



Digital Storytelling Experiences and Outcomes with Different Recording Media: An Exploratory Case Study with Older Adults

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ABSTRACT

Digital storytelling is an advantageous practice for older adults. Although researchers have widely studied the effects of various recording media on users, including even their feelings of loneliness, to the best of our knowledge, there is no study that distinguishes and compares those effects within the digital storytelling process. In this exploratory case study, we tried to gain further insights into older adults' technology-mediated storytelling, the interactions, and the outcomes that different kinds of recording media have on users. Therefore, three storytelling components (paper notebook, voice recorder, and web platform) were used to probe their usability and emotional outcomes on five pensioners in Greece. Semi-structured interviews and questionnaires, among others, were implemented for data collection. According to the results, there was a variety of benefits and shortcomings for each tool. However, the web platform had a clear effect on decreasing users' loneliness. Implications and future work on digital storytelling are discussed.

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1. Introduction

1.1. Older adults and new technologies

The world population of older adults constantly rises. According to the World Health Organization (2019), the global population aged 65 years or higher has increased since 1990 and in 2050 is expected to be twice as large as it was in 2019. At that time, Japan, the Republic of Korea, Spain, and Greece will be the countries with the highest percentage of older citizens in their adult populations.

Aging is associated with a series of biological, psychological, cognitive, and social changes that affect the way older adults interact with technology

(Czaja, Boot, Charness, & Rogers, 2019; Loos & Romano Bergstrom, 2014; Salthouse, 2010, 2016). As it seems, older adults are just a different kind of technology users, compared to younger generations, with diverse and unique skills, constraints, and expectations from technology (Harley & Fitzpatrick, 2009; Lindsay, Jackson, Schofield, & Olivier, 2012).

1.2. Memories, reminiscence, and storytelling

People across all age groups look back into their past on several occasions. Memories contribute to who we are and their preservation across all life stages is linked to our identity. Recalling past events also helps us teach others, maintain our social relationships, or even prepare ourselves for our own mortality (Webster, 1997), while narrations, issues of generativity, and knowledge transfer to younger generations are considered to be important aspects of adult development (McAdams, de St Aubin, & Logan, 1993). Notably, it has been remarked that when people feel that they reach the end of their lives, they tend to record some of their past experiences (Unruh, 1983). Furthermore, shared stories are vital to our sense of community (Grimes, Bednar, Bolter, & Grinter, 2008; Rappaport, 2000). In this study, the sense of community is defined as a feeling of belonging that the group members share, a belief that they are important to each other and to the group, and a common trust that their needs will be fulfilled through their commitment to the group (McMillan & Chavis, 1986).

1.3. Loneliness and memories

Issues of loneliness are among the factors that affect substantially older adults' lives, health condition, and their total well-being. Loneliness is generally referred to as a subjective distressing feeling which is based on the imbalance between one's desired social peers and his/her actual peers (Peplau & Perlman, 1982). It also seems that there are cross-national differences in older adults' loneliness and that aged people in southern European countries tend to feel lonelier than their peers in northern Europe (Fokkema, De Jong Gierveld, & Dykstra, 2012).

There is an extensive ongoing worldwide discussion about possible interventions. Therapeutic processes related to memories prove to have positive effects on reducing feelings of loneliness (Brownie & Horstmannshof, 2011; Chiang et al., 2010). Furthermore, the imagined audience (Litt, 2012) may also function as an antidote to everyday loneliness through writing or speaking. There is also an interesting relationship between loneliness (a negative emotion) and nostalgia (an ambiguous but mainly positive emotion). Loneliness can reduce one's perception of social support and increase

nostalgia, while nostalgia, in turn, nurtures and intensifies the sense of social support, thus counteracting the effects of loneliness (Zhou, Sedikides, Wildschut, & Gao, 2008).

1.4. Digital storytelling, loneliness, and different media

Digital storytelling is the process of presenting a story based on a combination of different digital media, such as texts, images, and sounds. It often starts with creating a basic script on paper, a written narration that is further transformed and extended through the use of digital elements. The produced digital artifact can be easily accessed by others, allowing storytellers to share their stories with a broad audience (Hausknecht, Vanchu-Orosco, & Kaufman, 2019). During the last few years, web 2.0 storytelling has also been applied as a popular form of digital storytelling. The therapeutic and emotional aspects of digital storytelling, considering even issues related to loneliness and well-being, have been broadly acknowledged in the academic literature (de Jager, Fogarty, Tewson, Lenette, & Boydell, 2017; Hausknecht et al., 2019; Lambert, 2013). However, writing on paper, narrating to voice recorders, or thinking about past events may have different or even opposite psychological effects on storytellers (Lyubomirsky, Sousa, & Dickerhoof, 2006) and different software applications may have various outcomes on users' behavior (Peesapati et al., 2010b).

1.5. Maps, memories, and the importance of place

A place is often described as the combination of a particular space and the meaning that is attributed to it (Turner, 2009). Places are important elements that under some circumstances could play a significant role in expounding loneliness. Place attachment has a valuable impact on older adults' well-being (Klok, van Tilburg, Suanet, Fokkema, & Huisman, 2017) and issues of place and space, as notions containing geographical, philosophical, social, and cultural meanings, have been also approached within the field of technology (Dourish, 2006). According to de Certeau (1984), a map is a visual representation of place. It has been stated that maps have the potential to become an archive of our memories and, perhaps, a kind of diary of our journey through life itself (Caquard & Cartwright, 2014). In conclusion, it appears that the intersection of memories, emotions, and places expands the benefits of storytelling, both for narrators and their audiences. Therefore, in the current study, geographical maps have been implemented in the storytelling process.

1.6. Contribution and article overview

Technology and storytelling are beneficial for older adults' well-being. Hence, this article contributes to the multidisciplinary field of technology-mediated storytelling by addressing three main research questions:

Which are older adults' attitudes and behavior toward technology-mediated storytelling?

Which are the perceived benefits and shortcomings for older adults when they use different storytelling media?

Could the usage of different storytelling media lead to diverse outcomes on older adults' feelings of loneliness?

The methodology applied for this study was based on a mix-method approach using both qualitative and quantitative methods for data collection. For this aim, interviews, structured questionnaires, users' diaries, observations, and log files were implemented. Further details are presented in the following sections.

This rest of this paper is organized as follows: Section 2 provides an overview of the related literature. In section 3 the goal and the research questions of this study are described. The methodology is introduced in section 4 and the results are presented in section 5. Section 6 discusses the results according to the reviewed literature. Finally, limitations and future work are proposed in section 7, followed by the conclusion section.

2. Background and related work

New technologies related to storytelling, reminiscing, and content creation (e.g., Brewer & Piper, 2016; Harley & Fitzpatrick, 2009; Jayaratne, 2016; Olsson, Soronen, & Väänänen-Vainio-Mattila, 2008; Waycott et al., 2013), as well as loneliness (e.g., Baecker, Sellen, Crosskey, Boscart, & Barbosa Neves, 2014; Harley, Howland, Harris, & Redlich, 2014; Wherton & Prendergast, 2009), have been a significant topic of research in the field of Human-Computer Interaction (HCI). Considering studies associated with memories, ranging from personal legacy (Gulotta, Odom, Forlizzi, & Faste, 2013; Thomas & Briggs, 2014) and collective storytelling (Dimond, Dye, LaRose, & Bruckman, 2013) to digital companions (Bickmore, Caruso, & Clough-Gorr, 2005), there is a growing body of work on digital capture of experiences. Apparently, diverse storytelling media can reveal different aspects of someone's story (Dena, 2004).

2.1. Digital storytelling and older adults

Digital storytelling is a creative and innovative activity for older adults. It has been implemented in several contexts ranging from lifelong learning

(Hausknecht, Vanchu-Orosco, & Kaufman, 2016) and intergenerational workshops (Hewson, Danbrook, & Sieppert, 2015; Jenkins, 2017; Loe, 2013; Romero, 2016; Sehrawat, Jones, Orlando, Bowers, & Rubins, 2017) to indigenous populations' narratives (Cunsolo Willox, Harper, & Edge, 2013). Several digital storytelling projects have also been related to positive changes on people with memory deficits such as dementia (Park, Owens, Kaufman, & Liu, 2017; Stenhouse, Tait, Hardy, & Sumner, 2013), while others focused on applicable mobile technologies for story creation and communication within local communities (Frohlich et al., 2009), with grandchildren (Quinn, Bederson, Bonsignore, & Druin, 2009), or peers (Waycott et al., 2013).

2.2. Reviewing the outcomes of different storytelling media

Writing diaries (Rodak, 2018) or letters (Binnie, 2019) have been valued as an important activity to combat loneliness. As it seems, the healing effects of storytelling and life review combined with the therapeutic essence of writing bear significant benefits for older adults, especially for those who are at risk of isolation and depression (Lyubomirsky et al., 2006; Robinson & Murphy-Nugen, 2018). According to Bolton (1999), the act of writing one's own recollections and then exhibiting and having them published has even greater potential than the act of telling. Nevertheless, under some circumstances, keeping diaries may bear significant risks to authors, such as confining them in their inner world (Rodak, 2018). Lyubomirsky et al. (2006) found that participants' life satisfaction was lower when they wrote about happy life experiences compared to simple reminiscing. Additionally, keeping notes on paper is more effort and time-consuming compared to other media (Mols, Broekhuijsen, van den Hoven, Markopoulos, & Eggen, 2015).

Sound and audio recordings are also valuable established forms of memory capture. Narrating negative experiences to voice recorders can improve storytellers' mental and physical health, as well as their life satisfaction, compared to simply thinking about them (Lyubomirsky et al., 2006). The sound of human voices, especially those from family members and friends, is one of the most favorite auditions (Hausknecht et al., 2019; Oleksik & Brown, 2008), as the recorded voice memories enclose a unique emotional quality (Grimes et al., 2008; Hausknecht et al., 2019; Massimi & Baecker, 2010). After someone's loss, his/her voice recordings are a type of mementos that his/her family places a high value on (Hausknecht et al., 2019; Massimi & Baecker, 2010). Additionally, from a usability perspective, posting verbal messages is faster (Baecker et al., 2014), easier (Lieberman, 1998), and less intrusive (Oleksik & Brown, 2008; Mols et al., 2015) than writing.

As a result, many inspiring technological interventions have been developed toward that direction. For example, with the Memory Tree (Jayaratne, 2016), a tree-like interactive artifact that supports reminiscing through audio-recorded life stories, users can experience a connection with the storyteller, which is more intimate compared to visual mementos. The FM Radio, a digital sound player for family audio archives, was based on the remark that sounds can rouse more memories and feelings compared to pictures (Petrelli, Villar, Kalnikaite, Dib, & Whittaker, 2010). Likewise, the implementation of EatWell (Grimes et al., 2008), a cellphone-based system for creating voice memories upon nutrition behavior, can have a better emotional effect on users compared to sharing written memories. Campbell, Frohlich, Alm, and Vaughan (2019) in their work proposed future research upon the value of memories triggered by recorded sounds. Interestingly, they resembled the emotional effects of sounds with the role of nostalgia in balancing loneliness. However, audio capturing past experiences has also some disadvantages. Similarly to writing on paper, talking about positive life experiences could reduce storytellers' life satisfaction (Lyubomirsky et al., 2006). Audio recordings may cause embarrassment to the narrators when they listen back to their stories and, also, editing tools can be too complicated for users (Oleksik & Brown, 2008).

Respectively, sharing written stories online has also been beneficial for older adults. Notably, it has been stated that digital technologies and the internet could offer a kind of immortality to the users that have stored their narratives (Manchester & Facer, 2015). Hausknecht (2018) found that older adults make use of digital media in different ways in order to express their life stories. Through blogs, Social Networking Sites (SNSs), and other online tools, users achieve substantial improvements regarding self-exploration, identity development, and well-being. Furthermore, they support communication with families, social interactions, socialization, and sense of community (Brewer & Piper, 2016; Chonody & Wang, 2013; Olsson et al., 2008). Web-based platforms for collecting memories to promote interactions between older adults and children (e.g., Morganti, Riva, Bonfiglio, & Gaggioli, 2013), as well as systems that trigger reminiscing and sharing life stories through mobile devices (e.g., Olsson et al., 2008), have also been proved to be valuable for older users. Nevertheless, age-related declines often lead to keyboard and mouse usability difficulties (Loos & Romano Bergstrom, 2014). Moreover, while online platforms are valuable tools for communicating, creating, and sharing digital content, receiving unpleasant comments can have negative effects on older authors (Lazar, Diaz, Brewer, Kim, & Piper, 2017). The most representative benefits and shortcomings of the aforementioned media are shown in Table 1.

Table 1. Benefits and shortcomings of different media use.

Category	Benefits	Shortcomings	Type of feedback	Age of participants	Reference
Paper/Diary	Relief from anxiety, depression, loneliness, etc. Resembles oral communication.	May confine the author in his/her inner world, hindering contact with others.	Literature overview	n.d.	Rodak (2018)
Paper/Letter	Alleviates loneliness. Positive outcomes to mental well-being.		Qualitative, quantitative	Intergenerational	Binnie (2019)
Paper		Time and effort consuming.	Qualitative, quantitative	18–25	Mols et al. (2015)
Paper, Computer	Creative, mentally stimulating, and psychosocial rewarding.		Qualitative	75–90	Robinson and Murphy-Nugen (2018)
Paper, Sound	Improves life satisfaction, mental and physical health compared to simple reminiscing when focused on negative life experiences.	Lower life satisfaction when focused on positive life experiences, compared to simple reminiscing.	Quantitative	17–38	Lyubomirsky et al. (2006)
Sound	Triggers imagination, feelings, and memories. Quick and easy to use, spontaneous, less intrusive. Relationship between sound and visual/emotional reconstruction of time and space.	May cause embarrassment to the narrator when listening back to himself/herself. Complicated and time-consuming editing tools.	Qualitative	Families	Oleksik and Brown (2008)
Sound Sound	Easier than writing. Less intrusive.		Qualitative Qualitative	n.d. 18–25	Liberman (1998) Mols et al. (2015)
Sound	Recorded voice memories have a better emotional quality compared to written experiences.		Qualitative	18–54	Grimes et al. (2008)
Sound	The recorded voices of beloved people that have passed away evoke strong memories and emotions.		Qualitative	18–65	Massimi and Baecker (2010)
Online	Statistical valid relationship between web 2.0 image and sound tool usage and		Quantitative	55+	Díaz-Prieto and García-Sánchez (2016)

(continued)

Table 1. Continued.

Category	Benefits	Shortcomings	Type of feedback	Age of participants	Reference
Online/Sound	perceived loneliness. Voice recording is faster than writing/typing.		Qualitative	65–90	Baecker et al. (2014)
Online/Writing	With writing/typing users have the time to think about what to mention.		Qualitative	65–90	Baecker et al. (2014)
Online/Writing	Loneliness reduction.		Quantitative	18–22	Deters and Mehl (2013)
Online/Writing	Promotes identity development, social interactions, sense of community.		Qualitative	65–82	Brewer and Piper (2016)
Online/Multimedia	Memory sharing strengthens social bonds and creates a sense of community and belonging.		Qualitative	18–80	Olsson et al. (2008)
Online/Writing	Sharing stories with others. Communication with their families.		Qualitative	65–85	Chonody and Wang (2013)
Online/Writing		Receiving offensive comments by others can have negative effects on authors.	Qualitative	50+	Lazar et al. (2017)
Online/Writing		Age-related usability difficulties when using the keyboard and/or the mouse.	Literature overview	n.d.	Loos and Romano Bergstrom (2014)
Online/Multimedia platform	Promotes cross-generational interactions. Connection between reminiscing and loneliness reduction.		Qualitative, quantitative	Older adults and children	Morganti et al. (2013)

Additionally, research upon online technology use has revealed different or even contradictory outcomes in terms of users' loneliness (Aarts, Peek, & Wouters, 2015; Deters & Mehl, 2013). However, Morganti et al. (2013) emphasized the connection between reminiscing and loneliness reduction and Deters and Mehl (2013) found that posting Facebook status updates had a reducing effect on users' loneliness regardless of whether their posts were answered or not. Díaz-Prieto and García-Sánchez (2016) found that

the use of web 2.0 image and sound tools by older adults was related to less perceived loneliness. Furthermore, online platforms like text-based virtual worlds (McRae, 1997) and massively multiplayer online games where players use avatars and communicate with each other through text messages (Ducheneaut, Yee, Nickell, & Moore, 2006), appear to provide users a sense of social presence and an audience, which could be effective in alleviating loneliness.

2.3. Digital storytelling and benefits of maps

Maps have also been used as tools that depict the spatiotemporal dimension of oral, written, or audio-visual stories (Caquard & Cartwright, 2014). Storytellers often take advantage of digital maps to locate and depict their personal memories. Historytelling (Volkman, Sengpiel, & Jochems, 2016), Collective City Memory of Oulu (Ringas, Christopoulou, & Stefanidakis, 2011), and Hollaback (Dimond et al., 2013) are only some of the projects used to depict personal memories on a common map. Moreover, Nold's (2009) Emotional Cartography included a creative combination of different elements, such as digital technologies, experiences, emotions, and places. Other, place-related virtual tools such as Google Streetview can further facilitate older adults' storytelling needs, trigger nostalgia, and spark users' positive feelings (Peesapati, Schwanda, Schultz, & Cosley, 2010a). Matassa and Rapp (2015) proposed a framework for a mobile application, through which users can store, visualize, and share their recorded memories, enriched with their emotions and the geographical places where they happened. What is more, in his research on a map-based crowdsourcing application, Ramos (2017) noticed that users developed through their avatars a sense of presence within the group of others.

2.4. Older adults' attitudes and behavior toward technology

In this article, behavior is defined as people's activities responding to internal or external stimuli, including objectively and introspectively observable activities, as well as non-conscious processes. Additionally, attitudes are described as lasting and general evaluations of individuals, objects, groups, topics, and notions. Attitudes range from positive to negative and they usually come from our beliefs, emotions, and previous behaviors that are related to the target issue (VandenBos, 2015). As for technology, it is not confined to digital devices and software applications but is a broader term that also includes traditional artifacts (Czaja et al., 2019).

Age-related deficits of our sensory and cognitive processes, as well as movement control, take place across the life span and impact human behavior (Loos, 2012). Regarding technology adoption, our behavior is affected by our intentions which are further influenced by our attitudes. However, older adults' choices regarding adoption or rejection of new technologies are not always based on usability (Knowles & Hanson, 2018). Although older adults hold mostly positive attitudes toward new technologies (Alexandrakis, 2019), they are more reserved regarding adoption compared to younger age groups, partly because they feel less comfortable and more anxious about technology usage (Czaja et al., 2019). Furthermore, it seems that people are deeply influenced by the life stage they are in, as well as the socioeconomic environment and the technology available during the period they were teenagers and young adults (Ivan, Loos, & Bird, *in press*; Loos, 2012; Loos & Romano Bergstrom, 2014), a fact that could also explain older adults' attitudes, preferences, and behavior patterns toward traditional media. According to Knowles and Hanson (2018), their sense of social responsibility, also explains, up to a point, their resistance to new technologies.

3. Goal and research questions

On the one hand, digital storytelling is a beneficial activity for older adults. On the other hand, loneliness is an important issue for the elderly and a lot of work has focused on the design and the emotional outcomes of technology usage. However, there has been a lack of research regarding the comparison of the usability and emotional effects of the different kinds of media used in the digital storytelling process. According to the literature presented in the previous sections, each storytelling technology has a unique combination of advantages, disadvantages, psychosocial, and emotional outcomes. Nevertheless, technology adoption is determined not only by the tool qualities but also by end-users' attributes, such as their attitudes and behavior. As follows, the goal of this exploratory study is to enrich our knowledge on technology-mediated storytelling, the interactions, and the outcomes that different kinds of media (paper, voice recorder, and web platform) have on older adults. The research questions are

RQ1: Which are older adults' attitudes and behavior toward technology-mediated storytelling?

RQ2: Which are the perceived benefits and shortcomings for older adults when they use different storytelling media?

RQ3: Could the usage of different storytelling media lead to diverse outcomes on older adults' feelings of loneliness?

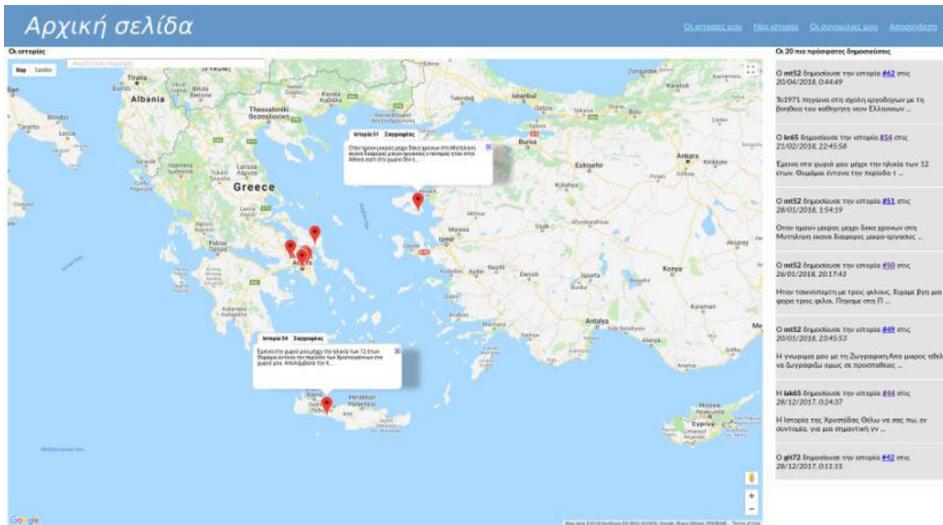


Figure 1. The initial page of the online storytelling probe.

As memories and reminiscing apply to a multidisciplinary research field, this study was based on previous findings and ideas from HCI, Geriatrics, and Cartography. To the best of our knowledge, there is no similar research in the literature.

4. Methodology

An exploratory case study has been conducted, based on a multiple-case embedded design (Yin, 1994). Data were collected using semi-structured home interviews and structured questionnaires. They were further enriched by users' diaries, based on the diary-interview method (Zimmerman & Wieder, 1977), as well as the log files and researchers' observations.

Methodologically, this study was triggered by Mogensen's (1992) work on provocation through concrete experience. In particular, the main idea was to get older adults to experience storytelling in alternative ways by provoking practice with different media. Also, regarding RQ1, some principles of reflective design (Sengers, Boehner, David, & Kaye, 2005), such as supporting users in reflecting on their lives and enhancing reflection through technology-mediated dialogic engagement between researchers and participants, were implemented during the interviews in order to examine participants' attitudes and implicit cultural assumptions.

4.1. Materials

The web platform is a prototype for storytelling (Figure 1). Its specifications were determined by the purpose of the study as well as the guidelines

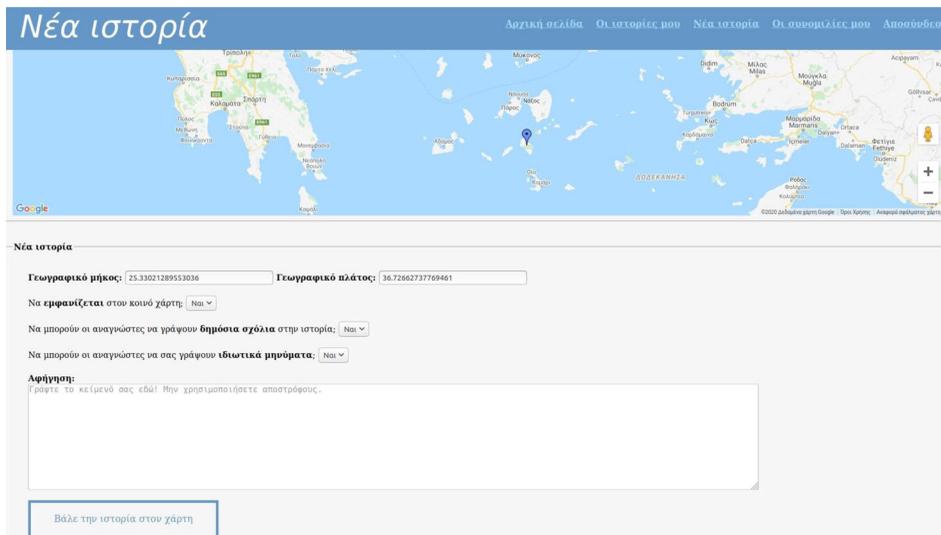


Figure 2. The story creation page of the online storytelling probe.

proposed by other researchers and designers for older adults (Peesapati et al., 2010a; Thiry & Rosson, 2012). Users could write and edit their stories, use pointers to locate those stories on a collective digital map (Figure 2), as well as read and comment on others' narratives. The Streetview function and log files were also activated.

The paper probe kit contained notebooks, paper maps, pens, and stickers. Similarly to the web platform, participants could write and edit their stories in the notebook, select a proper map for each story and indicate with a sticker the geographical location where their described experience occurred. Each author had access only to his/her records, except for the case of two participants who lived together and could read each other's stories.

With the voice recorder, which was a common device for all the participants, storytellers could record, delete, and playback their narrations, as well as listen to the stories of others. Also, they had the option to use paper maps if they wished to.

The implementation of the paper medium was inspired by Gaver, Dunne, and Pacenti's (1999) cultural probes. The other two digital media (voice recorder and web platform) were inspired by Hutchinson et al.'s (2003) work with technology probes. Although a more precise term for each recording medium would be "a set of reminiscence recording equipment", in the current study, they are referred to as "media" or "probes" for practical reasons.

4.2. Participants

A convenience sample of five older adults in Attiki (Greece) was recruited for this study. All participants, three men and two women aged 59–73 years

Table 2. Participants' background.

	Gender	Occupation before retirement	Educational level	Socioeconomic status	Family status	Technology efficacy
S1	Female	Primary school teacher	University degree	Middle	Married, two children	High
S2	Male	Academic	University degree	Middle	Married, two children	Low
S3	Female	Secondary school teacher	University degree	Middle	Married, two children	Low
S4	Male	Car mechanic	High school diploma	Low	Married, no children	Medium
S5	Male	Factory worker	Primary school certificate	Middle	Married, two children	Very low

(mean = 66, sd = 4.47), provided written informed consent as a prerequisite to be included in the current project. Participants are referred to by their ascending abbreviations, from S1 to S5. Two of them were married to each other (S2, S3). They were all healthy pensioners from a wide range of occupations, educational levels, socioeconomic and family statuses. As for their experience with new technologies, they varied from novice to expert users and they were all living in their homes with their spouses (see Table 2). The majority had access to the internet through one device (desktop pc, laptop, or tablet) and only one participant used both her smartphone and her desktop pc (S1).

Initially, the sample consisted of six individuals, but a participant quit before the second session. Although there was an effort for more participants to be recruited, it proved to be difficult due to two main reasons. First, the number of older adults in Greece that have access to the internet remains quite low (Eurostat, 2019). Second, many individuals that were qualified for this study kindly refused to participate mainly due to a shortage of spare time, a fact that is often depicted in the literature (Knowles & Hanson, 2018) and could also enclose their disinterest in digital storytelling or in doing something to address loneliness. Other researchers had also faced similar difficulties when recruiting older adults for computer interaction sessions (Dickinson, Arnott, & Prior, 2007).

4.3. Procedure

The project comprised of the starting interview session and three storytelling tasks, each of which was followed by another interview session. During the tasks, older adults should recall one or more meaningful life events from their past and record them to the indicated probe (voice recorder, paper notebook, or website). After each recording, they were expected to

keep notes in the paper diary regarding their experience using the technology. The recording medium was different in every task and the sequence of the media implementation was random for each storyteller. The researchers were not present during the storytelling tasks, the period of which ranged from one to three weeks depending on older adults' performance. The participants were free to record as many memories as they wanted until the next interview session.

Each interview session was conducted with one participant each time in his/her house, except for the participants S2 and S3 who took part in the same sessions. At the start of every session, they had to fill in the Greek translation of the UCLA Loneliness Scale (Kafetsios & Sideridis, 2006). Thereafter, a semi-structured interview was conducted during which the storytellers provided feedback about the tasks they had completed. After that, they were introduced and trained to the recording probe they should use during the following storytelling task.

4.4. Data analysis

Based on Thematic Analysis (Braun & Clarke, 2006), an iterative approach was used in order for the researchers to identify, analyze, and interpret the codes and themes that emerged from participants' feedback. The flexibility of Thematic Analysis, its capacity to pick out similarities and differences within the data set, and the fact that it allows social explanations of the data are only some of the advantages that make it suitable for research with multiple media and heterogeneous samples of older adults (Alhojailan, 2012; Braun & Clarke, 2006). Finally, the coding procedure led to the identification of seven core themes: attitudes, behavior, and preferences toward media use for storytelling; attributes of the recorded memories; attitudes and behavior during self-presentation; benefits and shortcomings of the voice recording medium; benefits and shortcomings of the paper recording medium; benefits and shortcomings of the web recording medium; web 2.0 storytelling, sense of community, and loneliness. The aforementioned themes that emerged from the data are embedded in the following section and are extensively discussed separately in the Discussion section.

5. Results

In this section, the findings of the study are presented in accordance to the research questions. Further information can be retrieved from our recent article (Alexandrakis, Chorianopoulos, & Tselios, 2019).

5.1. General observations on older adults' attitudes and behavior

All participants enjoyed the sessions, as they had a visitor in their home, and the storytelling tasks. Four participants (S1 to S4) had many daily activities and a shortage of spare time. S1 admitted at the end of the last session that this project kept her active and creative and that her storytelling activities during the tasks often made her escape from her daily problems. Finally, ten stories were audio-recorded, six stories were written on paper, and nine stories were posted online.

The majority (S1 to S4) were positive toward the storytelling procedure and they were satisfied with having their memories recorded. They all admitted that they felt like professional creators during the recordings, and some of them (S1, S4) expressed the desire to continue recording on their own. S1 and S2 combined reminiscing and story recording with pleasant everyday habits, such as having a cup of coffee. Nevertheless, they all stated that the most enjoyable process is reminiscing and telling their stories directly to their audience, a behavior that was obvious during the interviews. Storytellers were mostly interested in their recordings and less in others'. When they were asked if they would like to narrate stories to non-human agents (e.g., bots) all participants rejected this idea, revealing a clear negative attitude toward these technologies.

S3: Enough is enough with artificial interlocutors. Sometimes, I call the doctor or the hospital to make an appointment and ... Oh, my ... It seems awful to me.

S5: Artificial Intelligence? No, I prefer humans. With their mind and my mind.

Facebook was the most common SNS among the interviewees. However, only S4 was willing to use it for storytelling, while S1, S2, and S3 excluded the possibility of such an activity. Especially for S2 and S3, SNSs are regarded as technologies that are mostly addressed to younger generations and, also, Facebook usage hinders people from enjoying life in the physical world.

The most common topics of their depicted memories were events from their childhood associated with the place where they were born and raised. Notably, those places were different from the places where they live. Other topics were enjoyable stories from the first two decades of their adulthood, stories with people that do not live anymore, as well as recollections containing personal achievements or adventures. Although some stories contained negative sentiments or descriptions of unpleasant circumstances, the dominant feelings after each recording were positive (e.g., nostalgia, satisfaction, pleasure).

All participants were asked if they would allow others to have access to their stories for reading/listening or making comments. As for the former, although their answers were positive, they mainly preferred their audience

to be younger generations, people that were mentioned in the stories, their families, and their friends. In the case of a specific story, S4 expressed spontaneously a general desire for his mother, who had passed away, to have access to his story. All of them mentioned that their stories were significant life lessons and people could benefit from them. However, S1 was convinced that young people avoid older people's stories in the real world and S3 complained that every time she tried to tell her kids an event from her past, they refused to listen.

S3: I meant my children, but they get bored and their attitudes disappoint me. ... But when people are at a young age, they don't listen to the older ones. And the years go by and when they want to ask older people, they don't have them. So, I try to tell my children, and I try... until they react and tell me "stop it, you got us dizzy". And I stop.

After specific recordings, S1, S2, S3, and S4 seemed to have an implicit hope that their stories will be retrieved by their preferred audience. As for the comments they might receive from other users, their attitudes seemed to be positive and they initially declared that everyone was free to comment on their recorded memories. However, after a closer examination, it was obvious that most of them (S1 to S4) were anxious about receiving negative messages.

S1: I don't like it if there are too many people sending and receiving messages without control. I believe that everyone can have access to the stories. But if I start a conversation upon a specific story, as I have said... Because there are people who may make me sad. Or disappoint me.

Although they stated that they might write comments to authors of interesting stories, their behavior was different; they did not post any message despite the fact that some users found merit in others' stories. After further discussions, it has been realized that the Greek translation of the phrase "make a comment", had a negative meaning for them, often implying an offending action toward the addressee.

S4: I wouldn't comment on a story in an open group. First, I would ask the storyteller for his permission and then I would express my opinion to him.

5.2. The voice probe evaluation

The use of the audio recorder led to contradictory outcomes. S1, for example, was nervous during the recordings as she had to narrate her memories to a device instead of a person. On the contrary, S4 was fond of the process and he was thinking of acquiring himself a similar recorder to continue storytelling after the end of the project. All participants mentioned that a major disadvantage was that they could not edit their

recordings in order to make distinct changes in some narrations. Although manipulating the probe was quite easy, they had to be well prepared, as storytellers, before the start of each recording (S2, S4, S5). A general sense of time pressure and stress was undeniably present whilst narrating.

S1: I had a sense of time pressure while recording my voice. I don't know. As if someone was after me and I had to finish my narration. ... I wanted to hear my voice recording, in case there was something to add, because I was anxious while narrating. I was anxious and I wanted to hear what I had recorded.

Most of them chose to be alone and isolated during the recordings to avoid being interrupted by others or including unwanted sounds from their environment (S1, S3, S4). During the interview, all participants declared that they would like to listen to others' recorded stories. Nevertheless, they avoided it because of their worries that they might erase by mistake some recordings, the lack of spare time, or the lack of interest. An important finding that came up during the sessions was also the value of the human voice.

S2: Listening can be something different. It's the sound of the narrator's voice. It is very important. The emotions that you have while listening to it can be different.

Although users mostly preferred the other two media for storytelling, audio recordings were acknowledged as a kind of durable fingerprint of a person that may not live anymore (S3, S4). S3 asked us several times to provide her the audio recordings to hear her voice, while S4 mentioned that he had recorded his mother's voice in the past and, nowadays, after his mother's death, he sometimes plays back the audiotape with her narrations. Furthermore, a month after the end of the project, S5 had a sudden heart attack and unfortunately passed away. Then, his son contacted the researchers and asked for a copy of the recordings with his father's voice.

5.3. The paper probe evaluation

Writing stories on paper was the easiest task for all the participants. Despite some minor problems that came up during the project, such as a small injury on S1's wrist that prevented her from using her hand efficiently or S5's worries about spelling mistakes he makes during writing, all participants were comfortable and most of them (S2 to S5) preferred using the paper probe. S1, S3, and S4 admitted that, during this task, they discovered how much they liked writing down their memories. With this medium, writers could edit their stories and they had more time available to recollect and enjoy the described events while writing (S1 to S4). Also, S2 and S3 stated that after they had finished writing their stories, they had a feeling of safety that their memories would not

be lost. During the recordings, most of the participants tried to be alone to focus on their tasks (S2, S3, S4). As for the paper maps, they did not seem to be quite useful.

5.4. The web probe evaluation

Although posting stories online had many similar benefits to writing on paper (e.g., feeling safe having their memories stored, having more time to think about the described event and form their narration during the recordings, text editing) they further indicated some significant attributes. Despite the fact that most of them preferred writing on paper instead of typing (S2, S3, S4, S5), they all declared that they wanted to have their stories online. That was because they considered the web probe as (i) a safer, more reliable, and more attractive tool compared to paper in order to store, access, and communicate their memories (S1, S5), (ii) a technology that could facilitate younger generations to have better access to their stories, and (iii) a tool that provided them automatic spelling correction and text formatting (S1, S2, S3).

S1 found typing easier than writing and writing better than voice recording, even though she had her wrist damaged. Contrary to paper maps, online maps were a valuable part of the storytelling process. As for the Streetview, most of the users were so excited when they visited virtually their hometown that they were inviting others who were in the house at that moment to come and see that place (S1, S4, S5). According to S4, the only participant who agreed to post stories both on the website and in his Facebook account, the two platforms were used for different purposes; the recorded memories on Facebook were posted so that his friends could read them, while in the platform he had stored the same memories just for himself. The design simplicity of the probe was also an advantage compared to other online applications (S1). In general, most participants (S1 to S4) mentioned that they would prefer this platform to be accessible only to a group of five to fifteen users.

Safety issues and trust were also essential. Two participants (S1, S3) were worried about the map markers and other self-reported geographical information depicted on the platform which could be acquired by burglars. Although no one sent any message to the others, they all felt a connection and, somehow, a kind of sense of community with each other, just by having their personal stories posted online on a commonplace.

S2: I believe that when you take part in a team, there is some kind of companionship with the other participants.

S4: Somehow, you are part of the family... with one or two storytellers that you liked their stories.

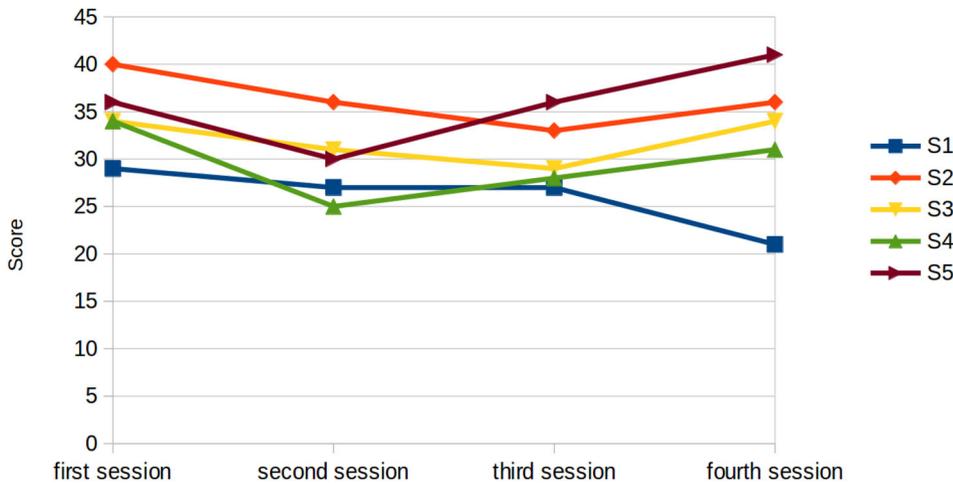


Figure 3. Participants' loneliness scores during the course of the project.

At the end of the web probe interview session, researchers presented the platform through a smartphone (screen display size: 5.0 inches, resolution: 720×1280 pixels). Apart from S4 who was negative about accessing online services through smartphones, all other users liked the view of the platform on the mobile screen and were fond of the idea of its portability. S1 would like to have a device to access stories while sunbathing on the beach and S2 mentioned that such a device could be handy when he meets his friends. A disadvantage was the small size of the screen, especially for typing.

5.5. Loneliness

In each session, the participants were asked if they had perceived any change regarding their feelings of loneliness during the last storytelling task period. Although they always declared that they had not noticed any change, their scores in the questionnaire indicated some interesting facts. First, the participants had a decrease in their loneliness scores after the start of the project and an increase near its end, in the third or fourth session. The only exception was S1 whose loneliness did not increase in any part of the study (Figure 3). Second, and most important, each storyteller's lowest point of loneliness was scored just after the end of the web storytelling task period (Table 3). It should be pointed out that the sequence of the recording media was different among the participants.

The UCLA Loneliness Scale that was implemented in this study includes 20 items that sum up to a number from 20 to 80. A lower score indicates a lower degree of perceived loneliness. Although this scale lacks cutoff scores, preliminary sub-groups have been used in several studies, such as in Perry's (1990) work. According to the classification in her research, a score

Table 3. Participants' loneliness scores after the use of each recording tool.

	Before storytelling tasks	After voice probe	After paper probe	After website probe
S1	29	27	27	21
S2	40	36	36	33
S3	34	31	34	29
S4	34	31	28	25
S5	36	41	36	30
Average	34.6	33.2	32.2	27.6

of 20–34 is labeled as a low degree of perceived loneliness and 35–49 as a moderate degree. At the start of the current project, three participants (S1, S3, S4) had a low degree of loneliness (29, 34, and 34 respectively) and two storytellers (S2, S5) a moderate degree (40 and 36, respectively). The average loneliness score was 34.6 at the start of the project, 33.2 after the voice storytelling period, 32.2 after the paper storytelling period, and 27.6 after the online storytelling session. The difference between each storyteller's initial loneliness score and the score after the web storytelling process ranged from 5 to 9 measuring points (14.7% to 27.6%). The two participants who had recorded the most stories on the web platform (S1, S4) had the maximum decrease in their loneliness scores compared to the start of the project (27.6% and 26.5%, respectively).

6. Discussion

6.1. Attitudes, behavior, and preferences toward media use for storytelling

Although the subject of this study was digital storytelling, it was obvious during the interviews that the participants preferred narrating their stories directly to their audience without using any media, which corresponds to Morganti et al.'s (2013) findings. Besides, older adults seem to prefer physical to digital forms of communication and socializing (Knowles & Hanson, 2018; Sayago & Blat, 2010). Additionally, they rejected the idea of communicating their memories to digital agents which opposes the results of Bickmore et al.'s (2005) project with an animated conversational agent for older adults, as well as Sin and Munteanu's (2019) work on telehealth bots for older adults. Three participants disliked posting their stories on SNSs, a fact that goes with Nosko, Wood, and Molema's (2010) findings, according to which as a user's age increases, disclosure of personal information on Facebook decreases. Similarly, Knowles and Hanson (2018) reported many older adults' aversion to SNS use. As for their audience, although storytellers declared that their stories could be accessed by anyone, they favored younger generations, friends, and family (Brewer & Piper, 2016; Volkmann et al., 2016). In agreement with Robinson and Murphy-Nugen's (2018) project which focused on a life review writing group of older adults, an

interviewee acknowledged that storytelling activities kept her mind active and they were an enjoyable and creative break from her daily issues.

6.2. Attributes of the recorded memories

The interviewees mentioned that their recorded memories can be used as life lessons to others, a finding that is also confirmed in the literature (Chonody & Wang, 2013; McAdams et al., 1993; Webster, 1997). The life periods that those events took place were mostly their childhood and the first period of adulthood, which is congruent with the "reminiscence bump", a phenomenon which refers to the tendency of people to recall more memories from the period of their life between 10 and 30 years of age (Glück & Bluck, 2007). Similar to Lyubomirsky et al.'s (2006) findings, participants had a positive emotional state after recording unpleasant experiences. Some stories were related to participants' home places, while other categories were achievements or adventures they had lived and friends that had passed away. Perhaps the last one, among others, could be also seen as a means for intimacy maintenance or even to get accustomed to the idea of one's own mortality (Webster, 1997). This fact, combined with a participant's desire for including his mother in the preferable audience of a story, reminded us of the literature related to digital technologies for legacy and bereavement (Brubaker & Callison-Burch, 2016; Hausknecht et al., 2019; Staley, 2014).

6.3. Attitudes and behavior during self-presentation

Olsson et al.'s (2008) findings regarding users' positive attitudes toward receiving comments on their shared memories, were not fully confirmed in this study. The fact that the interviewees might receive comments upon their stories often triggered a sense of anxiety, because of the possibility of someone posting offending content. Respectively, they did not write any comments themselves. There are several reasons for users to have reserve attitudes toward commenting and this has also been depicted in the results of the Morganti et al.'s (2013) and Grimes et al.'s (2008) projects, as well as Lazar et al.'s (2017) findings on the damaging effects of public blog comments. Also, anxiety was obvious to an interviewee because of the spelling mistakes he usually made while writing/typing. Some answers could be sought in the self-presentation field; people's self-presentation attempts before real or imagined audiences could trigger social anxiety (Schlenker & Leary, 1982). Under this scope, as social anxiety is linked to the prospect of personal evaluation, even in imagined social situations, the act of exhibiting personal stories and the likelihood of receiving undesirable comments

could be a source of anxiety for some participants. Consequently, four participants preferred the digital platform to have only a few users, which follows Olsson et al.'s (2008) findings, and three disliked the idea of using SNSs for storytelling.

6.4. Benefits and shortcomings of the voice recording medium

Narrating memories to a voice recorder was an easy and quick procedure (Baecker et al., 2014; Oleksik & Brown, 2008). Although the process was characterized as joyful, spontaneous, or even playful by the participants of other sonic recording projects (Baecker et al., 2014; Grimes et al., 2008; Oleksik & Brown, 2008), in this study, users focused mostly on the shortcomings. The lack of editing tools (Oleksik & Brown, 2008), a sense of time pressure while recording, anxiety, which might have been caused by the possibility of feeling vulnerable or being embarrassed by the audience (Oleksik & Brown, 2008), and a technophobic attitude toward this device, made the voice recorder the least popular among the three media. Interestingly, anxiety has a negative effect on perceived ease of use of technology, which, in turn, determines its acceptance by the user (Hackbarth, Grover, & Mun, 2003). Also, there might be a possible connection between anxiety and speech. Similarly, according to Satar and Özdeneron's (2008) experiment in text-chat and voice-chat computer-mediated communication, their participants' level of anxiety was decreased only in the text-chat group. Storytellers usually chose to remain physically isolated from others, a behavior also observed in the study of Mols et al. (2015) upon the use of different capturing technologies for remembering. An interesting finding came up when the focus was moved from recording stories to accessing stories of beloved deceased persons; people that were left behind seem to regard audio recordings as precious and, perhaps, more important than paper or digital text records, which is compatible with the findings in the Oleksik and Brown's (2008) study on the potential of sonic recordings for memory capture, as well as Massimi and Baecker's (2010) research upon technology, digital assets, and bereavement.

6.5. Benefits and shortcomings of the paper recording medium

Writing on paper was the most familiar and convenient process. Four storytellers preferred using the paper probe, despite the fact that telling stories is faster (Baecker et al., 2014) and easier than writing on paper (Lieberman, 1998). This appears to confirm that older adults are deeply influenced by the technologies available when they were young (Ivan et al., *in press*; Loos, 2012; Loos & Romano Bergstrom, 2014). Three of them also

chose to be alone during the recordings to better concentrate on their tasks (Mols et al., 2015). After each recording, two interviewees had a calm feeling of assurance that the events that had described will not perish over time. Additionally, they had plenty of time to reminisce, reflect, format, and edit their texts at their own pace (Baecker et al., 2014). However, a specific health problem created difficulties for an author who should handle pencils or pens. Despite the aforementioned benefits, all participants recognized the fact that digital media bear many important advantages compared to the traditional ones.

6.6. Benefits and shortcomings of the web recording medium

Posting stories online included many of the advantages of writing that were presented above. Although age-related declines impact keyboard and mouse usability (Loos & Romano Bergstrom, 2014) and, also, a sense of technology exclusion was obvious in one participant, all of them, especially the participants who complained that kids avoid listening to older adults' stories, acknowledged the remarkable usefulness of this probe for communicating their stories to younger generations (Chonody & Wang, 2013; Hausknecht et al., 2019; Morganti et al., 2013; Thomas & Briggs, 2014). It seems that some participants had an implicit expectation that through this project, their memories would eventually reach out to their children. The "scripta manent" reassuring feeling, which was observed during the paper probe usage, was stronger in the case of the web probe. Furthermore, during typing, they had plenty of time to reminisce and edit their narratives (Baecker et al., 2014). The web probe was valued as a more reliable, accessible, and durable memory archiving tool compared to the other two probes. This is in disagreement with the findings of Thomas and Briggs's (2014) research on lifelogging, in which the participants worried about the risk of losing digital information because of the constant technological changes. Also, there were some safety considerations upon self-reported geographical information uploaded on the platform.

6.7. Web 2.0 storytelling, sense of community, and loneliness

It appears that web 2.0 storytelling activities affected users' feelings of loneliness, as well as their sense of community. Notably, they had not met each other and they never communicated during the project. According to previous studies, sharing memories and thoughts online generates a feeling of community (Brewer & Piper, 2016; Olsson et al., 2008). Furthermore, the two participants with the maximum decrease on the loneliness scale were also the most technology-literate users and the ones with the most stories

posted online. Similarities and possible explanations could be found on previous studies on SNSs (Deters & Mehl, 2013) and other collective storytelling systems (Dimond et al., 2013; Grimes et al., 2008; Ringas et al., 2011), as well as on text-based virtual worlds (McRae, 1997), map-based crowdsourcing applications (Ramos, 2017), and online games (Ducheneaut et al., 2006). Perhaps, their story pointers on the collective map and their posted memories could have also served as a kind of personal avatars in the digital world of the platform. Although from a different perspective, due to Bolton (1999), the act of writing one's memories and having them published has greater potential even than the act of telling. Additionally, considering the interaction between nostalgia and loneliness (Zhou et al., 2008), triggering nostalgia through collective storytelling media, supported by visual representations of important places, e.g., digital maps and Streetview (Matassa & Rapp, 2015; Peesapati et al., 2010a), may also justify the decrease in participants' loneliness.

Projects that measure and compare the loneliness scores of a small number of participants are not common in the literature. However, they are not rare either. For example, there is the study of Larsson, Nilsson, and Larsson Lund (2013) on five older adults who used different sets of tools for social internet-based activities, as well as Julsaksrisakul, Chernyshov, Nakatani, Tag, and Kunze's (2017) project with five users who tested different demos of a pet robot. However, in both cases, the authors suggested that further investigation should be conducted.

7. Limitations and future work

Owing to the small size of the sample, no generalization should be derived. Also, additional limitations, such as the small duration of the research, the fact that the sample included only Greek older adults, and the lack of high scores on the loneliness scale, prompt our suggestions for future work: (i) Repeat the research with a larger sample, (ii) expand the research duration, and (iii) include people from different cultures and levels of loneliness.

8. Conclusion

Digital storytelling is a beneficial process for the aged population. It usually combines the implementation of several different media, such as paper notebooks, voice recorders, and online technologies. Thus, this exploratory case study focused on older adults' technology-mediated storytelling, the interactions, and the outcomes of different kinds of recording media. For this purpose, five individuals were given access to a voice recorder, paper notebooks, and a website, combined with other supportive material. Home semi-structured interviews, diaries, log files, and questionnaires were

implemented for data collection. According to the results, although older adults preferred unmediated communication, they were positive toward specific types of technology-mediated storytelling for several reasons, such as the ease of accessing younger generations and memory preservation. They had similar attitudes and behavior regarding commenting and most of them were negative toward SNSs and Artificial Intelligence (RQ1). Although each medium carried different advantages and shortcomings (RQ2), the web platform had the most prominent effect on reducing participants' loneliness (RQ3). These findings, among others, were discussed under the scope of the related literature. Nevertheless, due to the small size of the sample, as well as other limitations of this research, further examination and future work are suggested.

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Data availability

The data that support the findings of this study are available from the corresponding author upon request.

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