, considering the susceptibility of memories to contamination and distortion [15], spontaneous recall without any cues can have limitations [15]. To address this, existing HCI research has leveraged the Proust effect, where scents or music can involuntarily trigger memories, to develop and evaluate everyday remembering devices [79]. These efforts often incorporate metadata such as music-listening records [22, 53] or photo timestamps [9, 32] to aid in everyday remembering. Rebulb employed a different approach compared to previous research by using evocative stimuli such as music and photographs to trigger an instant past recall and enjoy serendipitous experiences [51]. Instead, Rebulb presents users with questions about the past, encouraging them to consciously and intentionally reflect on and record their answers. This method enables researchers or service providers to elicit reflections on specific topics (e.g., proud moments) and facilitates a broader retrospective of one's life even without digital records. However, Rebulb's approach may evoke less vivid and more ambiguous memories compared to music and photographs, and the process of concretizing these vague memories may be more challenging and less engaging. Integrating insights from existing HCI research and the Rebulb field study, we identified several discussion points for designing an everyday remembering device that fosters self-explorative retrospection through inquiry-based methods.

Using inquiry-based methods to prompt user recall enables individuals to actively engage in reflecting on their past by contemplation. Rebulb's queries are designed to prompt users to recall specific periods, register proud moments, and reflect on these significant times. To enhance user engagement and evoke more vivid memories, this approach may incorporate media (e.g., music, photo, message, news article) related to the user's past. Previous studies have explored media content as a cue for vivid recollections

Table 4: Overview of manual, semi-automatic, and automatic approaches to generating reflective questions through media content

Approach	Description	Source for question generation	Example question
Manual Semi-	The user selects media directly and explores their memories.	-	"Find a memorable photo in an old photo album and write about the memories associated with it." "Is there a song you used to listen to frequently in your childhood? Listen to it again and share the memories." "Here is a list of hit songs from the 1980s. Do any of
automatic	The system suggests public content (e.g., music charts, news articles), and the user selects items to reflect upon.	Publicly accessible web documents	these bring back special memories? If so, write about your experience." "Do any of the 2000s drama titles listed below relate to your past? Write about your experience in detail."
Automatic	The system analyzes the user's digital footprint to automatically generate personalized reflective questions.	Users' digital footprints	"Do you remember this song you often listened to in March 2015? Write about the memories associated with that time." "Do you have any specific memories linked to this photo? Please describe them in detail."

[9, 39, 47, 49, 51]. Building on this, integrating reflective questions can enhance both memory recall and self-explorative journaling. Table 4 categorizes approaches to generating such questions based on user involvement in media selection. The manual approach offers deep personalization but requires active effort. The semiautomatic approach curates popular media to trigger memories, though relevance may vary. The automatic approach personalizes reflections using digital footprints but struggles with data consolidation and recency limitations. While manual selection fosters broader reflection, automation may constrain thoughts to the provided content.

Furthermore, during weekends or holidays, users could receive recommendations based on their social relationships or locations. For example, "How about reconnecting with someone you often spent time with during [specific period] and sharing memories?" or "Consider visiting [specific place] this weekend and reminiscing about past events that occurred there." Visiting such places might trigger memories associated with those locations, and meeting people from the past could facilitate new recollections or cross-validation of shared memories.

6.3 Guiding Present Mindset to Shape Acceptance of Evoked Memories

Although Rebulb's questions are framed positively by focusing on proud moments, participants are not always received as entirely positive and can evoke ambivalence [70]. This is due to the nature of writing about past rather than current experiences, as even positive memories might not be perceived positively from a present perspective. Thus, it suggests that both the inherent nature of the memory (positive or negative) and the current mindset toward that memory play a crucial role.

The field study of Rebulb revealed that when activities and states once considered fulfilling no longer persist into the present, they can elicit negative emotions. For instance, a person who once exercised diligently might feel negative emotions if their exercise frequency decreases due to a busy work schedule, leading to health deterioration. Comparing their past health with their current situation could evoke such negative feelings. To address this, users might be encouraged to focus on setting new goals in order to regain past states or to concentrate on their current achievements. For example, asking, *"Is there something you once excelled at that you feel you could challenge yourself to do again?"* could help shift the focus from comparing past and present states to future. Alternatively, users could be encouraged to recognize and appreciate the gains made by reducing exercise, such as professional achievements, thereby focusing on their growth and new accomplishments rather than past deficiencies.

Moreover, we found that negative memories can be accepted if they are reinterpreted with a positive conclusion from the present perspective. One of Rebulb's design features is that it prioritizes recording proud moments and encourages users to trace back to the memories associated with those moments. Specifically, users first document their proud moments and then record the associated challenges or failures. This approach allows users to rationalize negative memories by acknowledging that they contributed to positive outcomes. This finding aligns with Verplanken, et al. [81] suggestion that lessons learned from negative experiences can be accepted positively. Considering this, prompting users to recall memories of new challenges or achievements, even if they are not pleasant, can help them emotionally engage with their past. For example, questions such as "Can you recall a past failure from which you learned something?" or "Do you have any past mistakes from which you gained valuable lessons?" can focus users on the lessons learned from negative experiences. Additionally, follow-up questions like "Has there been a proud moment influenced by [unpleasant_diary_title]?" could help users connect their unpleasant experiences with positive outcomes.

7 LIMITATION AND FUTURE WORK

Before drawing out our conclusion, we would like to address the limitation of this study and outline future research plans. Regarding the scope: As outlined in the introduction, this study explored users' epistemological perspectives on evoking memories and journaling, along with the potential clinical applications of recorded entries, focusing primarily on users' experiences. Future research could extend this scope by examining clinical implications through expert interviews, assessing whether Rebulb's life history data aids in understanding users' backgrounds or mental states, potentially refining its approach. Additionally, since diaries reflect emotional states, future studies could analyze these emotions using diagnostic models. To this end, we plan to deploy the Rebulb mobile app, conduct large-scale experiments, and collect quantitative data to derive more generalizable insights beyond the individual experiences explored in this study. Regarding Rebulb design: The design of Rebulb was researcher-driven, focusing primarily on the table form with limited exploration of alternative forms (e.g., small interactive objects, mobile-based interfaces). Additionally, the design was based solely on researcher intuition and predefined design goals (DGs) without incorporating user feedback or conducting extensive iterative experimentation. Future research should explore various physical form factors and adopt a more user-centered iterative design process to examine their impact on memory recall and engagement. Regarding participants who do not have a history of mental health issues: The current study involved participants without any mental illness history because the effects of framing memories as "proud moments" were uncertain, and it may have a potential risk for individuals with mental health vulnerabilities. Future research could first explore the impact of "proud moment framing" on individuals with mild psychiatric conditions (e.g., feelings of depression or mild depression) within a controlled environment that includes psychiatrists. This would help understand the differentiated responses based on mental illness history and contribute to producing more practical and ethical research outcomes.

8 CONCLUSION

In this paper, we present the design process and field study of Rebulb, which provides reflective questions framed as proud moments to trigger users' self-explorative retrospection and journaling of past events, helping them to form a life history. Our four-month field study revealed that providing time for reflective questions about past proud moments into daily routines heightened users' awareness of their proud moments. This practice also encouraged reflection on both intentional and unintentional memories during their daily activities. However, during this process, we observed that these evoked memories could be contaminated, with individuals potentially filling gaps with personal biases or rationalizations. Finally, when recalling memories, framing them within a positive context may evoke ambivalence, leading to self-comparison between one's past and present selves. Similarly, past negative events can have a positive impact on the present self if they contain lessons that can be applied to the current self. Based on our Rebulb design and the findings from the in-field study, our research offers the potential design space for everyday memory devices, which evoke

memories and form a lifespan history through the accumulation and recording of these memories. More specifically, it provides further considerations for helping users recognize appropriate times for active self-explorative retrospection to retrieve memories, encouraging the long-term practice of writing past diaries, which may have limited content in acceptable ways.

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