

‘You have a new memory’: Uses and Gratifications of Automated Photo Memory Notifications in Smartphones

U&G of Automated Photo Memory Notifications

This is the subtitle of the paper, this document both explains and embodies the submission format for authors using Word

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Automated photo memory notification (APMN) and memory suggestions curated by the gallery of the smartphone serve as reminders of past events, experiences, and personal connections, often eliciting a range of emotional responses. By employing a mixed-methods approach, this study aims to investigate the uses and gratifications users derive from APMNs of automated photo curated by the digital photo applications in smartphones. In addition, the study also explores the behavioral and psychological effects of APMNs. Using the qualitative study, we identified 7 gratifications namely, nostalgia, convenience, user control, social interaction, entertainment, escapism, and reflection. It was observed that social interaction gratification was a significant predictor of engagement with these APMNs. The content of the APMNs acted as points of conversation with friends and family, allowing users to maintain their social relationships. This gratification drives users to make future plans with friends and family, take more photos and share photos previously unshared. This study contributes to the HCI literature by adding to the uses and gratification theory and by providing design recommendations for AI managed photo gallery applications.

CCS CONCEPTS • **Human Centered Computing** ~ Human Computer Interaction (HCI) ~ Empirical Studies in HCI

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1 INTRODUCTION

Personal photo collections are an intimate collection of personal memories and serve the purpose of storing camera-captured memories [1]. From the days of analogue photography, captured photographs have been viewed as unique, irreplaceable cherished objects. By externalizing memories of events, people and experiences, photo collections serve as prosthetic memory devices [2] or mnemonic aids [3] that outsource the memory capacity of humans.

As new-age smartphones bring in better cameras with larger and affordable digital storage spaces, the number of pictures people capture has increased multi-fold. An average personal photo collection in the smartphone contains thousands of pictures spanning over years making it unmanageable [4; 5]. In addition to the pictures taken with an intention to be shared on social media, personal photo collections house photos that are not sorted (curated), looked at (retrieved) or interacted with in any way. Galleries house screenshots, WhatsApp forwards, and a treasure trove of other photos that are not curated or processed for sharing. Unmanageably large photo collections hinder the function of smartphones as a prosthetic memory device as activities surrounding the organization, preparation, and retrieval of photos, termed 'photowork' [6], become increasingly difficult. Sometimes the size of collection that is unattended makes people anxious and guilty for leaving them unorganized [7]. Organizing these large personal photo collections, as an attempt to organize one's past, is a time-consuming process and involves agonizing decisions about what to keep and what to throw away [3].

In such a context, people tend to rely on the use of modern artificial intelligence (AI)-based methods, that allow for automatic photo curation and retrieval, to manage this problem [7]. Lee (2020) describes Google Photos' capacity to automatically identify and sort photos into albums based on complex multi-layered algorithmic and machine learning processes. Algorithmic and automatic retrieval has been introduced to provide throwbacks to "memories" through photo platforms with system notifications like: "Your memories are waiting" [2]. As of 2019, a billion users were using Google Photos [8]. This quick success of Google Photos was largely due to the pivot made to solve the problem photo management than photo sharing. The photo app focused on "helping people preserve, organize, and enjoy their own images, and only secondarily about sharing them with others" by using AI [8]. As media technology evolves, new gratifications emerge from a wide range of affordances that influence the psychological aspects of user interaction with media. U&G 3.0 unveils specific gratifications such as convenience, user control, and user profiling, which are derived from the utilization of automated features [9]. By automating this process these apps are not only managing but also proactively retrieving photos for its users. Looking at the sheer number of people who are engaging in using these automated photo memory applications, it stimulates interest and necessitates enquiry into the uses and gratifications of these applications for the users.

This research studies how the APMNs are being used and what gratifications users derive out of them. This feature can provide important gratifications for users who are probably drowning in photos they have taken on their smartphones. The business model surrounding Google Photos focuses on selling additional storage for increasing album size and printed photo books to users and not on ad generated revenue [8]. But understanding the uses and gratifications of the automatic curation and retrieval of photos can help identify other ways to improve the app feature, attract users, improve engagement and other behavioral outcomes.

In the context of the increasingly digital and interconnected world we live in, the uses and gratifications theory [10] remain highly relevant, as it provides a valuable lens through which we can understand the motivations and needs that drive the adoption and use of new media technologies and platforms. One such example is the growing popularity of APMNs, a feature that has become a staple of many social media platforms and photo storage applications. These notifications serve to remind users of past events, experiences, and social connections by surfacing photos and other visual content from their digital archives, often with the aim of evoking nostalgia and fostering a sense of continuity in users'

digital lives. For the purposes of our research, we primarily focus on the traditional U&G framework and the advancements introduced in U&G 3.0.

1.1 Psychological Benefits

Photographs are objects that mediate the relationship between individuals and their past and constitute a person's identity. Photos act as scaffolds for autobiographical (or personal) memory to establish a personal identity by maintaining a sense of continuity over time, establishing the notion that one remains the same person throughout the past, present, and future [3]. Moreover, memories of past personal events can direct our present and future actions making photos act as a tool for self-growth and well-being [13]. Lastly, by forming memories of adverse or stressful experiences and incorporating them into a broader context, autobiographical memory assists in managing and resolving negative emotions. Even viewing generic photos can influence, positively and negatively, how one judges their past personal memories or predicts future events by biasing and distorting autobiographical memories [11]. This cognitively important act of remembering the past is currently automated wherein photo contents of personal memories are selected by an algorithm and people are notified as and when a memory suggestion is ready. Recent algorithmic affordances have attempted to support both curation and retrieval activities. In general, curation activities predict successful photograph retrieval in the future [12] and serendipitous retrieval has been associated with further spontaneous photo browsing [5]. These human activities of curation and serendipitous photo browsing are slowly being replaced by automated prompts that proactively share our past that is AI curated. In addition to studying the uses and gratification, this study analyses the psychological outcomes associated with autobiographical memories and the automation of the human activity of remembering and reminiscing on one's past. It is for these reasons that understanding how the everyday use of APMNs and how it contributes to psychological benefits.

1.2 Research Questions

In this paper, we present comprehensive research on the uses and gratifications of APMNs received on our smartphones, either through applications such as Google Photos, Apple Photos or the built-in gallery app. We take a traditional approach to U&G study to assess the content-oriented gratifications derived from these photo memories. We also take a U&G 3.0 [13] approach to understand the automation gratifications associated with automatic curation and retrieval of photo memories. The research questions are given below:

RQ1: What gratifications do individuals seek when interacting with APMNs?

RQ2: How do these gratifications influence people's engagement with the APMNs and other behavior outcomes?

RQ3: How do these gratifications influence people psychologically and overall well-being?

2 METHODOLOGY

Following the literature on U&G research, we employed a mixed method approach [14] to answer the research questions, starting with interviewing participants who were aware of and have received APMNs on their phones. To learn more about people's typical photo viewing and photo-taking habits, as well as their experiences with automatically created photo memories and notification, open-ended interviews were conducted. A particular focus was placed on discovering the gratifications and uses of automatically curated photo notifications and memories. Survey items were created using gratifications identified from interviews and those already described in earlier U&G literature. Finally, a quantitative investigation, or survey, was carried out to verify the gratifications found and investigate their effects. Institutional ethical approval (IRB) was obtained prior to data collection.

2.1 Study 1: Qualitative Study

2.1.1 Participants.

Participants for the qualitative study were recruited using purposive sampling method. Interviews were conducted with participants meeting the criteria i) age 18 years and above, ii) own a smartphone and iii) receive APMNs. This study had 7 participants who self-identified as Asian (Female= 6, Male= 1, Mean age=28.86 years). Five participants reported using Apple phone (iOS) and two used Android Phone.

2.1.2 Procedure.

Interviews were conducted in person or online via zoom as per the participant's convenience and location. The interviews lasted between 35 minutes to 1 hour. After obtaining consent from the participants, all interviews were recorded and transcribed. To understand the participants' experiences with APMNs, a semi-structured interview protocol was designed using the following structure: We started the interview with a section on demographic information, in the next section we asked the participants about their photo taking, viewing, and managing behavior over the phone. The next set of questions focused on how people felt, thought, and behaved after receiving photo memory notifications and memory suggestions. Participants were then asked to provide 5 words for both benefits and what they liked best about the APMNs and suggestions. Finally, we investigated how participants perceived their level of control over these notifications. Participants were also requested to provide any further special insights or intriguing comments concerning the APMNs as closing remarks.

2.1.3 Results.

The data was analyzed using the principles of thematic analysis [15]. Three researchers coded and evaluated the interview data to better understand the usage pattern, gratifications, sense of control and consequences (behavioral and psychological) of using APMNs. Data were analyzed to validate gratifications identified in previous literature like nostalgia, user control, convenience [9] and to create measurement items to pinpoint the gratifications specific to APMNs that support its usage. We focused on both those that came up most frequently and those that were only sometimes mentioned in the interview to ensure an exhaustive examination. Data also offered intriguing new perspectives on the folk theories of the participants about the APMNs and their underlying mechanism (not reported in this study).

2.2 Study 2: Survey

Participants for the survey were recruited on Cloud Research's cloud connect platform and were reimbursed through the platform upon survey completion. To check if the participants meet the inclusion criteria, they were asked to indicate (by clicking yes or no) if they were 18 years or older in age, they owned a smartphone and received APMNs on their phones. An image of photo memory notifications from Android and iOS phone was provided for participant's reference to avoid any misunderstanding. If the participants clicked yes to all three conditions, they were directed towards the consent page and upon responding 'No' to any of the three inclusion questions they were unable to continue further. Out of 100 participants only 84 met the inclusion criteria and finished the survey. Two participants (outliers) were removed leaving 82 participants (mean age=35.5, male= 44, female= 40). The survey included items on demographic information like age, gender, ethnicity. Participants were asked to respond to items on different gratifications, desirability of control, behavioral and psychological effects, and folk theories on Likert scale. Participants were also provided with the opportunity to provide open-ended responses for a few items like feelings while watching photo memories and ideas about how photo memories

work. In addition, one attention check question was added to check the attentiveness of the participants. The average completion time for the complete survey was 35 to 60 minutes.

2.2.1 Measurement Item Generation.

Each of the three researchers engaged in the process of identifying and categorizing the gratifications from the interviews conducted by them. Items identified by each researcher then validated after discussion with the other two researchers. The original measuring items list contained 71 items. The items were subsequently narrowed down to 23 after iterative talks and consensus among the researchers that some items may be meaningfully combined because they were expressing extremely similar concepts. Additionally, the researchers incorporated these items into existing measures of gratifications to make those measures more relevant to the current study. Nostalgia appeared repeatedly in all the interviews therefore a pre-existing scale was used to measure nostalgia without any modifications. The measures of all the gratifications, uses, behavioral, and psychological effects are listed in Appendix A.

2.2.2 Data Analysis.

Multiple regression analysis was used to identify the gratifications that predict participants' engagement with APMNs and the different behavioral outcomes of using APMNs. The discriminant validity of each of the gratifications was tested to ensure that all the factors were distinct and uncorrelated with each other. Structural equation modeling was used to calculate the factor loadings for each of the items and the average variance extracted (AVE) was calculated. The square root of the AVE score of each variable was compared with its correlations with each of the other variables to identify the factors to be included in the analysis. Age, gender, OS and photo interaction tendency score were included as control variables.

The psychological effects of reflection and user control gratifications were analyzed using multiple regression analysis while controlling for age, gender, OS, frequency of APMNs and the duration of usage of APMNs.

3 RESULTS

3.1 Descriptive Statistics

The means and standard deviations of the gratification variables, the dependent behavioral and psychological variables and the individual difference variable are given in Table C1 in appendix C. The AVE scores for the gratification variables are also listed in Table C1 in appendix C. Comparing the positive square root of the AVE score for each of the gratification with its correlation with the other gratifications (for the factor loadings and correlations see Table C2 and Table C3 in Appendix C), it was decided that convenience, user control, social interaction, entertainment, and reflection can be included together in the multiple regression analysis. Escapism was ignored from the analysis as the AVE score could not be calculated for a 2-item measure. Nostalgia's AVE score (0.5) was less than expected and was also excluded from the analysis for the behavioral outcome. However, the effect of nostalgia on the psychological outcomes was explored.

3.2 Inferential Statistics

RQ2 sought to understand which of the identified gratifications predict the four different behavioral outcomes identified in user interviews. The results of the analysis are given below. The independent variables are convenience, user control, social interaction, entertainment, and reflection. It was controlled for age, gender, OS and photo engagement tendency score.

3.2.1 Make future plans with friends and family.

The analysis showed that social interaction was a significant predictor of this behavioral outcome of making future plans with friends or family ($b = 0.47, p = 0.0024$). Other gratifications (convenience, user control, entertainment, and reflection) and the control variables (age, gender, OS and photo engagement tendency) did not predict this behavior outcome.

3.2.2 Improve how one takes photos.

The analysis showed that none of the considered gratifications (convenience, user control, social interaction, entertainment, and reflection) significantly predicted the behavioral outcome of improving how one takes photos. Among the control variables, age, gender, OS did not relate to this behavior outcome significantly. However, individual's tendency to engage with photos in general (photo engagement tendency) significantly predicted whether one improves how they take photos ($b = 0.47, p = 0.0199$).

3.2.3 Take more photos.

Among the gratifications analyzed, the analysis showed that only social interaction significantly predicted the behavior of taking more photos due to APMNs ($b = 0.37, p = 0.0239$). Among the control variables, age ($b = -0.45, p = 0.0022$) and photo engagement tendency ($b = 0.55, p = 0.0050$) significantly predicted this behavior outcome where age is negatively correlated.

3.2.4 Share initially unshared photos.

Convenience ($b = 0.30, p = 0.0477$), social interaction ($b = 0.66, p = 0.0002$) and reflection ($b = -0.44, p = 0.0322$) significantly predicted whether users shared the photos that they did not initially share where reflection is negatively correlated. User control and entertainment did not predict this behavior. Among the control variables, age, gender, OS did not relate to this behavior outcome significantly. However, photo engagement tendency significantly predicted if one reshared their previously unshared photos ($b = 0.68, p = 0.0010$).

3.2.5 Engagement with APMNs.

Social interaction ($b = 0.23, p = 0.0032$) and entertainment ($b = 0.19, p = 0.0389$) gratifications significantly predicted users' engagement with APMNs. Convenience, user control and reflection did not predict this behavior. Among the control variables, age, gender, OS did not relate to this behavior outcome significantly. However, photo engagement tendency ($b = 0.40, p < 0.0001$) significantly predicted whether one engages with the APMNs.

RQ3 sought to understand if reflection and user control gratifications predict the psychological outcomes of sense of self-continuity and self-acceptance. The results of the analysis are given below. Age, gender, OS, frequency of APMNs and the duration of usage of APMNs were controlled for in the analysis.

Both reflection ($b = 0.50, p < 0.0001$) and user control ($b = 0.31, p = 0.0002$) significantly predicted self-continuity as a psychological outcome of using and engaging with APMNs. None of the control variables (age, gender, OS, frequency of APMNs and the duration of usage of APMNs) had an effect.

Reflection ($b = 0.53, p < 0.0001$) and user control ($b = 0.22, p = 0.0300$) significantly predicted self-acceptance as a psychological outcome. None of the control variables (age, gender, OS, frequency of APMNs and the duration of usage of APMNs) had an effect.

3.2.6 Exploratory analysis.

Multiple regression analysis showed that nostalgia significantly predicted self-continuity ($b = 0.50, p < 0.0001$) and self-acceptance ($b = 0.53, p < 0.0001$). None of the control variables (age, gender, OS, frequency of APMNs and the duration of usage of APMNs) had an effect.

4 DISCUSSION

The goal of the present study was to understand the uses and gratifications of APMNs, and memory suggestions curated by the gallery of the smartphone. In addition, the researchers were interested in understanding the behavioral and psychological effects of these APMNs. Using the qualitative study, we identified 7 gratifications namely, nostalgia, convenience, user control, social interaction, entertainment, escapism and reflection. We were also interested in understanding the relationship between the identified gratifications with the engagement with APMNs and the behavioral effects. It was observed that social interaction gratification was a significant predictor of engagement with these photo memory notifications. The content of the photo memories notifications acted as points of conversation with friends and family near and far allowing users to maintain their social relationships. This gratification drives users to make plans with friends and family to meet and recreate memories, take more photos and share photos previously unshared.

It was observed that people who generally take, share, and curate photos (photo engagement tendency) are more likely to engage with the APMNs. This could be because these memory suggestions could be seen as a novel way to engage with one's personal photos in addition to the existing photo activities. Such users tend to take more photos and learn to improve how they take photos by viewing them via APMNs. These types of users generally share their photos more and new curations of memories provide them with novel content to be shared with friends and family.

Users experienced convenience when using the PMNs when it comes to sharing previously unshared pictures. They found these new types of curations and automatic retrievals as a convenient way to revisit their past in a novel way and reassess the photos to be shared. They also saw APMNs are reducing their time and effort when it comes to sorting and categorizing personal photos which could help in sharing well-organized photos/albums to friends and family. However, people who tend to experience reflection gratification shared photos relatively less than those who did not. This could be because people who revisit their old photos because they liked to keep their reflections personal, or they could be overthinking, over analyzing the photo contents and end up not sharing their old photos. This hints at how APMNs could facilitate unhealthy rumination in some users.

Both automation gratification (user control) and content gratification (reflection) of APMNs contributed positively to the sense of self-continuity and self-acceptance experienced by the users. These are important dimensions of overall psychological well-being. User control gratification measured the importance of having control over the automatic curation and retrieval of personal photo memories. People who did not find it important to control this feature experienced low levels of self-continuity with the past and acceptance of one's attributes. Having a sense of mastery and competence in interacting with the environment (environmental mastery) is one of the 6 core dimension of psychological well-being (PWB) according to Ryff,'s (1989) PWB model. In this study, users who realized the importance of controlling the PMNs had better psychological outcomes. Similarly, reflecting on how one has changed over time, past achievements and social interactions leads to a better sense of coherence with the past and acceptance of oneself.

4.1 Theoretical Implications

Having observed that automation and content gratification together contribute to dimensions of wellbeing. It can be inferred that there is a trade-off between human and machine agency when it comes to remembering one's past via photos. Remembering and reflecting has long been a human task and it is guided by one's own experience. Consciously and

unconsciously remembering and forgetting one's past is a coping mechanism and a major contributor to one's well-being and now this task is taken over by the machine. What, when and how of revisiting one's past is determined by the machine, at least for people who use the APMNs from their personal unsorted gallery. This study found largely positive emotions associated with APMNs with only a rare few finding this feature annoying or inducing depressive feelings. The long-term theoretical implications of this introduction of machine agency in the human processing of past needs to be further studied. The study found the role of APMNs in fostering social connections and communication, as people might be more likely to share and discuss memories with friends and family members.

4.2 Design Implications

Designers could provide users with the option to personalize and customize their photo memory notifications. This might include selecting the frequency of notifications, the types of memories to be displayed, and the preferred time of day for receiving notifications. Further, designers could facilitate social interaction around APMNs by providing easy-to-use sharing features, allowing users to share their memories with friends and family and engage in conversations about the past. Finally, using AI technology we can analyze the user's engagement patterns with notifications to determine the most convenient time for delivering tailored notifications that match each user's preferences.

4.3 Limitations & Future Work

When interpreting the results, it is important to consider the limitations of the current study. The homogeneity of the sample employed in Study 1 is one such restriction. Due to the sample's similar demographic makeup, which included university students, the range of replies may have been limited and the spectrum of experiences may not have been fully represented. Additionally, the small sample sizes for Study 1 and 2 may limit the generalizability of the results to wider populations. Another limitation of the study is that it only included participants who received APMNs, excluding those who had turned them off and therefore had more user control. The absence of this group may have limited the generalizability of the findings since people who have more control over their notifications may have different experiences, ideas, and reactions to APMNs. As a result, the study may not fully capture the range of gratifications experienced by users in relation to these notifications. Further, the measure of escapism used in the study only consisted of two items, which may not have been sufficient to fully capture the complexity of the construct. Therefore, this measure did not yield itself for further analysis. Finally, the measure of nostalgia used in the study had 13 items, which may have been too long for participants to recall the stem for each item. This could have potentially impacted the discriminant validity of the measure. Future work will address the sample and measurement limitations of the present study.

5 CONCLUSION

The emergence of photo memory notifications and their ability to remind us of past events brings forth intriguing questions about the impact on our daily lives and emotional states. Identifying the uses and gratifications people obtain from these photo memory notifications, we uncovered insights into the factors that contribute to user engagement, satisfaction, and psychological effects. Furthermore, our findings can potentially assist app developers and smartphone manufacturers in designing more user-centric experiences, ultimately enhancing satisfaction and well-being for their users. In conclusion, investigating the uses and gratifications of photo memory notifications allows us to achieve a more profound understanding of how these reminiscences of the past affect our lives.

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A APPENDICES

A.1 Measures of Questionnaire Study 2

Through study 1, we identified the gratifications that were treated as the independent variables for study 2 and measured through following measures/scales.

Nostalgia was measured using the modified version of the Nostalgia Inventory adapted from Batcho (1995). The scale comprised of 14 items ($M = 4.02$, $SD = 1.03$, Cronbach’s $\alpha = 0.87$), to understand what people miss about their past and was rated on a 6-point Likert scale from 1 (I did not miss this aspect of my life at all) to 6 (I miss this aspect of my life a lot).

Convenience was measured using the modified version of convenience subscale developed by Chen, Lee & Sundar (2023) which reflects how gratifying it is for users when automated features work on their behalf. The scale consisted of 5 items ($M = 3.87$, $SD = 1.027$, Cronbach’s $\alpha = 0.85$) and were rated on a 6-point Likert scale from 1 (not important at all) to 6 (very important).

User Control was measured using the modified version of convenience subscale developed by Chen, Lee & Sundar (2023) suggesting the gratification that comes from having control over photo memory notifications and photo suggestions. The scale consisted of 5 items ($M = 4.30$, $SD = 1.08$, Cronbach’s $\alpha = 0.80$) and were rated on a 6-point Likert scale from 1 (not important at all) to 6 (very important).

Reflection was measured using the adapted version of the scale used by Bentvelzen et al. (2021). The measure consisted of 4 items ($M = 4.61$, $SD = 1.05$, Cronbach's $\alpha = 0.78$), and it was rated using a 6-point Likert scale from 1 (strongly disagree) to 6 (strongly agree).

The following 3 gratifications were measured using the adapted version of the scales used by Palmgreen & Rayburn (1979). They were measured using a 6-point Likert scale from 1 (strongly disagree) to 6 (strongly agree).

Social interaction measure consisted of 4 items ($M = 4.05$, $SD = 1.41$, Cronbach's $\alpha = 0.94$) reflecting the gratification of interacting with friends and family to discuss photo memories.

Entertainment measure consisted of 3 ($M = 4.24$, $SD = 1.07$, Cronbach's $\alpha = 0.75$) items reflecting the gratification of entertainment upon receiving and viewing APMNs.

Escapism measure consisted of 2 items ($M = 4.21$, $SD = 1.31$) reflecting the feeling of momentary escape from the stresses of current life upon receiving and viewing APMNs.

The behavioral and psychological outcomes measured through (self-continuity and self-acceptance) are the dependent variables studied.

Behavioral Effect. Participants were asked to indicate on a scale of 0-5 (0=Never to 5=All the time) how often they encountered the following situations when using photo memory suggestions: "The memory suggestions lead me to make plans for the future with my friends/family to recreate past moments", "I improve how I take photos after looking at my old photos from photo memories", "I find myself taking more photos because of these memory suggestions" and "I share the photos I did not share when I initially took the photo".

Engagement with APMNs were measured using 10 items on a scale of 0-5 where 0 indicated never engaging with the APMNs and 5 indicated engaging with the APMNs all the time. The items included questions on how quickly one would open the APMNs, how much one would ignore it, how much they share the contents of an APMN and how much they would save the suggested memories.

Self-continuity was measured using the adapted version of the scale used by Sedikides et al. (2014). It consisted of 4 items measured on a 6-point Likert scale from 1 (strongly disagree) to 6 (strongly agree).

Self-acceptance was measured using the adapted version of the scale by Ryff (1996). It consisted of 4 items measured on a 6-point Likert scale from 1 (strongly disagree) to 6 (strongly agree).

In addition to the age, gender and the OS of the participants, we also controlled for people's tendency to engage in photo taking, photo sharing and photo curation activities (photo engagement tendency) which was measured using 10 items on a scale of 1 to 6 where 1 indicates 'the statement does not apply to me at all' and 6 indicates 'statement always applies to me'.

A.2 Interview questions of study 1

Demographics

1. What is the highest level of school you have completed or the highest degree you have received?
2. What is your ethnicity? Please choose all categories that apply.
3. What is your gender?
4. What is your age? (open-ended)
5. Occupation (open-ended)

Smartphone + Photo Gallery related questions:

1. How long have you been using your smartphone? (Please specify answer in YEARS)
2. What is the operating system of your phone?

3. What photo gallery apps do you use?
4. How many photos do you have on your smartphone currently? (Check your gallery to see how many photos are stored in your 'camera' album)

Memory Notifications related questions:

1. Is there any other term you use to refer to or heard someone else referring to these notifications?
2. Do you have 'memory notifications' set up on your photo/gallery app(s)?
3. How often do you receive memory notifications on your phone?
4. When was the last time you remember receiving a memory notification?
5. Identify the types of memory notifications you have received- how are they usually named/categorized?
6. What kinds of memories do the notifications typically remind you of?
7. What do you typically do when you receive a memory notification? Do you interact with it in any way?

Photo use related questions:

1. How frequently do you use your mobile device to take photos?
2. How often do you open your photo/gallery app(s) to find or to look at photos?
3. Do you like sharing your photos with my friends/family or on social media?
4. How much time do you typically spend managing, organizing, and editing your photos on your mobile device?
Sorting albums/adding to favorites/adding tags/deleting photos/ editing/create collages.

Gratifications (+ves and -ves)

1. Can you describe how you feel when you receive a memory notification?
2. What is the first thing that comes to your mind when you think about what you enjoy most when viewing/using photo memories notified by your phone?
3. What 5 words describe what you enjoy about viewing/using photo memories notified by your phone?
4. Do memory notifications ever evoke negative emotions for you? If so, can you describe those experiences?
5. Do you feel like memory notifications impact your overall well-being? How so?
6. How do you think your phone's memory notifications influence your thoughts or feelings?
7. Are there any specific benefits you receive from receiving memory notifications?

Uses

1. What purposes do you think memory notifications serve for you?
2. Using single, easy-to-understand terms, what do you use photo memory notifications for?
3. What uses of photo memory notifications are most important to you?
4. How do you think your phone's memory notifications influence your behaviors? Behavior we mean photo sharing, photo curating, photo taking)

Agency

1. How important is it for you to manually manage, organize, edit your photos on your smartphone?
2. Do you feel like you have control over when and how you receive memory notifications on your phone?
3. How do you feel about the fact that your phone sends you memory notifications without you actively seeking them out?
4. Have you ever taken steps to modify or disable the memory notifications on your phone? If so, can you describe why?

Wrap-Up Questions

1. Is there anything else you'd like to add about your experience with memory notifications on your phone?

2. Is there anything I didn't ask about that you think is important to mention?

A.3 Questionnaire for study 2

Demographics

1. How old are you?
2. What is your gender?
3. What is your ethnicity? Please choose all categories that apply.
4. What is the operating system of your smartphone?
5. How old is your current smartphone?
6. What photo/gallery app(s) do you use? (Select all that apply)
 - a) Apple Photos
 - b) Google Photos
 - c) OneDrive
 - d) Default gallery app on my smartphone
 - e) Others _____
 - f) I don't use any photo gallery apps.
7. Do you store your photos in cloud storage?
8. How many photos do you have on your smartphone currently? (You can check your gallery to see how many photos are stored in your 'camera' album)

Individual Differences: Photo behavior.

Please indicate on a scale of 1-6 to what extent the following statements apply to you.

1=The statement does not apply to me at all, 6=The statement always applies to me.

1. I like to take a lot of photos with my smartphone.
2. It is important for me to take photos often.
3. I take a lot of photos/videos.
4. I click photos all the time.
5. I click photos only during important events.
6. In a social group, everyone expects me to take a lot of photos of to record the event.
7. It is important to personally sort/tag/favorite/delete my photos on my smartphone.
8. I like scrolling through my photos on my smartphone.
9. I like sharing a lot of photos with my friends/family or on social media.
10. It is important to share my photos with my friends/family or on social media.
- 11.

Desirability for control

Please indicate on a scale of 1-6 to what extent the following statements apply to you.

1=The statement does not apply to me at all, 6=The statement always applies to me.

1. I prefer a job where I have a lot of control over what I do and when I do it.
2. I try to avoid situations where someone else tells me what to do.
3. I would prefer to be a leader than a follower.
4. I enjoy making my own decisions.

5. I enjoy having control over my own destiny.
6. I like to get a good idea of what a job is all about before I begin.
7. I prefer to avoid situations where someone else has to tell me what it is I should be doing.
8. There are many situations in which I would prefer only one choice rather than having to make a decision.
9. I like to wait and see if someone else is going to solve a problem so that I don't have to be bothered by it.

Photo memory notifications

Note: Throughout this survey, we will refer to these types of notifications (shown below) that fetch your old photos or videos as photo memory notifications or photo memory suggestions interchangeably.

1. How frequently do you receive photo memory notifications from your photo gallery apps?
 - a) Everyday
 - b) Everyday more than once
 - c) Once a week
 - d) More than once a week
 - e) Once a month
 - f) More than once a month
 - g) Not sure
2. How many months/years have you been receiving memory notifications from your photo gallery apps?
 - a) Less than 6 months
 - b) 6 months – 1 year
 - c) 1 – 3 years
 - d) 3 – 5 years
 - e) 5 years and above
3. Identify the type of memory notifications you have received. (Select all that apply)
 - a) N year(s) ago today
 - b) Themed memories with different titles. (e.g., Sand and Sea, Trip to NYC, In the woods, Sunrise)
 - c) A new memory is ready for you.
 - d) Others _____
4. Have you ever manually adjusted your photo memory notification settings?
 - a) Yes
 - b) No
 - c) Not sure
5. On a scale of 1-6, indicate how much the following statements reflect your feelings when you receive the photo memory notifications?

1 = Do not reflect my feelings at all, 6 = Reflect my feelings very well

 - a) I feel curious.
 - b) I feel excited.
 - c) I feel distracted.
 - d) I feel fascinated by the title of the memory notifications.
6. Please specify any other feelings you have experienced.

7. On a scale of 0-5, how often do you engage in the following activities?

(0 = Never, 5 = All the time)

- a) I would quickly open the suggested memory.
- b) I would check the title of the memory.
- c) I would decide to open the memory suggestion based on the title.
- d) If I am busy or not in the mood, I keep the notification to view it later.
- e) I ignore the notification (reverse coded)
- f) I would share the memory with friends or family.
- g) I would share the memory publicly on social media.
- h) I would add the suggested memory to my favorites/save it.
- i) Once I am done viewing my suggested memory, I end up viewing other photos.
- j) Viewing my photos from memory notifications leads me to manually sort/curate/organize my photo collection.

Gratifications

1. Think about your most recent memory notification that you opened.

On a scale of 1-6, how accurately do these emotions describe your own reactions when looking at those photo memories?

1 = Do not reflect my feelings at all

6 = Reflect my feelings very well

- a) Nostalgic
- b) Happy
- c) Grateful
- d) Refreshed
- e) Joy
- f) Contentment
- g) Sad
- h) Anger
- i) Disgusted
- j) Embarrassed
- k) Relaxed
- l) Fascinated

Nostalgia. 2. While thinking about the most recent memory notification that you opened, please indicate the degree to which you missed the following aspects of your life.

1 – I did not miss this aspect of my life at all.

6 – I miss this aspect of my life a lot.

- a) Not having to worry
- b) Things I did
- c) Someone whom I loved
- d) The way people were
- e) The way I was
- f) Places

- g) Feelings I had
- h) My school
- i) Having someone to depend on
- j) Holidays I went on
- k) My pets.
- l) Not knowing sad or evil things
- m) My home/family
- n) Being innocent and naïve

Convenience. 3. On a scale of 1-6, rate the following items based on the importance of automatically categorized photo suggestions.

1 = not important at all

6 = very important

- a) It frees me from curating/organizing photos manually.
- b) It frees me from looking at my old photos on my own.
- c) It facilitates the task of categorizing my photos.
- d) It saves me time and effort when it comes to sorting my photos.
- e) It makes sharing old photos with friends/family or on social media convenient.

User Control. 4. On a scale of 1-6, rate the following items based on importance of having control over the automated photo memory notification and photo suggestions.

1 = not important at all and 7 = very important

- a) It asks me before sending notifications.
- b) I have control of what I want to do with my photos.
- c) It allows me to change how the notification appears.
- d) I can customize the feature to fit my needs (e.g., disable memories of a specific person)
- e) It allows me to set preferred time for receiving notifications.

Social Interaction, Entertainment, Escapism, Reflection. 5. How much do you agree with the following statements with respect to your engagement/experience with photo memory suggestions? 1 = Strongly disagree, 6 = Strongly agree

- a) Photo memory suggestions give me things to talk about with family/friends.
- b) Photo memory suggestions allow me to stay in touch with my family/friends.
- c) Photo memory suggestions help me reconnect with family/friends I have not spoken to in a while.
- d) Photo memory suggestions support family and friendly relations by evoking shared memories with different descriptions.
- e) I view photo memory notifications for enjoyment.
- f) Algorithmically generated titles of notification entertain me.
- g) I enjoy the thematic arrangement of the photos.
- h) For a short while these photo memories make me forget about school, work or other things.
- i) Photo memories allow me to escape the daily grind.
- j) Engaging with memory notification/photo memories has led to the realization of how life has changed over time.

- k) The memory notifications/photo memories make it easy to see how much I have changed.
- l) I reflect on the memories shared in the picture with other people.
- m) The photo memories make me think of my achievements in the past.

Uses and Behavior Outcomes

1. On a scale of 0-5, how often do you encounter these situations when using photo memory suggestions?

0 = Never

5 = All the time

- a) The photo memory notifications act as reminders of upcoming events like anniversaries and birthdays and festivals.
- b) It reminds me of some of my forgotten memories.
- c) The memory suggestions lead me to make plans for the future with my friends/family to recreate past moments.
- d) I improve how I take photos after looking at my old photos from photo memories.
- e) I find myself taking more photos because of these memory suggestions.
- f) I share the photos I did not share when I initially took the photo.

Psychological effects

1. How much do you agree with the following statements with respect to your engagement/experience with photo memory suggestions?

- a) When engaging with my photo memory suggestions, I feel that I am connected with my past.
- b) When engaging with my photo memory suggestions, I feel that I am connected with who I was in the past.
- c) When engaging with my photo memory suggestions, I feel that important aspects of my personality remain the same across time.
- d) When engaging with my photo memory suggestions, I feel that there is continuity in my life.
- e)

End of survey.

A.4 Results and Tables

Table 1: Means, standard deviations and average variance extracted of variables.

Independent Variables	Mean	Standard deviation	Average Variance Extracted
Convenience	3.87	1.27	0.585
User control	4.30	1.08	0.489
Social Interaction	4.05	1.41	0.789
Entertainment	4.24	1.07	0.542
Escapism	4.21	1.31	-
Reflection	4.61	1.05	0.501
Nostalgia	4.02	1.03	0.338
Behavioral Outcomes	Mean	Standard deviation	
Make future plans with friends and family	3.38	1.46	-

Independent Variables	Mean	Standard deviation	Average Variance Extracted
Improve how one takes photos	3.56	1.51	-
Take more photos	3.34	1.60	-
Share initially unshared photos	3.17	1.80	-
Engagement	2.97	0.94	-
Psychological effects	Mean	Standard deviation	
Self-continuity	4.45	0.97	-
Self-acceptance	4.45	1.06	
Control variable (Individual difference)	Mean	Standard deviation	
Tendency to interact with photos (take photos, share, curate).	3.93	0.96	-

Table 2: Comparison of square root of variance and correlation between factors.

Factor 1 (square root of AVE)	Factor 2 (square root of AVE)	Correlation
Nostalgia (0.581)	Convenience (0.765)	0.461
	User control (0.669)	0.4
	Social Interaction (0.888)	0.635
	Entertainment (0.736)	0.538
	Reflection (0.708)	0.61
Convenience (0.765)	User control (0.669)	1.31
	Social Interaction (0.888)	0.92
	Entertainment (0.736)	1.02
	Reflection (0.708)	1.13
User control (0.669)	Social Interaction (0.888)	0.443
	Entertainment (0.736)	0.309
	Reflection (0.708)	0.356
Social Interaction (0.888)	Entertainment (0.736)	0.61
	Reflection (0.708)	0.614
Entertainment (0.736)	Reflection (0.708)	0.704

Table 3: Means and standard deviations of the emotions measured.

Positive emotions	Mean	Standard deviation
Nostalgic	4.90	1.24
Happy	4.68	1.16
Grateful	4.60	1.30
Refreshed	3.94	1.35
Joy	4.48	1.27
Contentment	4.51	1.29

Positive emotions	Mean	Standard deviation
Relaxed	4.16	1.28
Fascinated	3.98	1.38
Negative emotions	Mean	Standard deviation
Sad	2.28	1.31
Anger	1.44	0.92
Disgusted	1.45	1.02
Embarrassed	1.75	1.13