석 사 학 위 논 문
Master's Thesis

메모리 가든: 경작과 탐험 게임 메커닉스를 활용하여 회상, 정서적 연결, 긍정 정서를 촉진하는 디지털 사진 공유 시스템 설계

Memory Garden: Designing a Digital Photo-sharing System to Foster Reminiscence, Emotional Connection, and Positive Affect through Cultivation and Exploration Game Mechanics

2025

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Memory Garden: Designing a Digital Photo-sharing System to Foster Reminiscence, Emotional Connection, and Positive Affect through Cultivation and Exploration Game Mechanics

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Advisor: Juho Kim

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Approved by

Juho Kim
Associate Professor of Computer Science

The study was conducted in accordance with Code of Research Ethics[1].

[1] Declaration of Ethical Conduct in Research: I, as a graduate student of Korea Advanced Institute of Science and Technology, hereby declare that I have not committed any act that may damage the credibility of my research. This includes, but is not limited to, falsification, thesis written by someone else, distortion of research findings, and plagiarism. I confirm that my thesis contains honest conclusions based on my own careful research under the guidance of my advisor.

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초 록

소셜 미디어 및 기타 디지털 사진 공유 플랫폼은 사용자의 수동적인 상호작용을 부추기고, 회상에 적합한 공간을 제공하지 않는다. 본 연구에서는 메모리 가든을 소개한다. 메모리 가든은 사진 공유 행위를 제작 및 탐험 메커니즘이 포함된 아늑한 게임 경험으로 재구성함으로써 회상, 정서적 연결, 긍정적 정서 상태를 촉진하도록 설계된 디지털 사진 공유 시스템이다. 메모리 가든에서 사용자는 디지털 정원의 형태로 사진 앨범을 제작하여 상대방에게 보낼 수 있고, 수신자는 해당 정원을 탐험하며 그 안에 숨겨진 사진 메시지를 발견할 수 있다. 본 연구는 총 15쌍의 참가자를 대상으로 탐색적 사용자 연구를 진행하였으며, 이들이 메모리 가든을 통해 어떻게 사진을 공유했는지, 그리고 그 경험이 정서적 상태와 관계적 연결감에 어떤 영향을 미쳤는지를 분석하였다. 분석 결과, 메모리 가든은 회상과 정서적 연결, 그리고 전반적인 긍정적 정서 경험을 촉진하는 데 기여한 것으로 나타났다.

핵 심 낱 말 회상, 아늑한 게임, 디지털 사진 공유, 정서적 연결

Abstract

Reminiscence—the act of recalling and reflecting on past experiences—can enhance one's overall sense of well-being and emotional connection with others. Nostalgic digital photographs provide a rich and ubiquitous resource for reminiscence, but their emotional impact is often diminished by the design of the platform they are shared within. Social media and other digital photo-sharing platforms inadvertently encourage passive user engagement and provide little space for reminiscence. We introduce *Memory Garden*, a digital photo-sharing system designed to foster reminiscence, emotional connection, and positive affect by re-framing the act of photo-sharing into a cozy game-like experience with basic cultivation and exploration mechanics. In *Memory Garden*, users can create and send a digital photo album in the form of a digital garden. Recipients, in turn, can explore their partner's garden and uncover the hidden photo messages left for them. Through an exploratory study with 15 pairs (N=30), we examined how participants used *Memory Garden* to share photos with their partner, and how it influenced their affective state and sense of connection. Our findings showed that *Memory Garden* helped foster reminiscence, emotional connection, and overall positive affect in participants.

Keywords Reminiscence, Cozy Game, Digital Photo-sharing, Emotional Connection

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Chapter 1. Introduction

Emotional connection forms the bedrock of a happy and healthy life. One way to strengthen our connection with others is through shared reminiscence—the act of reflecting on significant memories with those who also experienced it. Engaging in shared reminiscence reinforces emotional connection by basing it on a sense of shared history [14]. As we reflect on the positive experiences we have had with others, we gain a sense of warmth, belonging, and gratitude towards them and an overall greater sense of well-being and resilience towards life's stressors [5, 13, 41].

Photographs, being visual records of the past, serve as valuable prompts for shared reminiscence [9]. With the ubiquity of smartphones today, many individuals now possess large collections of personal digital photographs that could facilitate nostalgic reflection and memory-sharing. Most digital photographs are now shared online [32] through social media platforms such as Instagram and Snapchat, digital messaging applications such as WhatsApp and Facebook Messenger, or shared cloud storage services such as Google Drive and Apple iCloud. While these platforms provide accessible and efficient means of sharing photographs, they are not inherently designed to support deeper forms of reminiscence. In the case of social media and digital messaging apps, these platforms are designed to support rapid and lightweight message exchange, which, while effective for maintaining existing relationships [28], often lack the emotional depth required to effect closer connection [25]. Moreover, when users share nostalgic photos on these platforms with the intention of reminiscing on shared experiences, such activities are often fleeting and cursory, as the photos and conversations surrounding them become buried over time by other unrelated exchanges [43]. As a result, it becomes difficult for users to revisit and appreciate their shared memories over the long term, limiting the depth of emotional connection that such digital memories could foster. In fact, recent research suggests that modern-day social media use is contributing to the rising rates of global loneliness. [40, 33]

Most digital photos are arranged and shown in an *film roll*-like format, where photos are arranged linearly in some forced—usually chronological—order. Axtell et al. [7] critique the film roll metaphor, arguing that it is ill-suited for reminiscence-based interactions because it restricts how photographs are naturally arranged and reduces user interaction to passively scrolling through an "endless" stream of photographs taken in the past. Such a viewing experience, they argue, is more akin to a utilitarian file browsing task, which distances users from the lived experiences of their digital memories. In contrast to the film roll, Axtell et al. propose an album-based metaphor that allows users to arrange their photos in a more thematic manner. While an album-based design can improve the experience of reminiscence over the existing film roll interfaces, we argue that systems supporting shared reminiscence should go beyond these physical analogues and instead leverage the unique interactive and immersive qualities of digital media to create more engaging and meaningful reminiscent experiences.

One medium that shows how digital interactivity can enable deeply engaging and experiential interactions are video games [34]. In particular, the popular genre of *cozy games* has shown how slow gameplay centered around cultivation and exploration can nurture a relaxed, positive affective state [30, 44, 27] conducive for deep, emotional reminiscence. Drawing inspiration from the cozy game genre, we propose *Memory Garden*, an interactive system that reframes digital photo-sharing as a cozy garden decorating game. Using *Memory Garden*, the photo sharer can cultivate a digital garden by planting various flora like sunflowers and pumpkins and embed hidden photo messages within the garden for their

intended target to read. The recipient, in turn, can explore their partner's garden and discover the hidden photo messages as they navigate throughout the garden.

To evaluate the potential of *Memory Garden*, we conducted an exploratory study with 15 pairs of participants (N=30). Each participant acted as both the photo sharer and recipient by first creating their own garden and then subsequently exploring their partner's garden. Our qualitative findings highlighted the diverse ways that participants creating their garden for their partner, the emotions that they experienced while creating their own garden and exploring their partner's garden, and the notable comparisons between *Memory Garden* and the regular ways that participants share their digital photos.

The contributions of this work are as follows: 1) The design and development of *Memory Garden*, an interactive system for sharing digital photo collections as an explorable digital garden, and 2) An exploratory user study demonstrating how *Memory Garden* enhances the emotional experience and interpersonal impact of sharing and exploring past digital photos.

Chapter 2. Background

Reminiscence and its emotional analogue nostalgia have been a subject of study across various disciplines, and several studies have identified reminiscence as a key psychological resource that helps individuals regulate emotions [36, 21, 38, 37] and restore a sense of social connection [1, 2, 13, 46]. In fact, reminiscence has been applied in a therapeutic context to support the mental health of older adults, particularly those experiencing depression or the onset of Alzheimer's and Dementia [18, 19, 23].

Previous works in HCI has explored various strategies to support reminiscence, including temporal, spatial, spontaneous, and collaborative approaches. Peesapati et al. [31] developed Pensieve, a system designed to encourage spontaneous reminiscence by emailing users at random times past content from their social media posts or general reflective prompts, and they found several benefits, including reported improvements in mood and user value in the spontaneous prompts but also found several drawbacks, including negative emotional reactions to unpleasant or overly personal memories and privacy concerns. McGookin [29] investigated spatially-situated reminiscence through Reveal, a location-based system that proactively resurfaces digital photos tied to users' current locations and found that Reveal prompted user reflection on changes within both the environment and personal lives. Lucero et al. [26] focused on collaborative reminiscence through Pass-them-around, a mobile phone-based photo-sharing application leveraging tangible and spatial interactions to support social and conversational reminiscence among collocated groups. They found that participants enjoyed the playful, social, and collaborative nature of photo-sharing enabled by their system. Finally, Chen et al. [11] explored temporally-fluid reminiscence through Chronoscope, a handheld telescope-like device designed to help users peer back on their own digital photo archives at different time scales. They found that Chronoscope created opportunities for curiosity-driven exploration and rediscovery of forgotten photos.

A few works have focused on reminiscence in the context of gift-giving. Gibson et al. [16] explored how hybrid gifts can evoke nostalgia by re-purposing digital media, such as old photographs, alongside physical gifts. Their study found that the digital layer enriched the physical gift by transforming it into a more personally meaningful gesture. Spence et al. [39] corroborated these findings and observed that digital elements elevated physical gifts—transforming what otherwise might seem generic or a clichéd gift (like a box of chocolates) into a more personalized and emotionally meaningful experience.

Chapter 3. *Memory Garden*

Building on the album metaphor proposed by Axtell et al. [7] and inspired by the slow, interactive mechanics of cozy games, we built *Memory Garden*, a system that allows users to share a collection of photos in the form of a virtual garden and encourages their recipients, in turn, to explore their partner's garden and find the hidden photos. In this section, we first discuss the design choices of *Memory Garden* and then describe the user journey of both the photo sender and photo receiver.

3.1 Design of *Memory Garden*

The design of *Memory Garden* is centered around re-framing photo-sharing as a cozy game-like experience in order to foster deeper reminiscence, emotional connection, and positive affect. We chose the gardening metaphor for its themes of cultivation and nature-based healing, reflecting the system's emphasis on slow, reflective engagement and mental well-being. Just as a physical garden can encourage individuals to slow down and enjoy their surroundings, *Memory Garden* encourages recipients to slow down and explore the shared memories that their partner selected. Visual assets were purchased and used in accordance with the creator's license agreement.[1]

We developed *Memory Garden* with the following design goals:

1. Introduce slowness, effort, and storytelling depth into the act of digital photo-sharing
2. Turn the act of photo-sharing into a fun, creative process for the sender
3. Turn the act of photo-viewing into an immersive, exploratory experience for the receiver

To achieve these goals, *Memory Garden* incorporates two interactive features: cultivation and exploration.

Cultivation

One of the core elements of meaningful digital sharing that we found in [**kwon˙its˙2017**] was the need for personalization, especially for digital objects which lack the inherent effort evident in more physical objects. Handcrafting, the act of personally creating or customizing an object, imbues it with immense symbolic meaning and emotional value [15]. One prior work Auggie [45] demonstrated how handcrafting a digital object (In Auggie's case, a virtual bear) can elevate the meaning of a digital message to the point where it could be considered a gift. We took the idea of handcrafting and implemented it in *Memory Garden* as cultivating flora. We did this to align with the system's overall garden-centric metaphor as well as to give users the sense that they were creating something that could live and grow into the future. We gave senders the affordance to freely customize their digital garden space by planting 11 different types of flora—some of which are immediately recognizable (e.g., sunflower, carrot, tree, etc.) and some of which are intentionally ambiguous (e.g, blue face plant).

[1] Assets from https://cupnooble.itch.io/sprout-lands-asset-pack

Figure 3.1: Interface elements of *Memory Garden*

(A) Photo Message Window: (A.1) Photo Upload Area, (A.2) Message Area, (A.3) Plant Message Button; (B) Cat Avatar, (C) Flora with a Photo Message, (D) Regular Flora, (E) Flora Selection Bar

Exploration

In order to satisfy our second design goal, we implemented a treasure hunt mechanic where, when the receiver first loads their partner's garden, all of the photo messages are hidden. Only when the user navigates close to a planted photo message does the message indicator balloon pop up allowing the receiver to see the contents within. The treasure hunt mechanic draws upon the experiential design principle of serendipity [17], which refers to the experiential quality that arises from unexpected, yet pleasant encounters while using a system. Serendipity often evokes positive feelings of delight and curiosity and can create meaningful experiences [24]. In the case of *Memory Garden*, the treasure hunt mechanic provides users the experience of serendipitous discovery, which can provide for a profound experience [20].

3.2 User Journey in *Memory Garden*

In *Memory Garden*, the user controls a cat avatar (Fig. 3.1B) to navigate the garden space using the standard arrow keys or WASD keys. The user can craft their garden by planting various types of flora in any arrangement and quantity they desire. By pressing Q or E, the user can toggle through the available flora types (Fig. 3.1E) and plant the selected flora at the cat avatar's location by pressing the P key. The user can remove flora using the O key. The user can also shrink or grow flora by pressing the left and right bracket keys, respectively.

The user can also plant special flora that include a photo and a text message, referred to as "photo messages." These plants look identical to regular flora but display above them a clickable message bubble (Fig. 3.1C) that opens the photo message window. To plant a photo message, the user presses Shift+P,

which opens the photo message window (Fig. 3.1A). This window comprises of a photo upload area (Fig. 3.1A.1) at the top and a text input area at the bottom (Fig. 3.1A.2), allowing the user to upload a photo and write a message. When the user finishes creating the photo message, they click the plant button at the bottom of the window (Fig. 3.1A.3), which solidifies the flora's appearance, changing it from translucent to opaque, and changes the message bubble's icon from a pencil to a heart-shaped tulip, as seen in Fig. 3.1C.

After crafting the garden, the user can click the Save Garden button to download the garden as a file, which they can share with a partner. The recipient can then load the garden by clicking the Load Garden button. Initially, all photo message bubbles remain hidden, but when the recipient navigates close to them, they instantly pop up. The recipient can then click on the bubble to view the photo message left by the user.

Chapter 4. Exploratory Study

To evaluate the potential of *Memory Garden* as a platform for fostering reminiscence and social connection, we conducted an exploratory study in which pairs of participants created digital gardens for one another using nostalgic photographs and subsequently explored each other's digital gardens. We chose to do an exploratory study because there was little existing research on applying interactive, game-like approaches to digital photo-sharing, and we wished to gather insight into how users utilize and experience this novel format. The study aimed to examine how participants engaged with *Memory Garden* and what their subjective experiences and emotional responses were. Our investigation was guided by the following research questions:

1. Does *Memory Garden* influence the interpersonal connection between the giver and the recipient?
2. Does *Memory Garden* influence the affective states of both the giver and recipient?
3. How do users interact with and experience *Memory Garden*?

4.1 Participants

We aimed to recruit a diverse population in terms of age, cultural background, relationship status, relationship age, and frequency of contact with their partner. Participants were recruited through a combination of online recruitment, word-of-mouth, and convenience sampling. We distributed recruitment messages in local group chats, and we encouraged participants to refer their friends. We imposed minimal restrictions on participants; the only requirement was that each participant have at least five photos that they and their partner would find nostalgic. Photos were not required to include the participants themselves, nor did they have to have been seen by both participants before. We initially recruited 19 pairs of participants. However, four pairs were ultimately excluded due to either not following the instructions (e.g., planting fewer than five photos) or not completing all of the tasks within the study period. In the end, we recruited and interviewed 15 pairs (N=30; 9 males, 21 females; mean age = 27.2 years; age range = 22-37). Participants' demographic information is presented in Table 4.1.

4.2 User Study Procedure

The study consisted of four tasks: (1) a 15-minute onboarding session, (2) a garden crafting task, (3) a garden exploration task, and (4) an exit interview. Participants did the onboarding session and exit interview synchronously with the researcher over Zoom, whereas they did the crafting and exploration task asynchronously and independently from each other.

In the onboarding session, participants were introduced to the study's purpose, the system, and the instructions for using *Memory Garden*. Following this, participants were provided with a link to the pre-survey for the crafting task. After completing the pre-survey, participants could access *Memory Garden* through a provided link in the last page and begin crafting their garden. Participants were free to plant as many or as little flora as they wished, but they were required to plant at least five nostalgic photos within their garden. Once they were done crafting their garden, participants saved their completed garden to a file and submitted it along with their crafting post-survey.

Table 4.1: Participant Demographics

Pair	Gender	Age	Nationality	Relationship	Number Years Known	Frequency of Contact
1a, 1b	F, M	37, 35	US, KR	Married	6-10 years	8+ times / week
2a, 2b	F, F	31, 25	TH, TH	Friend	3-5 years	4-7 times / week
3a, 3b	F, M	31, 25	RU, GB	Dating	3-5 years	8+ times / week
4a, 4b	F, F	30, 23	TH, TH	Friend	3-5 years	8+ times / week
5a, 5b	M, F	25, 29	ID, ID	Sibling	10+ years	¡1 time / week
6a, 6b	F, M	25, 28	KR, KR	Dating	3-5 years	8+ times / week
7a, 7b	F, F	28, 28	MY, MY	Friend	10+ years	4-7 times / week
8a, 8b	F, M	33, 23	CZ, KR	Friend	3-5 years	¡1 time / week
9a, 9b	F, F	24, 27	NP, IN	Friend	1-2 years	8+ times / week
10a, 10b	F, F	22, 22	ID, ID	Friend	1-2 years	8+ times / week
11a, 11b	M, F	27, 25	ID, ID	Friend	10+ years	¡1 time / week
12a, 12b	M, F	29, 28	ID, ID	Married	6-10 years	8+ times / week
13a, 13b	F, M	32, 23	MX, MX	Sibling	10+ years	1-3 times / week
14a, 14b	F, F	25, 28	DE, BR	Friend	3-5 years	1-3 times / week
15a, 15b	M, F	24, 25	ID, MY	Dating	3-5 years	8+ times / week

Note: Nationalities are written as ISO 3166-1 codes.

Once both partners completed the crafting task, we emailed each their partner's garden and a link to the pre- and post-surveys for the garden exploration task. Similar to the crafting task, participants first completed the exploration task pre-survey, then loaded and explored their partner's garden, and then completed the exploration task post-survey. Although we did not impose a strict time limit, we asked participants to complete the crafting and exploration tasks each within three days of starting.

After both partners completed the exploration task, we scheduled a 1-hour joint interview with both partners. We chose to interview both partners together for two reasons. First, some participants were not comfortable talking in English and required their partner's help. Second, interviewing both participants together ensured that they were fully aware of their partner's thought process while creating the garden, ensuring nothing was missed and allowing for more comprehensive feedback. We asked participants open-ended questions about their:

1. Past experience sharing and receiving nostalgic digital photos
2. Thought process behind their garden
3. Experience with crafting their garden for their partner
4. Experience with exploring their partner's garden
5. Thoughts on *Memory Garden* compared to other forms of digital photo-sharing

After successful completion of the study, each participant received compensation worth 25,000 KRW.

4.3 Analysis Procedure

We analyzed the semi-structured interviews using reflexive thematic analysis [8]. Since one researcher did the coding and iterative analysis, we describe this researcher's position, assumptions, and bias as recommended by Braun & Clarke. The researcher was the sole developer of *Memory Garden* and thus has

a vested interest in the application's success. As such, the researcher would be biased towards the positive aspects of *Memory Garden*. Being conscious of this, we have made every effort to be as transparent as possible in our analysis and to be as inclusive of all participant perspectives wherever applicable. We do acknowledge, however, that the reflexive nature of the analysis means that the researcher's biases will inevitably influence the interpretation of the data. However, considering that this was an exploratory study of a novel approach to nostalgic photo-sharing, we believe the results are valuable, nevertheless.

Chapter 5. Results

We employed a mixed-methods approach to analyze the data collected from our exploratory study. Quantitative data was gathered through pre- and post-surveys conducted before and after the crafting and exploration phases, while qualitative data was derived from participant interviews at the end of the study.

We assessed *Memory Garden*'s effect on participants' affective states using a modified version of the Positive and Negative Affect Schedule (PANAS) [42]. The study measured nine positive affective states—*interested*, *inspired*, *calm*, *nostalgic*, *attentive*, *cared for*, *reflective*, *emotionally connected*, and *enthusiastic*—as well as five negative affective states: *lonely*, *disconnected*, *bored*, *nervous*, and *overwhelmed*. To measure participants' sense of connectedness, we utilized the Inclusion of Other in the Self (IOS) scale [6]. We applied the Wilcoxon signed-rank test to analyze the statistical significance of the pre- and post-study differences in participants' PANAS & IOS scores. The results of PANAS and IOS are presented in Figure 5.1 and Table 5.1, respectively.

With regards to PANAS, statistically significant changes were observed in nearly all affective states, with the exceptions of *calm* and *overwhelmed* (in the exploration phase). On average, the exploration phase had a greater impact on participants' emotional states compared to the crafting phase. The affective states most influenced by the crafting phase were *nostalgic*, *attentive*, and *reflective*, whereas the exploration phase most strongly affected *nostalgic*, *reflective*, and *emotionally connected*. The substantial increase in *nostalgic* across both phases was expected, given that participants were explicitly instructed to use nostalgic photographs.

The significant increase in the *reflective* state suggests that *Memory Garden* caused reminiscent thinking for both the sender and receiver of the garden. Furthermore, the significant increase in the *emotionally connected* state during the exploration phase indicates that participants felt a deeper sense of emotional resonance, as a result. This finding aligns with the statistically significant increase observed in the IOS score during the exploration phase, providing evidence that *Memory Garden* helped to strengthen feelings of emotional connection.

The lack of significant change in the *calm* and *overwhelmed* affective state may have been attributed to two factors. First, unlike many cozy games, *Memory Garden* lacked immersive elements such as ambient background music that might have encouraged a greater sense of calm & relaxation. Second, participants were using *Memory Garden* within the context of a time-sensitive user study, which may have induced a task-orientation mindset within the participants, potentially limiting the relaxed engagement typically associated with cozy gameplay.

Table 5.1: Effect of crafting and exploration on Inclusion of Others in Self (IOS) scale

	Mean (Before)	Mean (After)
Crafting	5.00	5.13
Exploration	4.90	5.43***

*p<0.05 **p<0.005 ***p<0.001

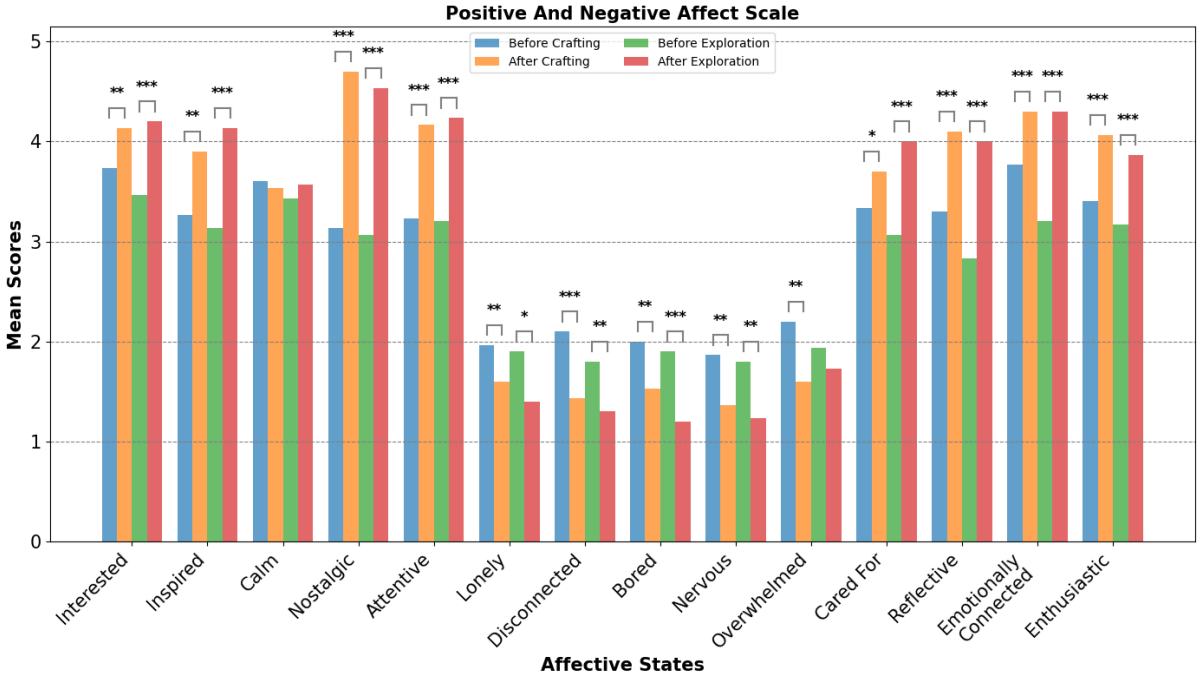

Figure 5.1: Effect of crafting and exploration on affective states.

Building on these quantitative findings, our qualitative analysis provides deeper insights into how participants utilized the various features of *Memory Garden* and what experiences they had while using it. We organize the rest of this section according to the themes generated from our reflexive thematic analysis.

5.1 Users Personalized Their Gardens using Various Strategies

Participants highlighted the various means that they used to craft their gardens for their partner. These included the intentional choice of selection, size, and arrangement of flora within their garden, the placement of photo messages, as well as the contents of the photo messages themselves.

Flora Selection, Size & Arrangement

Participants planted flora in a way to communicate visual messages to their partner. Many participants used flora to draw shapes in their garden such as hearts (P2A, P3A, P4B, P7A, P11B, P12B, P14A, P15A, P15B), and some also spelled out the (nick)names of their partner (P2A, P11A, P11B, P15A, P15B) as well as simple messages like "HI" (P2A, P11A, P12A), or variations of the phrase "I love you" (P3A, P12B). In some cases, participants drew things that were related to their partner. For example, P5A, P15A, and P15B each drew badminton rackets in their garden because their partner played badminton. P5A also drew a laptop because her partner worked as a computer programmer, and P7A drew "2003" because it signified the year she and her partner first met.

Some participants crafted gardens with complex designs. P13A created a framed abstract painting. P4A created a map of the Korean peninsula and Japan. P2B, P5B, and P10A created intricate mazes, and P9A created a sweeping landscape of her mountainous homeland in Nepal.

While most participants crafted their gardens using arbitrary flora, some participants chose specific

flora to represent certain meanings. P3B planted a portrait photo of P3A using a blue star flower. This was a pun, as he explained, because his partner was his "star". P7B used both flora *selection* and flora *distance* as symbolic representations. In her garden, the tree near the bottom represented herself, while the various sunflowers represented her partner P7A at different points in their lives. The choice of a tree to represent herself and the sunflower to represent her partner was to symbolize the fact that P7A had moved around a lot since high school, while P7B had stayed rooted in the same place:

> "It's just like how like sunflower needs sun. So that's why the sun cannot be blocked by the tree. And that's why she is a little bit far from me...I move around...but she is always there like the tree." - P7A (translating and explaining for P7B)

Besides flora selection and arrangement, some participants used *flora size*. In some cases, participants used it to convey personal significance. For example, P10B enlarged the photo message tree in the middle of her garden to signify it as a core memory, and P3B enlarged the previously mentioned blue star flower to make it stand out in his garden. Some participants, however, used flora size to try to trick their partner like P12B who explained, "I wanted him [P12A] to think that, oh, maybe the bigger flowers are the ones with the messages, you know?...that's why I was into it. So I wanted to make it as personalized as possible."

Location of Photo Messages Within the Garden

Some participants reported placing their photo messages in deliberate locations. Most participants who drew objects in their garden also placed photo messages within them. In some cases, some of these photo messages were thematically related to the objects. For example, P15A planted a photo of his and P15B's first badminton competition together within the badminton racket shape that he drew. P2A planted within her drawn heart shape a photo of a traditional Chinese dish *malatang* that she and her partner used to eat together to signify their shared love for the dish. P4A created a map of Korea and Japan, and within it, she placed photos in roughly the same location where they were taken in real life, and she planted a photo message in the middle between Korea and Japan as a way of saying that they would meet again one day somewhere in the middle.

Several participants used location as a means to control the narrative flow within their garden. For example, P2B created a maze and planted photo messages in a way that told the story of her relationship with her partner from the beginning to the present. At the beginning of the maze was a message commemorating their first meal together, and at the end was a message wishing her partner a merry Christmas and happy 2025. P10A also created a maze and planted photo messages in a similar story-telling manner. In her case, the order of photo messages was less chronological and more thematic. The first photo message carried a silly tone while subsequent photo messages became more heartfelt and sincere.

Written Messages & Photo Selection

Participants wrote a variety of messages for their partner, ranging from simple captions that described the photo to more personal messages that conveyed their thoughts and perspectives. Many participants reported that the latter conveyed more meaning than the picture itself, especially in cases where the they had already seen the image. P9B described it as such:

> You make the memory actually beautiful by adding the caption...it [is] more nostalgic compared to the images because the images I know–like, I have seen the images.

In addition to photos messages that were more nostalgic in nature, many participants planted other types of photo messages, including references to inside jokes, words of encouragement, as well as future-oriented messages. In describing one of her longer messages, P14B explained:

> We have a lot of goals for this next year, so I wanted to remind her that I am up to achieving those goals and just follow through our goals and ideals of keep improving. And so I wanted to make sure that she knows that I just hope for the best.

Even the photo selection was used to convey meaning. P8A mentioned that her photo selection was based on the theme of "first times." She selected photos that were taken during the first time she and her partner went to a certain place or the first time they did a certain activity together.

Although most participants did not have a specific theme in mind when selecting their photos, their partners still found it meaningful as it implicitly communicated which memories were personally important to them. P2B explained:

> When you're looking through the gallery, there's like hundreds of photos, but when making the Memory Garden, it's kind of like you select top 10 memory [sic], like the photos that create the best memories and deliver the message to the specific person.

This sentiment was also shared by P11B who said, "I think the photos that [P11A] chose is also for me to know what kind of memories that he appreciates."

5.2 Users Felt Strong Emotions from Crafting And Exploring

Participants experienced a range of strong emotions while crafting their garden and exploring their partner's garden, nostalgia being the most prominent but also feelings of engagement and excitement, emotional resonance, as well as embarrassment and guilt.

Nostalgia

Participants reported feeling nostalgic, particularly during the crafting phase. They mentioned that the act of going through and curating past photos made them feel nostalgic and that writing messages for each photo further intensified their nostalgia.

> When I crafted the garden, I had to look over all of my album and the process of looking [through] all the photos and the process of like choosing which photos to give to him as a present. And each photo reminded me of like each moment. And it was like what happened to us for the past two years. And while I was writing the message, I myself got so...emotional and very nostalgic. - P6A

Some participants, however, mentioned that nostalgia was not necessarily something that they enjoyed because it also carried feelings of sadness and longing. For example, P8B said, "Nostalgia comes whenever I see old photos, and usually I think I don't like that. Like it has a kind of a sad mood. So I usually don't go around old pictures." For others, nostalgia brought regret over missed opportunities to connect. P11B explained, "I also feel like, oh, should have contacted [P11A] more, should have like talked more with [P11A] as well."

Engagement & Excitement

Participants enjoyed crafting their gardens, appreciating the opportunity to experiment with designs and explore different flora. P11B enjoyed the creative process that came with crafting her garden, stating:

> I like to like draw or like create some things, but recently don't really have time. And I think creating this kind of gives me the opportunity to do like craft or create something like arts...But I think for me personally also exploring the different types of plant and how to navigate and it's, yeah, it's fun and I think it's cute.

P5B described how crafting helped him achieve a flow state, comparing it to programming:

> When you are focused on, you know, coding and everything and you're in the zone, you don't feel anything outside at that time. It feels like that...so it's kind of fun for me because it's [been] a long time since I've been feeling that.

During the exploration phase, participants experienced anticipation and excitement, especially when discovering unexpected photo messages in their partner's garden. P14A mentioned how she had felt excited when finding more messages than the expected five:

> I was expecting her to only do 5 as I did. But then when I went I think she did like 7 maybe or maybe 8 even. But I went around and then I was like I found the 6th and I was so excited. I was like, there's more and then I found another one and I was like, wow, there's so many.

P9B highlighted how exploring her partner's garden created a whirlwind of emotions from excitement to nostalgia:

> Because you are exploring, so your excitement is...high compared to your normal state. And then you found something...The excitement level increases and then you see the picture. So you go into the nostalgic memory and you read the caption. So you laugh or you cry or you smile, whatever be what is happening.

Emotionally Touched

One of the most common words that participants used to describe their emotion after seeing their partner's garden was the word "touched." Participants reported they felt this upon seeing the effort that their partner put into crafting the garden, particularly when it came to the messages that they wrote.

> When I opened the message, I also feel the effort that he put in. I think that's what I feel the most because especially knowing him, he is the type of person that hates writing messages, hates writing letters and stuff. So looking at him putting in effort, like choosing pictures and writing the message, I think it also touches me. - P15A

> When I get this garden from [P1B], it's like, wow, amazing. Like, she have to put much effort and time to make this kind of thing...Yeah, I can see her effort for me and it's really cute. Yeah, I'm impressed about that. - P2B

In some cases, both partners selected the same photos or photos of the same memory, which created a sense of emotional resonance and deep connection. Both P10A and P10B selected different photos from the same event and noted how it made them feel more emotionally connected in that moment.

> when I saw this picture, I was very excited. Like I also put the same, I uploaded the picture from the same moment in my memory garden. So it shows that that moment was valuable not only for me but also for her. So it was equally valuable for both of us. That moment. - P10A

> For me, it's a very touching moment because, like, to see her seeing it as a very core, memorable memory...and then like it matches mine, like, Oh my God. So we're actually living this moment together, you know. - P10B

Embarrassment & Guilt

While *Memory Garden* mostly evoked positive emotions, some participants experienced embarrassment and guilt when they felt their effort did not match their partner's. For example, P2A felt embarrassed about his garden's minimal design compared to his partner's, saying that he was not a very creative person. P9B admitted to only following the minimum guidelines during the crafting phase but mentioned feeling regret after seeing her partner's garden, saying, " When I saw [P9A]'s garden, I thought, "Oh no, I should be more creative. I should make some good looking view like the actual garden." P15A reflected on prioritizing aesthetics over meaningful messages and wished she had balanced her effort differently:

> My garden only had exactly 5 messages, but I wish I also put like after seeing [P15B]'s garden, I wish I put more emphasis on the messages instead of the garden because I think I was thinking more about like how to make the garden look pretty.

5.3 *Memory Garden* Facilitated Closer Connection...But Not For All

For many participants, *Memory Garden* fostered pro-emotional feelings, particularly when their partner's garden reflected significant effort. However, the act of crafting the garden alone often made participants feel closer to their partner, even before viewing their partner's garden.

> I got to have time to think about my partner, like what kind of message I should craft for my partner. And so all this process gives me time about the partner, which eventually makes me feel closer. – P5A

For some, like P6A, the process prompted reflection on their relationship. Revisiting photos from challenging times reminded her of their resilience and brought renewed optimism for their future together:

> It kind of made me think about the past, but also our future... Some pictures were about hard times, but we were still smiling. It reminded me that even in difficult moments, we could smile, and I believe we can do the same in the future. – P6A

However, participants in close, daily contact with their partners felt that *Memory Garden* had limited impact on their sense of connectedness. The participants who were living with their partners (P1, P3) said that it was virtually impossible for them to become closer to each other since they shared nearly every aspect of their daily lives together. P1A said, " If a friend sent this to me, it would make me feel much closer to them rather than my husband, 'cause we're already very, very close and share everything."

Similarly, P3A mentioned that "When you live together and communicate constantly, you can't feel closer."

5.4 Memory Garden Was More Expressive and Effortful Than Regular Photo-sharing

When asked how using *Memory Garden* compares to the normal ways that participants shared photos, participants compared *Memory Garden* to digital messaging platforms such as Instagram, Snapchat, and WhatsApp. Across these comparisons, participants highlighted several distinctive aspects of *Memory Garden*, particularly its 'cute' and appealing visual design, its ability to convey the sender's effort and thought, and its unique approach to viewing photos.

Participants mentioned that *Memory Garden* required more effort and creativity than other forms of photo-sharing because they were compelled to design a garden and write a direct message to their partner for each photo.

> I think it's also similar to Google Photos, but I think here it requires more like creativity and to put more effort into like creating something nice to the other person. It's a really nice way to communicate to the other person, not only like...to put some image there and that's all. Here you have to put like plants, like decide which one and to think where you can plant the plant, because in Google photo, even the the app create some collage for you, but you cannot edit those. So it's only like, OK, this one, that's all. But here you have to be creative. So yeah, I think that's the best part. - P13B

And this process of having to write out a message for each photo helped some participants to reflect more deeply about their memories, which in P2A's case, came with more nostalgic intensity.

> "By writing the message, it's kind of like, it's more reflective because you have to type it in the sentence. For me, the difference is the intensities. So the memory garden kinda give me the more intensities, more [feeling] when I see the photos." - P2A

P7A and P15B both compared *Memory Garden* to WhatsApp and said that the former allowed for better communication of feelings compared to the latter:

> So as I was making, I was kind of thinking more about what memories that we made together and also like how thankful am I to have her...Like if I just send a message on WhatsApp, it's just like, oh, I found this haha. That's like, I don't think that much. - P7A

> And comparing to WhatsApp. I mean, I, I do send pictures and stuff, but it's only... It doesn't really convey any feelings because sometimes we just like put one picture and then send it and then with it feels like a report sometimes for some occasion. So yeah, I think this really puts on the feeling more. - P15B

However, not all participants enjoyed the process involved. For example, P13A said, "It's really nice experience, but it's too, well, at least for me, it's like too much job to put the pictures there." Other participants found the process of writing personalized messages difficult or uncomfortable. P8A, who regularly communicates with friends and loved ones digitally said:

> "This, I don't think this was like that comfortable for me because it didn't really...I don't know. It was, it was not like I would write like super long messages. I just wrote like, you know, 'Hey, like remember this time or remember that time?' I don't think that even with other person or other pictures, I would be willing to write crazy long messages in this format."

Similarly, P8B mentioned that the effort of writing messages for each photo detracted from their enjoyment, saying "Doing my garden was not that fun...it was hard and making my message was also hard because my brain isn't that talkative."

When asked how they felt receiving the photos in *Memory Garden* versus how they would have felt receiving the photos through usual means, most participants said that receiving the photos in *Memory Garden* would feel more personally meaningful because they could not only see the effort that the sender expended in personalizing it, but also because they could get a better sense of the overall narrative being told through the photos, compared to digital messaging or emotional media.

> For me, I think it would be more special and personalized if it's in the memory garden because it feels like much effort is put in compared to only sending the photos through DM. And we can like compile many odd photos together, but...maybe it is harder to create a storyline if it's only through DM. But in memory garden it kind of help us to do the storytelling of the old photos. So I feel like if I receive it in the terms of memory garden, it's more special. - P5A

> I'll probably love it if someone sends something like this to me, I'll be like so touched because they will put much effort and then much, you know, importance in this, in the memories, rather than just sending it to like, you know, Kakaotalk or like Instagram or something like that. - P11A

Finally, participants described how the more involved nature of exploring the garden and looking for the photos in *Memory Garden* elevated the overall experience and gave them a personal feeling of fulfillment, not seen in other photo-sharing apps.

> My thought is that you have to do more things than Instagram. Like when you approach, you have to approach the photo and you have to open it and if it's in Instagram, it's instant...You can see just many photos just by scrolling very easily. That's what makes [*Memory Garden*] maybe more fun because you took more effort to see this photo. That makes you more...fulfilled or satisfied when you see the photo because you've done more than Instagram. - P8A

> Because I think in terms of like photos and videos, people can just like look at it very, very quickly. And the experience is just so fast and it's just very [wasted]. But I feel like if they use something like this, they can really like explore like 1 by 1. And I think it really elevates the whole experience - P15A

While most participants did enjoy the process of discovering the photos in their partner's garden, P12B expressed concerns about the potential for the experience to feel repetitive and stale over time, saying:

> "For my first experience, of course, it's been very enjoyable. But I can see it being kind of repetitive later in the long run if it just keeps being like this."

Chapter 6. Discussion

In this section, we reflect on our findings and discuss broader implications for digital interventions for mental well-being. We then discuss some limitations of our study and possible future directions for this work.

We set out to explore how features unique to digital systems such as video games could enhance the emotional impact and interpersonal connection of digital photo-sharing, and our findings showed that introducing game mechanics like cultivation and exploration can foster a sense of reminiscence and positively influence users' affective state and sense of connection with each other. Our findings also showed how users used flora and photo messages in various creative ways to express meaningful messages to each other. Our findings also revealed areas where systems like *Memory Garden* may fall short. While the open-ended design and emphasis on creative construction enabled users to express care and thoughtfulness—often leading to a strong sense of personal connection—this very flexibility could also pose challenges. Some participants felt pressure to design a visually pleasing garden, which could become a source of anxiety or even discourage participation, especially for those who lacked confidence in their design skills or were uncertain about how much effort to invest. In such cases, the open-endedness may inadvertently undermine the system's goal of facilitating emotional expression and shared reminiscence. Additionally, the exploratory nature of the experience, while generally enjoyable, sometimes led to frustration. In particular, recipients who expected a greater number of hidden photos reported feelings of confusion or disappointment when they could not find as many as anticipated. Because the system provided no explicit indication of how many messages were embedded, some participants mentioned how someone could spend a significant amount of time searching for content that may not exist. This mismatch between user expectations and system affordances points to a tension between surprise-based discovery and clear communication, which future designs must carefully balance.

6.1 Possible Directions for Future Works

6.1.1 Utilize Playful Elements that Encourage Exploration

The perception of effort plays a significant role in elevating the status of a digital object to something more personally meaningful—like a gift [22]. Previous research, such as Auggie [45], have demonstrated how systems could reduce procedural effort while increasing personal effort and touch through playful customizations like animation, 3D drawing, background music, and voice note.

Similarly, *Memory Garden* showed how customization options, particularly those centered around creating a navigable space, evoked positive emotions from the recipient. Participants often expressed feelings of curiosity, anticipation, and excitement as they explored the garden and uncovered the photos. The hidden nature of these photos transformed the passive nature of digital photo-viewing into one of playful discovery. Notably, some participants leveraged these playful elements to trick their partner and to introduce surprises, which added an additional layer of personalization and meaningful experience. The process of discovering the photos one-by-one rather than showing them all at once elevated the experience of photo-sharing and resulted in recipients feeling more appreciate of the effort that their partner invested into crafting the garden.

Building on these findings, we recommend future works incorporate playful mechanics that encourage active exploration and participation from the receiver. Possible ways that this can be achieved in a system similar to *Memory Garden* is by allowing senders to plant subtle audio clues that indicate a photo's location or embed puzzles or riddles tied to the photos, requiring recipients to solve these challenges to unlock the hidden content.

Such interactive playful mechanics could foster more engagement from the receiver and in turn, deepen their appreciation for the photos and the sender.

6.1.2 Support Expressive and Emotionally Resonant Messaging Through Scaffolding

One of the challenges participants reported during their experience with *Memory Garden* was writing messages for each photo. While we initially envisioned long, heartfelt messages to accompany each photo, we observed that most participants wrote brief captions, with the notable exceptions being P10A and P6A. Despite their brevity, recipients mentioned such messages added significant meaning to the photos, and that they appreciated the emotional intent and effort behind them.

This finding underscores the meaningful potential of personalized messages but also highlights the difficulty users face when articulating emotions in writing. To address this, we recommend integrating scaffolding mechanisms to ease the message-writing process while enhancing the expressiveness of users' words. Writing prompts, for example, can guide users by suggesting themes or specific questions (e.g., "What kind of memory does this photo represent to you?" or "What was your partner doing during this time?").

Moreover, we propose leveraging Large Language Models (LLMs) to assist users in crafting messages. LLMs have demonstrated the ability to enhance writing quality and creativity [4, 10], and their integration into systems like *Memory Garden* could serve multiple purposes:

- Conversational Agents: a conversational agent could be employed to help users articulate their thoughts on a deeper level. By transforming the daunting task of writing from scratch into a dialogic experience, users could potentially create more meaningful and emotionally impactful messages for their intended recipient.
- Enhanced Creativity and Personalization: LLMs can inspire users to explore creative expressions, such as poetic forms, metaphorical language, or tailored themes, which could elevate the aesthetic and emotional appeal of the garden and showcase the sender's effort and thoughtfulness.
- Fostering Pro-Social Sentiment: The process of engaging with a conversational agent could itself encourage gratitude and reflection on the sender's part, allowing them to connect more deeply with their own feelings and memories while composing messages.

By reducing the cognitive load of writing and empowering users to express themselves more effectively, these scaffolding tools could deepen the emotional resonance for both the sender and the receiver.

6.1.3 Introduce Co-creation to Enhance Social Bonding

Before the ubiquity of digital cameras and online photo albums, co-creating photo collections was a common social activity among families and close-knit groups [9]. Such shared endeavors created opportunities for storytelling, reminiscing, and relationship building. Digital systems have the unique

potential to recreate and upon expand these dynamics as they are unrestricted by physical location or synchronous collaboration.

In the case of *Memory Garden*, we had initially aimed to develop a real-time multiplayer system, allowing users to plant photo messages collaboratively within the same virtual garden. Due to time and resource constraints, however, this feature was excluded from the current study. However, we believe this co-creative affordance remains one of the most significant advantages digital interfaces can offer over physical ones.

Many participants mentioned how receiving a garden from their partner felt like a gift. In traditional gift-giving, the gift is typically given once in a single act of exchange. However, in digital systems like *Memory Garden*, there is potential to turn a one-time gift into a shared object that can organically grow as both the sender and receiver add to more content to it. This continuous interaction not only keeps the digital gift from becoming buried out of sight but also transforms it into a dynamic artifact that grows over time with the relationship.

Despite its potential, the impact of co-creation in digital gifting remains relatively unexplored. While previous game research has examined co-creation in a game settings [3, 12, 35], relatively little work has focused specifically on co-creating through digital gifts. Future studies could investigate how real-time or asynchronous co-creation within digital gifting systems affects emotional connection, mutual appreciation, and overall relationship satisfaction.

6.2 Limitations

This study has several limitations worth noting. First, the system implementation of *Memory Garden* was restricted to a desktop-centric web application with keyboard-based interactions for moving, planting, and removing flora. While functional, several participants said they would have preferred a mobile application, since many of their photos reside on their phones. Second, the data analysis was conducted solely by the first author, who also developed the system and conducted the interviews. This overlap may have introduced bias, potentially skewing findings toward positive aspects of the system. Collaborative analysis involving multiple researchers could have enhanced rigor and reduced individual bias. Third, the participant sample was limited and imbalanced, with a predominantly female group and no male-male pairs, potentially excluding critical perspectives, including the influence of gender dynamics on nostalgic photo-sharing. The age range (22–37 years) also excluded teenagers and older adults, limiting the generalizability of the findings to primarily young adults. Finally, the user study was conducted over a two-week period, and participants were only tasked to create and share a single garden with at least five photos. This meant that we only observed the effects from the initial exchange of photos.

Future research should address these limitations by implementing a mobile-compatible version of *Memory Garden* to align with users' preferences and photo management habits. Employing a more diverse and representative participant pool, including varied genders and age groups, could offer richer insights and broader applicability. Additionally, involving multiple researchers in the analysis process would improve methodological rigor, ensuring a balanced interpretation of participant experiences and mitigating potential bias. Finally, a longitudinal study could reveal richer insights into how cozy game mechanics could influence user's affective states and interpersonal relationships over the long term.

Chapter 7. Conclusion

In this paper, we presented *Memory Garden*, a system designed to . Through an exploratory study involving 15 pairs (30 participants), we investigated how *Memory Garden* influenced users' affective states, sense of reminiscence and personal connection to their partner.

Our findings indicate that *Memory Garden*'s cultivation and exploration game mechanics coupled with its cozy game-inspired aesthetic enhanced users' engagement with their digital memories, evoking positive affective states beyond nostalgia, including excitement and reflectiveness. Even with a basic selection of flora and customization affordances, photo sharers were able to create and customize their gardens in ways that their partners found personally meaningful. However, some participants reported feelings of self-consciousness or embarrassment, especially when seeing the mismatch in effort in their gardens, highlighting the importance of balancing aesthetic expression with emotional sensitivity in system design.

Our findings extend the literature on introducing game elements for supporting mental well-being and it illustrates how playful interactions inspired by video games and applied to daily activities such as photo-sharing could enhance our personal connections and mental well-being.

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