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Autobiographical memory in the digital age: Insights based on the subjective reports of users of smart journaling apps

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Abstract

Humans have long used external memory aids to support remembering. However, modern digital technologies could facilitate recording and remembering personal information in an unprecedented manner. The present research sought to understand the potential impact of these technologies on autobiographical memory based on interviews with users of smart journaling apps. In Study 1 ($N = 12$), participants who had no prior experience with smart journaling apps tested the app Day One for 2 weeks and were interviewed about their subjective perceptions afterwards. In order to cross-validate the obtained findings, Study 2 ($N = 4$) was based on in-depth interviews with long-time users of different smart journaling apps. Taken together, the two studies provide insights into the way autobiographical remembering may change in the digital age – but also into the opportunities and risks potentially associated with the use of technologies that allow creating a detailed and multimedia-based record of one's life.

KEYWORDS
autobiographical memory, digital age, new media, smart journaling, total recall

1 | INTRODUCTION

For thousands of years, humans have used external memory aids to support remembering, ranging from cave paintings and oral traditions to archives, calendars, and printed books (cf. Finley et al., 2018). The reason for this is straightforward: While internal memories are preserved in biological neural networks, external memories have far less limitations in terms of format and flexibility and greatly surpass the storage capacity of internal memories (Donald, 1991; Heersmink & Carter, 2020). It has already been speculated more than half a century ago that modern (computer) technologies could facilitate recording and remembering personal information in an unprecedented manner. In his famous "memex" vision, Vannevar Bush (1945) imagined a desk-like device that would enable individuals to store and retrieve diverse sorts of information ranging from books and newspapers to one's personal communication in an associative manner. Since then, the development and proliferation of mobile, digital technologies have in fact made documenting one's lived life extremely easy and convenient. It is not only possible to store great amounts of personal information in one place (Heersmink & Carter, 2020; Kalnikaite & Whittaker, 2012), but also to combine different media sources and to organize the data (Konrad et al., 2016). Furthermore, digital technologies enable users to search through large databases, to analyze the information, and to share it with others (cf. Clowes, 2013; Eliseev & Marsh, 2021). Taken together, this has lent the Bushian vision new credibility. In their book *Total Recall*, the two Microsoft researchers Gordon Bell and Jim Gemmell (2009) have argued, for instance, that digital technologies will help us to store and to *remember everything* we feel and experience. However, is it desirable to remember *everything*? In other words, is "total recall" rather a utopian or a dystopian vision?

Those who believe that total recall is desirable argue that it would enable us to compensate the weaknesses of human memory. While

human memory can change, fade, and even vanish over time and is therefore susceptible to biases and distortions, digital memory remains constant and is supposedly characterized by accuracy, completeness, and objectivity (Bell & Gemmell, 2009; Burkell, 2016; Harvey et al., 2016; see also Schacter, 2001). In addition, the recent technological advancements allow the automatic recording of vast amounts of data and the integration of a wide range of different media, resulting in easily available and searchable digital records (Elsden, Durrant, & Kirk, 2016; Heersmink, 2020). Thus, digital technologies can augment human memory and help us to reconstruct past events with far greater comprehensiveness and detail (Harvey et al., 2016; Heersmink, 2020; Loveday & Conway, 2011). As a result, narrating one's own experience could become much easier (Heersmink & Carter, 2020; see also Crete-Nishihata et al., 2012): Whenever we have forgotten something, we could turn to our digital memories to fill in the blank spaces. Another important benefit of the increased use of external memory aids is the reduction of cognitive load (Clark, 2015; Eliseev & Marsh, 2021; Heersmink & Carter, 2020; Lynch, 2016; van den Hoven, 2014): When personal data are stored in external memory devices, we need to worry less about forgetting important information. Ultimately, however, total recall may not only counterbalance the weaknesses of human memory but also enhance the quality of life in different areas – ranging from working life to physical and mental health as well as learning, knowledge acquisition, and education (Bell & Gemmell, 2009): The more we know about ourselves, the better we are able to understand, adapt, and optimize our behavior.

Critics of this optimist and utopian perspective counter that total recall raises major privacy issues (e.g., data breaches, accidental data publications) and leads to a fear of surveillance (Harvey et al., 2016; Jacquemard et al., 2014). Moreover, as storage and file formats undergo constant changes and may become inaccessible over time, the longevity of digital content is not guaranteed (Bell & Gemmell, 2009; Petrelli & Whittaker, 2010; van den Hoven et al., 2012; van House & Churchill, 2008). In other words, it is questioned whether digital memories are as unchangeable and easily available as claimed by the proponents of a total recall. Another point of criticism that goes beyond mere technological problems is that increasing the dependence on external memory records could undermine an individual's autonomy and the formation of a coherent life narrative (Burkell, 2016; Heersmink, 2017; Heersmink & Carter, 2020). The basic idea behind this argument is that human beings develop a narrative identity by telling stories about their lives and that these stories may change over time when the circumstances of their lives change (e.g., McAdams, 2008). If all experiences are stored in an external digital memory system, it could potentially become harder to make these kinds of adjustments to one's life story as this could lead to inconsistencies between the internally constructed narrative and the recorded data. In this context, it is also important to mention the adaptive function of forgetting, which is arguably prevented by total recall (Heersmink, 2017; Jacquemard et al., 2014; Mayer-Schönberger, 2011). In certain situations, forgetting can be just as important as remembering – especially when people want to leave their pasts behind or when they want to avoid being reminded of specific negative experiences (Heersmink & Carter, 2020; Koops, 2011; Storm & Soares, in press; van House & Churchill, 2008). In sum, these considerations make the vision of a total recall appear more dystopian than utopian.

Crucially, however, it has been argued that the question as to whether total recall would be good or bad, utopian or dystopian, misses the actual point of the recent technological developments. First, because of practical limitations: Capturing virtually *everything*, that is, a complete and exhaustive record of all aspects of one's life including one's thoughts and emotions, is not possible (Sellen & Whittaker, 2010). Second, the recorded information needs to be curated, arranged, and interpreted in order to become meaningful – and meaning-making is a specifically human ability that cannot, at least not completely, be delegated to an algorithm (Banks, 2011; Sellen & Whittaker, 2010; van den Hoven et al., 2012; see also Elsden, Durrant, & Kirk, 2016; Elsden, Kirk, & Durrant, 2016). That is, just as other external memory aids, digital technologies should not be regarded a substitute for biological remembering but as tools that can support people's memory and efficient information management (Harvey et al., 2016; Kalnikaite & Whittaker, 2012; Sellen & Whittaker, 2010). Against this background, it has been argued that the developers of digital technologies should not pursue the vision of total recall but select more carefully which memory activities require assistance (Heersmink, 2018; van den Hoven & Eggen, 2008) and focus on so called "situation-specific capture", that is, a more intentional logging of rich data in very specific situations (Sellen & Whittaker, 2010). In their concept of "situation-specific capture", Sellen and Whittaker (2010) propose to distinguish five memory activities that could benefit from digital technologies: recollecting, reminiscing, retrieving, reflecting, and remembering intentions. *Recollecting* refers to remembering past events in the sense that one tries to relive these experiences in detail (e.g., thinking about an evening that one has spent with friends). *Reminiscing* means to think back to past experiences for emotional and sentimental reasons (e.g., looking at a photo album to indulge in memories). *Retrieving* refers to recalling a specific piece of information (e.g., looking up the name of a restaurant where one has recently had dinner). *Reflecting* is reviewing past experiences from a more abstract perspective (e.g., thinking about the meaning and purpose of a past event). *Remembering intentions* is future-oriented and involves remembering intentions and plans for future actions (e.g., remembering to show up for a doctor's appointment). While recollecting, reminiscing, and reflecting seem to be memory activities that are directly concerned with *episodic* and *autobiographical memories*, retrieving a specific piece of information clearly refers to a memory activity that is connected to *semantic memory* (for the distinction between these types of memory, see, e.g., Fivush, 2011; Squire, 2004; Tulving, 1972). Moreover, remembering intentions is a paradigmatic instantiation of *prospective memory* (cf. McDaniel & Einstein, 2007). In other words, the memory activities proposed by Sellen and Whittaker (2010) seem to be in line with established psychological theories of human memory (see also Finley & Naaz, 2022).

One way of investigating how these and related activities that play a role in (autobiographical) remembering change in the digital age

is to analyze smart journaling practices. Smart journaling apps are as close to the "Bushian" future of autobiographical remembering as possible for several reasons (cf. Elsden, Durrant, & Kirk, 2016; Harvey et al., 2016). First, they allow storing and integrating information from multiple sources—ranging from written text, photos, videos, and audios to social media posts and weather and location information. Second, the information can typically be organized, searched, and filtered, allowing creative ways of interacting with the content that traditional journals do not offer. Finally, many smart journaling apps encourage their users to engage with past entries, for example by reminding them what happened on the same day a year ago. Although smart journaling apps have become more widely used in recent years, only very few studies have addressed their impact from a scientific point of view (e.g., Elsden, Durrant, & Kirk, 2016; Harvey et al., 2016; see also Schueller et al., 2021).[1] Even more importantly, to the best of our knowledge, there is no previous study explicitly dedicated to investigating the effects of smart journaling apps on the above-mentioned memory activities. Hence, the present research had two main goals: First, we wanted to understand the ways in which the use of a smart journaling app affects memory and processes of remembering from the users' subjective point of view. That is, our focus was on understanding how smart journaling apps influence the users' perceptions of their own experiences and the self-assessments of their own memories, rather than measuring or quantifying potential effects on the amount of retained information. Second, we wanted to provide a comprehensive overview of the opportunities and risks potentially associated with the continued use of a technology that allows creating a multimedia-based, rich, and detailed record of one's life. To this end, we conducted two studies. In Study 1, participants who had no prior experience with smart journaling apps tested the app Day One for 2 weeks and were interviewed afterwards. We chose the app Day One because of its widespread use and great range of functions (cf. Manjoo, 2019). As the participants in Study 1 had no prior experience with smart journaling apps, they shared the same starting conditions, allowing standardization and ensuring that results can easily be compared across participants. However, a two-week test phase can be considered too short to draw definitive conclusions about the perceived long-term effects of using smart journaling apps. In order to cross-validate the obtained findings, Study 2 was therefore based on in-depth interviews with long-time users of different smart journaling apps. Taken together, these two studies provide several important insights regarding autobiographical memory in the digital age.

2 | STUDY 1

2.1 | Methods

2.1.1 | Participants

In total, 12 participants were interviewed (19–27 years, $M = 21.50$, $SD = 2.32$, 8 female, 4 male). The sample size was based on the idea of data saturation, that is, on the idea that data collection in qualitative research should be continued until adding further cases does not lead to new insights (Boddy, 2016). As previous research has indicated that data saturation typically becomes evident somewhere between 6 and 12 cases (Guest et al., 2006), although smaller or larger samples may be appropriate under certain circumstances, we decided to recruit eight participants. As all of these participants were female, we decided to collect additional data from four male participants. Participants were recruited through the participant recruitment system used by the University of Würzburg (Germany). Based on the regulations for conducting psychological research in Germany, no formal IRB approval was required. The study was conducted in accordance with the Helsinki Declaration and the ethical guidelines of the German Psychological Society (DGPs). All participants provided written informed consent and received course credit. The interviews were conducted between the end of July and the end of October 2021.

2.1.2 | Day One

The smart journaling app Day One is offered in a basic and in a premium version (for screenshots of the app's design and more detailed information, see https://dayoneapp.com/). The premium version that was used in Study 1 offers a wide range of different functions, including writing text entries, creating drawings, importing photos, videos, and audio recordings, an automatic import of all existing and future Instagram posts, as well as data from Spotify, YouTube, Facebook, and Twitter, the possibility to save the content of websites, to tag and favorite entries, to search and filter the recorded content, and to scan documents to PDF using the in-app scan camera. In addition, users can allow the app to auto-tag text entries and media with information regarding date, time, weather, and location. The app also offers daily reminders as well as various templates that can serve as a potential starting point for beginning a new entry. Users are able to edit and delete previous entries. That is, users decide which aspects to include in their record, and what to emphasize and elaborate on. Entries that the users want to share with others can be posted on social media. Moreover, content can be exported as a digital file or printed as a book. Users can opt to receive a notification when a day has entries from a previous year. In an attempt to deal with privacy concerns, the app offers biometric security measures (Touch ID or Face ID) and end-to-end encryption. Day One can be used on mobile phones and computers.

2.1.3 | Procedure

Before beginning with the 14-day test phase, participants were informed about the purpose of the study in an online meeting. Participants were told that the study sought to investigate whether and, if so, how digital technologies affect autobiographical remembering. It was emphasized that the study was concerned with their subjective perceptions so that all kinds of observations are welcome and that there are no right or wrong answers. Participants were told to use the

smart journaling app Day One for 15 min per day during the two-week test phase. We assumed that 15 min per day would be enough time for participants to record the most important events of their daily lives and to have a meaningful interaction with the app that they could reflect upon after using the app for 2 weeks. Participants were encouraged to try out different functions in the beginning but also told to use only those functions that they felt comfortable with. Participants were reassured that the researchers would not have access to the content stored in their smart journal at any point of the study. Finally, participants were asked to sign up for a premium membership with Day One in order to have unlimited access to all functions. Participants were compensated for their financial expenses.

After completing the two-week test phase, another online meeting was scheduled in order to conduct the interview. The interviews were semi-structured. That is, they were based on an interview guide in order to ensure that all relevant aspects were discussed in the same manner across participants (see the Supplemental Material for the complete interview guides of both studies). However, the interviewer was allowed to ask ad-hoc questions when it seemed necessary. Each interview consisted of three parts. First, participants were asked about their *usage behavior*. This included questions regarding the used functions ("Which functions did you use and why?", "Which functions did you not use and why?"), the recorded content ("What kind of events did you record and why?", "What kind of events did you not record and why?") and the participants' overall evaluation of the app ("Which aspects did you experience as positive during the use?", "Which aspects did you experience as negative during the use?"). Second, participants were asked about the *perceived effects of the use of the smart journaling app on memory*. Following an open question that asked participants to state anything that came to their mind, participants were asked more specifically whether they had perceived any changes with respect to the five memory activities (i.e., recollecting, reminiscing, retrieving, reflecting, remembering intentions) identified by Sellen and Whittaker (2010). It was emphasized that perceiving a specific effect is just as informative as not perceiving it. Third, participants were asked about the *potential opportunities and risks* with respect to the continued use of a smart journaling app. More specifically, participants were asked to imagine that they would continue to use the app in the way they had done over the past 2 weeks and to think about the advantages and disadvantages of possessing a rich and detailed, digital record of their own lives potentially encompassing years or even decades.

After completing the interview, participants filled in an online questionnaire. They were asked about their age and gender as well as the time that they had actually used the app per day over the past 2 weeks and their intention to continue using the app (7-point Likert scale, 1 = "I will certainly not continue using the app", 7 = "I will certainly continue using the app"). The interviews lasted between 25 and 42 min ($M = 34.94$ min, $SD = 5.75$). All interviews were conducted by the same interviewer.

2.1.4 | Qualitative data analysis

The interviews were recorded and transcribed verbatim. The data were analyzed with MAXQDA 2020 (VERBI Software) using qualitative content analysis (Mayring, 2014, 2021). To ensure the objectivity of the coding process, two coders analyzed the data. First, a codebook was created based on initiating text work (Kuckartz, 2019). In order to do so, the two coders familiarized themselves with the data independently from one another and created an initial draft for a codebook. These two drafts were discussed between the two coders and integrated into a final codebook. The final codebook included categories to capture the used functions, the recorded content, and the overall evaluation by the participants as well as the perceived effects on memory and future expectations regarding opportunities and risks. Although participants had been asked about their reasons for using specific functions, their answers to this question were not analyzed systematically as they were deemed too superficial to be informative. The same applies to the question about the functions that the participants did not use as well as their reasons for not using them.

Next, the two coders coded the first two interviews independently from one another. Then, the interrater reliability was calculated (Brennan & Prediger, 1981). Two coded segments of the material were considered to match when the overlapping rate of the two codes was 90% or higher. The interrater reliability indicated a substantial strength of agreement (Landis & Koch, 1977), $\kappa = 0.73$. The coders discussed the differences with respect to the first two interviews that they had coded independently and agreed upon a final solution. Given the substantial agreement between the two coders, one coder coded the remaining material. However, open questions and potentially ambiguous sections were discussed between the two coders.

2.2 | Results

2.2.1 | Usage behavior

Participants were asked to use the app for 15 min per day during the two-week test phase (see above). As indicated by their answers in the online questionnaire, participants followed this instruction ($M = 15.33$ min, $SD = 4.92$, range: 10–25 min). Overall, participants seemed to enjoy using the app: When asked about their future intentions, only two participants stated that they tended not to continue using the app (ticking 3 on the 7-point Likert scale), while the remaining 10 participants stated that they would probably continue using the app (ticking the options 5–7 on the 7-point Likert scale). Details with respect to the used functions, the recorded content, and the overall evaluation are reported in the following.

Used functions

The participants did not use all functions offered by the app with equal frequency (see Table 1). All participants stored *photos* and wrote *text*, and the majority of participants automatically tracked their

TABLE 1 Used functions

Function	Number of participants
Text	
Open text	12
Template	4
Tags	1
Photos	12
Location	10
Audio	9
Video	5
Weather	3
Import from other apps	2
Scanning	1
Other	3

Note: Results from Study 1 ($N = 12$).

TABLE 2 Recorded and non-recorded content

Content	Number of participants
Recorded content	
Everyday events	8
Important aspects	12
Ideas and thoughts	6
Non-recorded content	
Everyday events	8
Personal events	6
Negative events and conflicts	5

Note: Results from Study 1 ($N = 12$).

location and used *audio recordings*. All other functions were used by a minority of the participants only. With respect to the audio recordings, it should be noted that most participants who had tried out the function did not use it on a regular basis, mostly because they found recording themselves "somewhat weird"[2] or because they found writing text "more enjoyable". However, two participants stated that they particularly liked this function. As one participant put it, recording herself felt "like talking to a friend" whom one is sharing one's day with. The *templates* included in the app, which offer cues to the users (e.g., a question to answer or to think about), were perceived as useful as they helped the participants in moments in which they did not know what to write or how to begin a new entry.

Recorded and non-recorded content

The content that participants recorded and stored within their smart journal can be sorted into three groups (see Table 2). First, participants recorded *everyday events* (e.g., cleaning one's apartment, doing the laundry, having breakfast). Second, participants recorded the *important and outstanding aspects of their lives*, including important events (e.g., attending a bachelorette party), being at specific places (e.g., being on vacation), and engaging in social interactions (e.g., conversations with family and friends). Third, participants took notes on *ideas and thoughts* that they had (e.g., reflections on a news article, interesting quotes).

Concerning the aspects of their lives that they decided not to record, participants mentioned *everyday events*, events that they deemed *too personal* as well as *negative events and conflicts* (see Table 2). Note that the participants who recorded everyday events and those who did not record everyday events were not mutually exclusive groups. In other words, most participants decided to document *some* everyday events, while not documenting others. Those participants who were reluctant to record personal events mostly explained this with privacy concerns and the "feeling that someone could somehow read these things". However, not documenting negative events and conflicts was explained in a different way. One participant stated, for instance, that she had decided to use the app "to recall the positive aspects" of her life only, while another participant added that writing down negative events "is simply not the way I deal with these things". Yet another participant stated that she did not document a conflict she had with another person because she felt ashamed when she realized in hindsight that the conflict "was really stupid".

Overall evaluation

With respect to aspects that they experienced as *positive* during the use, 10 participants named the app's *clear structure and overall usability* and half of the participants mentioned the app's *wide range of functions*. Apart from that, all participants referred to *particular functions* that they found useful (e.g., templates, calendar overview). Beyond these technical aspects, one participant explicitly mentioned that she liked the way the app influenced her memory for the events that she experienced during the two-week test phase. Although the overall evaluation of the app was quite positive (see also the intention of most participants to continue using the app), participants also mentioned aspects that they experienced as *negative*. Seven participants mentioned minor problems related to the app's *design and usability* (e.g., a function that was not working as expected). Two participants mentioned that they occasionally experienced moments in which they felt *obliged to use the app* because they had signed up for the study. In addition, one participant stated that her privacy concerns kept her from using the app in the way she would have liked to use it.

2.2.2 | Perceived effects on memory

Perceived effects on memory activities

Participants were explicitly asked whether the use of the smart journaling app had – from their personal point of view – affected the five memory activities originally identified by Sellen and Whittaker (2010): recollection, reminiscing, retrieving, reflecting, and remembering intentions (see Table 3). With respect to *recollection*, participants stated that they indeed used the recorded content "to remember what one has done overall" or "to go back through the days". More specifically, several participants stated that they saw the information

TABLE 3 Perceived effects on memory

Memory activity	Number of participants
Recollecting	10
Reminiscing	6
Retrieving	3
Reflecting	10
Remembering intentions	6
Improved internal memory*	7
Anticipated noteworthiness*	2

Note: Results from Study 1. Participants ($N = 12$) were explicitly asked about the first five memory activities—recollection, reminiscing, retrieving, reflecting, remembering intentions—originally identified by Sellen and Whittaker (2010). The two effects marked with an asterisk (*) were mentioned by the participants themselves.

they had stored the day before when opening the app and that they used this as a cue to recollect what they had done and experienced. *Reminiscing*, that is, reliving past experiences for emotional or sentimental reasons was also described by several participants. They stated, for instance, that they used the recorded information "to sentimentally dive into the experiences" or that they explicitly looked up moments that they had found beautiful. In contrast, participants did not use the app that frequently for *retrieving* specific bits of information. However, one participant stated that she had used the app to find the name of a cocktail that she had in a bar one evening, while another participant mentioned that she had looked up the name of a new colleague at work. Next to recollection, *reflecting* was the memory activity that was mentioned most frequently. Several participants noted that the very act of creating an entry for the past day made them think and reflect about their experiences: "How did I feel when it happened? What was the mood like, how do I see things now in hindsight?" In a similar vein, another participant added: "I believe that writing down your experiences automatically leads to reflecting them and to see them from another perspective". As this quote already illustrates, reflecting was closely related to *writing* for those participants who mentioned this memory activity. As far as *remembering intentions* is concerned, participants stated that they used the app to create to-do-lists and to be reminded about their friends' birthdays, for instance. Participants also noted that going through old entries made them remember things that they had intended to do.

As these results demonstrate, the use of a smart journaling app can influence the way individuals assess their own memories and the process of remembering autobiographical information. Although these subjectively perceived effects became already apparent during the relatively short two-week test phase, nine participants stated with respect to at least one of these five memory activities that they expected it to become (even) more important in the case of continued use. Note that participants were not explicitly asked about the anticipated future importance but made these statements on their own initiative. On the one hand, this hints at the potential transformative power of digital technologies regarding autobiographical remembering. On the other hand, it points to the importance of cross-validating the findings of the present study with the observations of long-time users in order to verify whether these expectations are actually justified.

Additional perceived effects on memory

Participants mentioned further subjectively perceived effects on memory that were not captured by the five categories described so far. Most importantly, about half of the participants reported that they had the impression that externally recording and storing information about their lives *improved their internal memory* for past events. For instance, one participant stated that "through uploading so many things, it was easier to keep them in my memory". Similarly, another participant explained that going through the events of the day when creating the entry helped to retain these events in memory compared to a setting "when something happens and then you go to bed in the evening and the next day things are happening again". In short and following the participants' line of reasoning, active engagement with the app leads to active engagement with one's experiences, which in turn leads to better memory for these experiences. Apart from that, participants also reported that they sometimes thought that an event was noteworthy while experiencing it (*anticipated noteworthiness*): "Sometimes I thought, well: This is something that you can write down later."

2.2.3 | Future expectations

In the last part of the interview, participants were asked about the *potential opportunities and risks* with respect to the continued use of a smart journaling app. These opportunities and risks are described in detail below (for an overview, see Table 4).

Potential opportunities

Participants argued that possessing a detailed digital record of their past would enable them to make *comparisons* and to trace their personal *development* over time. That is, they expected that they would be able to see how they have evolved as a person and how their life has changed. This advantage is closely connected to the idea that smart journals allow the creation of an *extensive archive* that includes various sorts of data and information. Especially in comparison to a traditional paper diary, participants emphasized several *practical benefits* of digital diaries, such as their searchability or the fact that they can easily be carried around. This potential advantage coincides well with the idea that digital diaries could also have a *social function* in the sense that they could be shared with others in order to tell them something about one's life. Moreover, participants explicitly mentioned that a multimedia-based diary would not only help them to recall events from their past, but also to *re-experience them intensively*. One participant also noted that the overview that the app offers would provide her with a brief and condensed *summary* of her life. Another participant stated that taking a look at the content stored in the diary could help to avoid repeating the same mistakes and to *learn from past experiences*.

TABLE 4 Potential opportunities and potential risks of continued use

Category	Examples	Number of participants
Opportunities		
Comparison and development	"I would find it very interesting to see where my focus is, what I focus on in life [and] whether that would change", "One would see much more clearly how one has developed and whether one has maybe changed over time"	10
Extensive archive	"It is a really nice thought that one could remember every event [from one's life], as one has it ready for recall", "One would not forget any memory anymore"	8
Practical benefits	"It's very practical, you always have it with you—in the app", "One could quickly look up things, find them again", "I could imagine that it will replace the photo album, as you simply know more specifically when you have done what"	6
Social function	"If you have children or grandchildren, for example. [You could say]: Here, read this, this was me in my younger years", "Maybe people that one got to know later could see some of the things that one experienced earlier"	3
Intense re-experience	"You get the opportunity to intensively re-experience the thoughts and feelings from back then", "One could sort of go back into the moment and see how life felt five months ago or a year ago"	3
Summary	"Also, [to have] a summary of the years. To see what the aspects of my life were that I considered important enough to be uploaded"	1
Learning from past experiences	"Maybe you will not make certain mistakes anymore, because you realize 'Ok, I have made this mistake and this will not happen again'"	1
Other		2
Risks		
Privacy and data protection	"I think I would be a little scared with regards to data protection", "The risk that others could access it. If one had really recorded *everything* for every day, one would be completely transparent […] and maybe one could also be manipulated"	10
Negative experiences through comparison	"If I had done it for one year and then another year and that year was just totally fucked up, it would be really sad to see the year before", "It could take away the motivation […] if you realize over longer periods of time that something in life is getting worse"	4
No forgetting	"There are certainly also experiences that one does maybe not want to see again and again", "Often you do not want to look back in certain periods of your life maybe"	3
More time with digital media	"It's again another reason to spend more time with your smartphone", "One is spending so much time with one's phone anyway—and that's another factor that makes you spend more time on the smartphone"	2
Data loss	"When it's gone, everything is gone"	1
Devaluation of the present moment	"Maybe it could make living in the moment a bit more difficult. Because, I do not know, if one would really capture every moment […], the moment itself would lose a bit of value. If you could basically access it at any time."	1
Other		3

Note: Results from Study 1 ($N = 12$).

Potential risks

Almost all participants mentioned concerns regarding *privacy and data protection*. The hesitance to record personal and intimate information already described in the section on usage behavior (see above) became even more prominent when thinking about a point in the future at which participants would have a much larger collection of data about their lives. Although participants had identified the possibility to make comparisons between past and present as one of the major advantages of a detailed record of one's life, some participants also noted that one could make *negative experiences through comparison* with one's former self – especially when this former self was happier or more successful than one's present self. In line with that, it was also emphasized that possessing a detailed record of one's past would mean that *no forgetting* takes place and that one runs at risk of being reminded of negative events and experiences. In addition, two participants noted that using a smart journal would result in spending (even) *more time with digital media*, which these participants did not consider advisable. One participant noted being afraid of a potential *data loss* because losing the stored data would – at least in a certain sense – mean losing one's past. Another participant stated that the possibility to access past experiences at any time could *devalue the present moment*.

2.3 | Discussion

In Study 1, participants who had no prior experience with smart journaling apps tested the app Day One for 2 weeks and were

TABLE 5 Smart journaling apps used by participants in Study 2

App	Brief description
Daylio	Daylio (https://daylio.net/) is a bullet journal that promises its users to keep track of their mood and their activities. Users can set themselves goals and adjust the items that are used for mood tracking. Adding text and photos to the diary entries is possible. The app provides users with charts and summary statistics. The stored content can be exported to PDF.
Diaro	Diaro (https://diaroapp.com/) enables users to combine text entries with photos. Mood tracking is possible. Entries can be tagged and location information can be added. Users are reminded of memories from the past. The app provides users with charts and summary statistics. The stored content can be exported to PDF.
iMoodJournal	iMoodJournal (https://www.imoodjournal.com/) is a mood tracking app that allows users to record their mood in combination with tags, location information, and photos. The app recommends to use self-portraits. The app provides users with charts and summary statistics. Data can be exported. Users can set automatic reminders.

Note: Each participant in Study 2 ($N = 4$) used a different smart journaling app. One participant used Day One. As the characteristics of Day One were described in detail in the Method section of Study 1, Day One was not included in this table.

interviewed about their subjective perceptions afterwards. These interviews provide insights into the possible changes to autobiographical remembering in the digital age as seen from the users' perspective as well as into the opportunities and risks potentially associated with the continued use of a technology that allows creating a multimedia-based, rich, and detailed record of one's life. As the participants in Study 1 had no prior experience with smart journaling apps, they shared the same starting conditions, allowing standardization and ensuring that results can easily be compared across participants. However, a two-week test phase can be considered too short to draw definitive conclusions about the perceived long-term effects of using smart journaling apps. In order to cross-validate the obtained findings, Study 2 was therefore based on in-depth interviews with long-time users of different smart journaling apps.

3 | STUDY 2

3.1 | Methods

3.1.1 | Participants

In total, four participants were interviewed (20–25 years, $M = 22.50$, $SD = 2.08$, 3 female, 1 male). As the interviews were based on the questions and categories already tested and established in Study 1, a smaller sample size was deemed sufficient. Individuals were invited to sign up for the study in case they were long-time users of a smart journaling app. Long-time use was defined as continuous use lasting 1 year or longer ($M = 1.48$ years, $SD = 0.53$, 1.08–2.25 years). Each participant used a different smart journaling app (Day One, Daylio, Diaro, iMoodJournal; see Table 5 for further information). Participants were recruited through the participant recruitment system used by the University of Würzburg (Germany). Based on the regulations for conducting psychological research in Germany, no formal IRB approval was required. The study was conducted in accordance with the Helsinki Declaration and the ethical guidelines of the German Psychological Society (DGPs). All participants provided written informed consent and received course credit. The interviews were conducted in January 2022.

3.1.2 | Procedure

Before completing the interview, participants filled in an online questionnaire. They were asked about their age and gender as well as the name of the app that they are using and the time that they spend with the app per day. In addition, participants indicated since when they are using the app. The interview procedure in Study 2 was largely similar to the interview procedure in Study 1 (see the Supplemental Material for the complete interview guides of both studies). Again, the semi-structured interviews were conducted online and consisted of three parts. First, participants were asked about their *usage behavior*. As in Study 1, this included questions regarding the used functions, the recorded content and the participants' overall evaluation of the app. In addition, participants were asked when and why they began using the app, whether their usage behavior has changed over time, and how they currently use the app. Second, participants were asked about the *perceived effects of the use of the smart journaling app on memory*. Following an open question that asked participants to state anything that came to their mind, participants were asked more specifically whether they had perceived any changes regarding the five memory activities identified by Sellen and Whittaker (2010) as well as the two additional memory activities identified in Study 1. Third, participants were asked about the *potential opportunities and risks* with respect to the continued use of a smart journaling app. Following an open question, participants were asked more specifically whether they saw the potential opportunities and risks identified in Study 1. Similar to Study 1, it was emphasized that perceiving a specific effect on memory, a certain opportunity or a certain risk, is just as informative as not perceiving it. The interviews lasted between 39 and 51 min ($M = 44.48$ min, $SD = 5.51$). All interviews were conducted by the same interviewer as in Study 1.

3.1.3 | Qualitative data analysis

The interviews were recorded and transcribed verbatim. The data were analyzed with MAXQDA 2022 (VERBI Software) using qualitative content analysis (Mayring, 2014, 2021). The codebook used for

analyzing the data was largely similar to the codebook used for Study 1. More specifically, the only changes that were made to the codebook were a direct result of the changes that were made to the interview procedure. That is, the codebook included categories to capture the participants' usage behavior, the perceived effects on memory, and the potential opportunities and risks. As the reliability of the coding process had already been established in Study 1, the same coder who had already served as the main coder in Study 1 coded the four interviews. However, open questions and potentially ambiguous sections were discussed with the second coder who had already been involved in coding Study 1.

3.2 | Results

3.2.1 | Usage behavior

All interviewed long-time users stated that they began using their apps upon the recommendation of another person: in three cases a friend, in one case a personal mentor. However, the motivation for keeping a smart journal differed between participants. While one participant stated that he wanted to identify patterns in his behavior in order to change dysfunctional aspects of his life, another participant initially intended to keep a dream diary and later decided to extend the use. Another participant took the Corona pandemic and the time that she had to spend in quarantine as a starting point and the last participant explained that she had always wanted to keep a diary and thought that using a smart journal could be a convenient way to do so. While two participants recorded content in their smart journal whenever they felt like doing so, the other two participants had set themselves an automatic reminder.

Used functions

As in Study 1, all participants stored *photos* and wrote *text*. Interestingly, other functions were only used to a very limited degree: One participant used *emojis* to tag the recorded content, one participant used the *rating scales and analytics* offered by the app, and one participant changed the app's *layout*. That is, the long-time users seemed to use fewer functions than those participants who had used a smart journaling app during a two-week test phase. Note, however, that this difference is hard to interpret for at least two reasons. First, participants in Study 1 had been encouraged to try out different functions while the long-term users might already have identified the (limited number of) functions that work best for them. Second, three out of four long-term users used different apps than Day One. Hence, the participants of Study 2 might also have used fewer functions compared to the participants of Study 1 because their app did simply not offer as many functions or was not as user-friendly and easy to explore as Day One.

Recorded and non-recorded content

As in Study 1, the content that participants recorded and stored within their smart journal fell into three categories: All long-time users recorded *important and outstanding aspects of their lives* as well as *ideas and thoughts* that they had. Two participants also reported recording *everyday events*. Concerning the aspects of their lives that they decided not to record, three participants mentioned *everyday events*. As in Study 1, the participants who recorded everyday events and those who did not record everyday events were not mutually exclusive groups. In other words, most participants decided to document *some* everyday events, while not documenting others. Interestingly, the long-time users did not mention the other two categories of non-recorded content identified in Study 1 (i.e., events that were deemed *too personal* as well as *negative events and conflicts*). One participant additionally noted that she does not store content regarding societal or political events, as they do not have the same intimate and emotional value as the events from her personal life.

Overall evaluation

With respect to aspects that they experienced as *positive* during the use, all participants referred to the *clear structure and overall usability* of the apps that they used and three participants mentioned the *wide range of functions* that the apps offer, confirming the impressions from Study 1. Apart from that, one participant named several *particular functions* such as the possibility to be reminded to create a new entry on a daily basis. One participant mentioned that the app helped her to reflect past experiences and to take time for herself, and one participant stated half-jokingly finding the app's logo attracting and energizing. Although the overall evaluation of the apps was quite positive, all participants also mentioned aspects that they experienced as *negative*. One participant mentioned occasional technical problems and another participant stated that her free version of the app showed too many advertisements. In addition, two participants mentioned minor problems related to the app's *design and usability*.

3.2.2 | Perceived effects on memory

Regarding the question as to whether and, if so, how the use of a smart journaling app affects different memory activities from the participants' personal point of view, the results confirmed the findings from Study 1. More specifically, all seven memory activities identified by the short-term users in Study 1 were also experienced by at least one long-time user. Furthermore, the long-time users did not report any additional memory activities that had not already been detected in Study 1. As far as the five memory activities proposed by Sellen and Whittaker (2010) are concerned, the two activities that were mentioned by most participants in Study 1, namely *reflecting* and *recollecting* (see Table 3), were also the activities that were mentioned by most long-time users (all long-time users in the case of *reflecting* and three in the case of *recollecting*). Half of the long-time users reported that using the smart journaling app has helped them with *reminiscing* and *retrieving* and one participant mentioned using the smart journaling app for *remembering intentions*. The interviews with the long-time users also confirmed the validity of the two additional subjectively perceived effects on memory identified in Study 1. All long-time users

reported experiencing moments of *anticipated noteworthiness*, that is, moments during an actual experience in which they were aware that they would later store them in their smart journal. In addition, three long-time users had the impression that externally recording and storing information about their lives *improved their internal memory* for past events. The one participant who had not experienced this effect stated that she does not believe that her "complete memory has improved. Only if I want to go back to specific moments: Then it is very helpful to read these things again."

3.2.3 | Future expectations

As in Study 1, participants were asked about the *potential opportunities and risks* with respect to the continued use of their smart journaling apps in the last part of the interview.

Potential opportunities

With respect to the potential opportunities associated with a continued use, the results confirmed the findings from Study 1. Five out of the seven opportunities identified in Study 1 were seen as such by all long-time users. This applied to the idea that possessing a detailed digital record of their past enables users to make *comparisons* and to trace their personal *development* over time, that smart journals allow the creation of an *extensive archive* while also providing a brief and condensed *summary* of one's life, that one can use the content stored in the diary to *learn from past experiences*, and that digital diaries have several *practical benefits*. The remaining two opportunities identified in Study 1, namely the possibility to *intensively re-experience* past events and the possible *social functions* of digital diaries, were seen as such by three long-time users. With respect to the possible social functions of digital diaries, the user who did not see them as a potential opportunity stated that he keeps his diary for himself and not to be shared with others, especially because he has recorded very personal thoughts and emotions. The long-time users did not report any additional potential opportunities that had not already been detected in Study 1.

Potential risks

The evaluation of the potential risks associated with a continued use of smart journaling apps was a bit more controversial among the long-time users than the evaluation of the potential opportunities. While all long-time users reported being afraid of *data loss* and three of them saw risks regarding *privacy and data protection* (the fourth participant stated that "this is something that one could think about but it does not really bother me"), the other risks were only confirmed by some long-time users whereas others provided arguments why they do not see these risks. Concerning the idea that using a smart journal could *devalue the present moment*, one participant stated that "if you are completely in the moment and enjoying the moment and then you take out your phone and start typing [...] this could definitely snap you out of the moment" and another participant added that "this could be a risk for some people". As these statements already make clear, these two participants acknowledged that such a problem could exist but had not directly experienced it themselves. A similar pattern could be observed regarding the idea that using a smart journal would result in spending (even) *more time with digital media*. While two participants generally acknowledged that this could be a problem without seeing a problem for themselves, the other two participants did not perceive the risk for different reasons. One participant stated that she only uses the smart journal for a couple of minutes per day and another participant remarked that keeping a smart journal is a better way of spending one's time with digital media than "watching something on Instagram for the tenth time during the day". The idea that possessing a detailed record of one's past would mean that *no forgetting* takes place and that one runs at risk of being reminded of negative events and experiences was considered "a great risk, if not the greatest" by one participant—and another participant added that it could keep individuals from suppressing memories that they may want to suppress. In contrast, the other two participants noted that being reminded of negative experiences is not necessarily negative in itself but could also help to "work through these negative things again in your mind". The closely related risk that one could make *negative experiences through comparison* with one's former self was also perceived by two participants. In contrast, one participant stated that making such a negative experience could also be a starting point for future positive developments and should therefore not be considered a risk. Another participant stated that she does not consider her past self identical to her present self so that comparing her past to her present self does not lead to negative experiences: "I mean, I am a student now and in ten years not anymore, hopefully. And then, some things will have changed in my life and I don't think that I would compare it like this." In addition to these risks identified in Study 1, one participant mentioned two more potential problems with the continued use of a smart journaling app. On the one hand, the participant—who was the only long-time user who had not observed an improved internal memory—remarked that keeping a detailed record of one's life could lead to an *inner impoverishment*. In other words, the participant hypothesized that it would be problematic if smart journals were indeed used for cognitive offloading. On the other hand, the participant stated that spending too much time with one's diary on the expense of sharing experiences with others could be considered a *solipsistic endeavor*.

4 | GENERAL DISCUSSION

The present research sought to identify possible changes to autobiographical remembering in the digital age by analyzing interviews with users of smart journaling apps. In particular, we had two main goals. First, to understand the ways in which the use of a smart journaling app affects memory and processes of remembering from the users' subjective point of view. Second, to provide a comprehensive overview of the opportunities and risks potentially associated with the continued use of a technology that allows creating a multimedia-based, rich, and detailed record of one's life. In Study 1, participants

who had no prior experience with smart journaling apps tested the app Day One for 2 weeks and were interviewed about their subjective perceptions afterwards. In order to cross-validate the obtained findings, Study 2 was based on in-depth interviews with long-time users of smart journaling apps. Taken together, these two studies provide several important insights.

As demonstrated in Study 1, participants believe that the use of smart journaling apps can positively influence the memory activities of recollecting, reminiscing, retrieving, reflecting, and remembering intentions (Sellen & Whittaker, 2010). In addition to these activities identified in previous research, participants described further perceived effects on processes of remembering. In particular, participants had the impression that *externally* recording and storing information about their lives improved their *internal* memory for past events. That is, participants do not seem to use smart journals for cognitive offloading, but rather for cognitive augmentation (Eliseev & Marsh, 2021). Given that one could assume that participants are able to remember events from their recent past without the help of an external memory aid and given that the participants used the app for only 2 weeks, the finding that even a short-term use of a smart journaling app significantly affects the way participants assess their memories may seem surprising—and hints at the transformative power that digital technologies could potentially have (see also Finley & Naaz, 2022, for a nuanced analysis). Support for this conclusion is also provided by participants' expectation that the perceived effects would become more pronounced with continued use.

This coincides well with the general observation that participants saw many opportunities in using smart journaling apps. Interestingly, the opportunities described by the participants seemed to be line with the key functions of autobiographical memory identified in previous research (cf. Bluck et al., 2005). That is, participants seemed to perceive opportunities in creating a detailed and digital record of their lives if and insofar as this record serves the directive function (e.g., by giving them the opportunity to learn from past experiences), the self function (e.g., by equipping them with an extensive archive of their lives), or the social function (e.g., by enabling them to share their memories with others) of autobiographical memory. Apart from that, the positive evaluation of the smart journaling app was also mirrored in the participants' concrete intention to continue using the app after the end of the study. Despite the apparent potential of smart journaling apps to become an enriching external memory aid, however, existing concerns regarding privacy and data protection could turn out to be a major problem—especially as these concerns led several participants not to record personal and intimate information. This is particularly interesting as the participants who signed up for the study were fully aware of the purpose of the research. In other words, although these participants were generally willing and curious to try out a new technology, they were still hesitant to fully embrace it.

These results regarding the perceived effects on memory and processes of remembering as well as regarding the potential opportunities and risks were largely corroborated by Study 2. To begin with, the long-time users perceived the same effects on memory and processes of remembering as the short-time users. In this context, two limitations should be noted that apply to both studies. First, the interviews reported in this paper were concerned with the users' subjective perceptions and evaluations. Hence, it remains to be determined whether these subjective perceptions translate into actual changes to autobiographical memory that can be measured. Interestingly, there are studies demonstrating that taking pictures can—at least under certain conditions—improve one's internal memory (for reviews, see Foley, 2020; Silva et al., 2018; see also Mair et al., 2017). Against this background, similar studies on the other potential effects identified in the interviews seem highly promising. In addition, exploring in more detail how specific features of smart journaling apps can support specific memory activities and the related memory systems is highly relevant from both a theoretical and a practical perspective. Second, it remains to be determined whether the perceived effects on memory and processes of remembering observed in the context of smart journals differ substantially from the effects of traditional paper-based diaries (cf. Elsden, Durrant, & Kirk, 2016). As the users repeatedly referred to the overall usability and the wide range of functions of smart journaling apps when being asked about the positive features of these new technologies, it seems plausible to speculate that smart journals could indeed have new transformative effects. However, more research is needed to further validate this speculation—especially as the range of functions that the participants effectively used was quite limited and did not exhaust all options that the smart journaling apps would offer.

As already mentioned above, the interviews with the long-time users in Study 2—by and large—also confirmed the results from Study 1 regarding the potential opportunities and risks associated with the continued use of smart journaling apps. More specifically, short-time and long-time users particularly agreed with respect to the potential opportunities, while the potential risks identified in the interviews with the short-time users were a bit more controversial among the long-time users. Note, however, that concerns regarding privacy and data protection also played a major role among long-time users. The differences between the two studies regarding the potential risks could, of course, be attributable to the fact that long-term and short-time users have made different experiences or used the apps with different motivations. While participants in Study 1 began using the app because they had signed up for participation in the study, participants in Study 2 were voluntary users who had decided to use their smart journaling app for personal reasons.

However, the observed differences between the two studies regarding the potential risks also point to two further issues. On the one hand and despite Bush's (1945) early vision, the technology underlying smart journaling apps is still relatively new. Hence, thinking about potential long-term risks and benefits necessarily remains speculative to a certain extent. On the other hand, the disagreement among participants mirrors the disagreement in the academic debate with respect to the future of autobiographical memory in the digital age (cf. Eliseev & Marsh, 2021; Heersmink & Carter, 2020; Storm & Soares, in press). As in the case of other digital technologies developed in recent years, it seems plausible to assume that smart journals can have both positive and negative effects on individuals and that

the strength of these effects depends on various boundary conditions (cf. Appel et al., 2020; Orben & Przybylski, 2019). Hence, the potential opportunities and risks identified by the participants can serve as a valuable starting point for further in-depth investigations but should not be taken as the last word on the subject.

In sum, the present research provides evidence for the idea that autobiographical remembering could change profoundly in the digital age. Smart journals offer a convenient possibility to collect and combine data from different sources in order to create a multifaceted record of one's life. As digital technologies have already transformed other aspects of our daily lives, there is no reason to believe that they could not also transform autobiographical remembering. At the same time, existing concerns regarding privacy and data protection could potentially undermine such transformative effects as they may prevent individuals from using these technologies. Importantly, the present research also demonstrates that both utopian and dystopian visions of the future of autobiographical memory are too simplistic to account for the complexity of reality. Instead of discussing the science-fictionesque vision of a *total recall* (Bell & Gemmell, 2009), it seems more important to investigate the specific effects that digital technologies can have on autobiographical remembering and on the users' perceptions of their memories in order to enable an informed discussion about potential risks and benefits.

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CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

DATA AVAILABILITY STATEMENT

Data are available upon reasonable request from the authors.

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ENDNOTES

[1] Note that we are fully aware that there is a vast amount of literature on *lifelogging* (for an overview, see Selke, 2016). However, lifelogging practices often follow in the footsteps of the vision of a total recall and are typically concerned with the *automatic capture of quantifiable information* about one's life. In contrast, smart journals focus more on active user involvement and encourage curating the stored information.

[2] As all interviews in both Study 1 and Study 2 were conducted in German, the direct quotes taken from the material were translated into English by the authors.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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