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Older Adults and Web 2.0 Storytelling Technologies: Probing the Technology Acceptance Model through an Age-related Perspective

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ABSTRACT

Although digital storytelling bears significant benefits for older users, much remains to be explored regarding their psychosocial attributes that could affect technology acceptance. The Technology Acceptance Model (TAM) is one of the most influential theoretical frameworks in the field and since its first introduction, there have been numerous studies upon its potential modifications throughout different cultures. Based on three factors that have been extensively depicted in age-related literature (chronological age, loneliness, and future time perspective), in this research, we designed a TAM extension in order to gain insights on the elements that influence Greek older adults' intentions to use online storytelling applications. Through a quantitative approach, we evaluated the proposed model with data collected from 112 participants. Due to our results, TAM has been validated as a robust model, future time perspective had a positive influence on perceived ease of use, while age and loneliness had no statistically significant effect.

1. Introduction

The population of older adults rises globally. It has been estimated that in 2030 there will be more people aged 60 or over than children under 10 years old. Furthermore, in 2050 older adults will have outnumbered people of ages 10 to 24 (United Nations, 2017). At that time, Japan, Spain, Portugal, Greece, and the Republic of Korea will be the countries with the highest percentage of older adults worldwide.

It seems that technology adoption grows among older citizens (e.g., Anderson & Perrin, 2017). However, the percentage of Greek older adults that use the Internet is one of the lowest within the European Union (Eurostat, 2017). Older adults are a highly diverse group of technology users. Beside the apparent differences in technology adoption rates and activities between younger and older adults, there is also heterogeneity within the older adult population itself (Hargittai et al., 2019; Van Boekel et al., 2017). According to Knowles and Hanson (2018), older adults have become more digitally literate; nevertheless, the stereotype of the technology-resistant older generation is still widespread. Nowadays, given the continuous digital integration of the society, the digital divide between the citizens who can use technologies and those who cannot may be more detrimental for the latter group.

A common argument for understanding older adults' behavior as technology non-users is usually attributed to the physical impairments that often come with age. Although these limitations do exist on many occasions, it seems that this is not the case (Waycott et al., 2016). Overall, there is evidence that technology adoption is not just a matter of usability or accessibility for older adults. The social and cultural contexts, as well as the personal preferences of the potential users, are some of the factors that could help us explain older adults' technology adoption or rejection (Knowles & Hanson, 2018; Waycott et al., 2016). Older adults not only consist of a heterogeneous group of citizens with different needs and abilities, as we have previously mentioned, but it also seems that their diversity increases with age (Nelson & Dannefer, 1992). Further, ICT design is affected by culture (Tedre et al., 2006) and several researchers have examined the technology acceptance by older adults in different cultures, e.g., Hong Kong (Chen & Chan, 2014), Spain (Ramón-Jerónimo et al., 2013), and the U.S.A. (Mitzner et al., 2016). Eventually, a growing number of designers and HCI scholars have realized that technology implementation for compensating older adults' diminishing physical condition might not be the objective that matters the most (Righi et al., 2017).

Nowadays, defining the factors, as well as the relationships among those factors, that could affect people's choice upon accepting a new technology is a matter of significant importance. From the Theory of Reasoned Action (Azjen & Fishbein, 1980) and the Theory of Planned Behavior (Ajzen, 1985) to the Technology Acceptance Model (TAM) (Davis, 1989), TAM 2 (Venkatesh & Davis, 2000), TAM 3 (Venkatesh & Bala, 2008) and the Unified Theory of Acceptance and Use of Technology (Venkatesh et al., 2003), there is a variety of constructs and theories proposed for understanding users' acceptance.

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Lately, loneliness among adults, both younger and older, has been characterized as a universal epidemic (Holt-Lunstad, 2017; Selimi, 2016). It seems to be a threat to our physical and mental health (e.g., Hawkley et al., 2010; Ong et al., 2016) and research upon this issue has gained significant attention. Loneliness is described as a negative subjective feeling which is triggered by the perceived imbalance between people's desired social relationships and their actual relationships (Pinquart & Sorensen, 2001). Notably, there are cross-national differences in older people's feelings of loneliness, especially between northern and southern European countries (Fokkema et al., 2012).

People's emotional regulation is a significant element in the field of Socioemotional Selectivity Theory (SST) as well. SST is a framework that helps us understand the motivation for human activities under a life span perspective (Carstensen, 1993; Lang & Carstensen, 2002). The cornerstone of SST is the concept of Future Time Perspective (FTP), which denotes one's subjective estimate of the remaining time left in life, which consequently affects his/her priorities and decisions (emotion-based or knowledge-based).

Study reports related to older adults and SST (e.g., Yang, 2019), feelings of loneliness (e.g., Dang et al., 2019) or storytelling (e.g., Alexandrakis et al., 2019) and legacy (e.g., Lindley, 2012) have been common themes within the HCI literature. As a result, the innovative purpose of this study is to deepen our knowledge on technology acceptance through a life-span and emotional framework. Specifically, our objective is to explore a potential extension of the TAM, combining loneliness, subjective time perspective, and chronological age as potential determinants, in order to gain further insights into Greek older adults' motives for technology usage.

The rest of this article is organized as follows: In Section 2 a review of the relevant literature is presented, as well as the hypotheses and the research model. Section 3 outlines the research methodology. In Section 4 the results of the study are presented and Section 5 discusses these results. Conclusions, limitations, and future work are put forward in Section 6.

2. Related literature, research model, and hypotheses

Reminiscing and storytelling are significant human processes that are related to people's well-being (Webster et al., 2010). Through stories and narrations, we make sense of who we are, build our identities, create and transmit culture and support social cohesion (Bietti et al., 2019; De Fina, 2015; Phoenix & Sparkes, 2009). Although storytelling has been a universal activity since the birth of civilization, the difference is that nowadays storytelling can be mediated and promoted by digital technology. As a consequence, a new term has evolved: Digital storytelling. Digital storytelling is a broad concept that is generally referred to as the process of composing and communicating a story through the implementation of digital media. There is a variety of relevant implications, ranging from short videos and games to blogs, social networking sites, and other web 2.0 tools (Alexander, 2017; Lambert, 2013; Snelson & Sheffield, 2009). Since the web 2.0 infrastructure bears valuable potentials to its end-users, such as collective activities, information sharing, and online social interactions (Wilson et al., 2011), in our study we focused on web 2.0 based storytelling technologies.

Due to previous research in the field, it seems that digital storytelling is a beneficial activity for older adults' welfare, especially for issues related to communication, emotions, sharing personal memories, and interacting with younger generations (e.g., Harley & Fitzpatrick, 2011; Hausknecht et al., 2019; Morganti et al., 2013). However, as we have previously mentioned, ICT is not culturally neutral (Tedre et al., 2006), so we should consider the fact that the use of digital storytelling tools by users of different cultures might have contradictory outcomes.

Since the eighties, researchers have focused on several models that could be used to predict technology acceptance. A successful example of those frameworks is the Technology Acceptance Model (TAM) (Davis, 1989; Davis et al., 1989), which is based on three core constructs: Perceived Usefulness (PU), Perceived Ease of Use (PEoU), and Behavioral Intention (BI). Specifically, a person's Behavioral Intention to use a technology is influenced by two beliefs: Perceived Usefulness and Perceived Ease of Use. The former is the extent to which the individual believes that using the particular technology will improve his/her task performance. The latter is the extent to which he/she believes that the system usage will be free of effort. Perceived Ease of Use has also an impact on Perceived Usefulness and, evidently, they both mediate the effect of other external variables on usage intention.

This model and its extensions have been widely utilized in many Information System studies, explaining approximately 40% of the usage intention and behavior variance (Venkatesh & Davis, 2000). King and He (2006) meta-analysis of 88 journal articles confirmed the influence of Perceived Usefulness on Behavioral Intention and suggested that Perceived Ease of Use could affect Behavioral Intention mainly through Perceived Usefulness, except for the internet applications in which the direct effect of Perceived Ease of Use on Behavioral Intention is also important. The core structure of the model is presented in Figure 1.

Nevertheless, on the one hand, it has been acknowledged that TAM (Straub et al., 1997) and its extensions (e.g., Dutot et al., 2019) may have significant distinctions upon how effectively they can predict technology acceptance across different cultures. On the other hand, there is limited research in Greece regarding the validation of TAM within the older adults' age group. As a result, we propose the following hypotheses, regarding older people in Greece:

H1. Perceived Ease of Use has a positive effect on Perceived Usefulness of the web 2.0 storytelling application.

H2. Perceived Ease of Use has a positive effect on Behavioral Intention to use the web 2.0 storytelling application.

H3. Perceived Usefulness has a positive effect on Behavioral Intention to use the web 2.0 storytelling application.

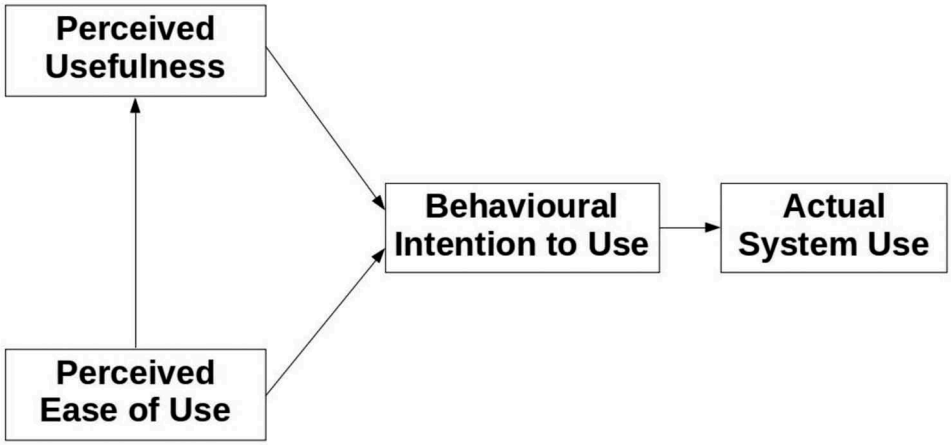

Figure 1. The Technology Acceptance Model (King & He, 2006; Venkatesh & Davis, 2000).

Figure 2 depicts the research model of this study.

According to the literature, there are diverse or even contradicting results concerning the effect of chronological age on TAM. For example, there are studies that confirm the negative association between age and factors such as Perceived Usefulness (PU) (Escobar-Rodriguez & Bartual-Sopena, 2013), Perceived Ease of Use (PEoU) (Porter & Donthu, 2006), and usage (Shin, 2009), while other studies report a positive influence of age, e.g., on Behavioral Intention (BI) (Martins et al., 2014) and PEoU (Jimoh et al., 2012). Furthermore, some studies reveal no statistically significant effect of age on PEoU (Escobar-Rodriguez & Bartual-Sopena, 2013), PU (Porter & Donthu, 2006), and acceptance (Morton & Wiedenbeck, 2010). Hauk et al. (2018) conducted a meta-analysis of 144 studies and they found that age was generally negatively related to PU, PEoU, and BI. The following three hypotheses were formed as a starting point for further investigation:

H4. Chronological age has a negative effect on Perceived Usefulness of the web 2.0 storytelling application.

H5. Chronological age has a negative effect on Perceived Ease of Use of the web 2.0 storytelling application.

H6. Chronological age has a negative effect on Behavioral Intention to use the web 2.0 storytelling application.

Despite TAM's effectiveness, it has been proposed that external variables related to human and social development should also be embedded in the model to increase its efficacy (Legris et al., 2003). Besides, cognitive and emotional changes, that take place across our lifespan have also an influence on our

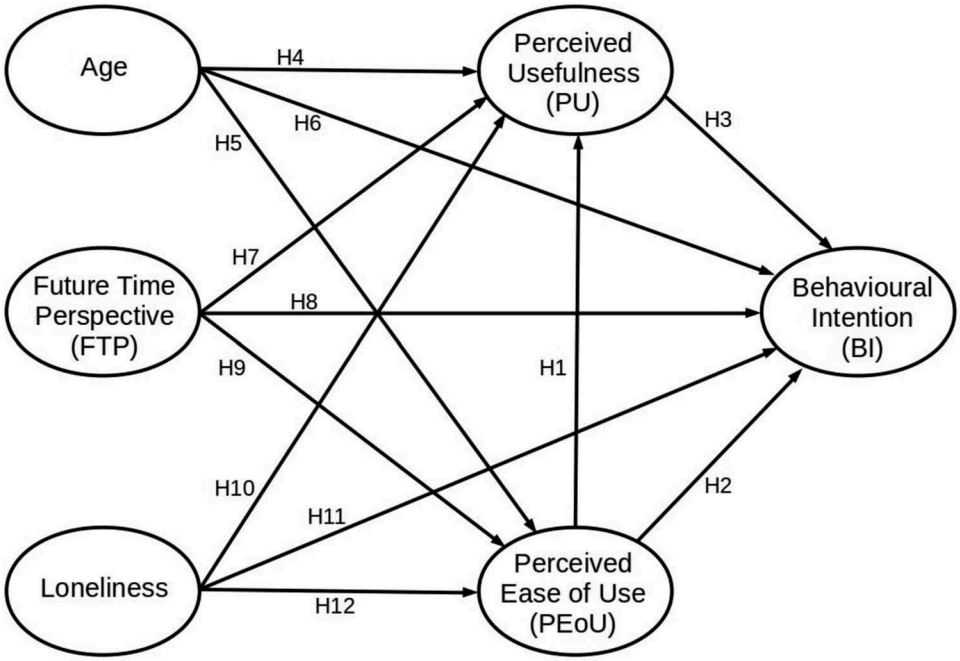

Figure 2. The research model.

interactions with technology (Charness & Boot, 2009). Withal, in order for researchers to gain further insights on older people's technology acceptance, Chen and Chan (2011) proposed that additional factors related to psychosocial attributes should be included in the model. Since constructs such as Future Time Perspective and loneliness have received scarce attention within the TAM research, we decided to explore their effectiveness on PU, PEoU, and BI as external variables.

According to Socioemotional Selectivity Theory, people's social motives can be affected by their Future Time Perspective. Specifically, when individuals perceive their future as open-ended, they prioritize goals related to knowledge acquisition and long-term benefits, whereas when they perceive it as limited, they tend to emphasize goals and activities that are more emotionally meaningful. In the former case, individuals' preferable social networks mostly comprise of intelligent and knowledgeable partners and friends, while in the latter case, individuals tend to prefer smaller social networks, mainly relatives, and they put more emphasis on the perceived quality of their social contacts (Lang & Carstensen, 2002).

In the current research, the web 2.0 storytelling platform included the stories of other anonymous storytellers. There were no declared access restrictions that could confine the users of this application to a specific preferable group, such as the respondents' relatives and closest friends. So, we presume that respondents who confront their future as open-ended will be more likely to have positive attitudes toward the presented application and perceive it as a useful tool for communicating their memories to anonymous others, compared to the respondents who perceive their future as narrow and, thus, tend to prefer interactions with a small number of specific social partners. As a result, the Perceived Usefulness of the system, as well as people's intention to use it, will be affected by the Future Time Perspective. Under this scope, the following hypotheses have been framed:

H7. Future Time Perspective has a positive effect on Perceived Usefulness of the web 2.0 storytelling application.

H8. Future Time Perspective has a positive effect on Behavioral Intention to use the web 2.0 storytelling application.

Future Time Perspective is often negatively connected to one's chronological age and older people regard their future time as less expansive compared to younger generations (Lang & Carstensen, 2002). Likewise, the evident usability differences between younger and older users (Mayhorn et al., 2005; Wagner et al., 2014) could be also examined under the scope of their subjective time horizon. More important, as people tend to prioritize knowledge-based goals when they perceive their time horizon as limitless, we assume that they will have a positive attitude toward profound knowledge-based functions, such as the perceived usability of a new digital application. Thus, the following exploratory hypothesis has been formed:

H9. Future Time Perspective has a positive effect on Perceived Ease of Use of the web 2.0 storytelling application.

Cristescu (2008) argued that people's feelings have a substantial influence on their perceptions and often formulate how they recall previous experiences. Apart from the negative consequences of loneliness on people's well being, it seems that this particular psychological state also functions as a powerful motive for humans in order to communicate and make social connections with others (Cacioppo et al., 2006). Likewise, Amichai-Hamburger and Ben-Artzi (2003), based on their findings, claimed that lonely women possibly used Internet social services as a means for reducing their loneliness. Some older adults regard web technologies usage as an antidote to their feelings of loneliness (e.g., Brewer & Piper, 2016; Harley & Fitzpatrick, 2011). According to Ye and Lin (2015), there is a positive relationship between individuals' feelings of loneliness and their preference for online social interactions. Shen (2015) examined the effect of loneliness on social networking sites acceptance and found that feelings of loneliness have a positive impact on social support seeking, which in turn has a positive influence on Perceived Usefulness. Besides, based on the Selection, Optimization, and Compensation model (Baltes & Baltes, 1990), tools or activities that help older adults enhance their resources or compensate for their deficits (e.g., possible social network size decline that could increase loneliness), should be perceived as helpful and useful. In our case, as the presented storytelling platform can facilitate communication among its users through storytelling posts and comments, the following hypotheses are proposed:

H10. Loneliness has a positive effect on Perceived Usefulness of the web 2.0 storytelling application.

H11. Loneliness has a positive effect on Behavioral Intention to use the web 2.0 storytelling application.

Johnson, Clarkson, and Huppert (2010) highlighted the fact that one's emotional state can affect his/her capabilities when using various tools and products. Feelings and emotions have been tested as factors that could affect TAM. For instance, Venkatesh (2000), as well as Hackbarth et al. (2003), showed a statistically significant negative link between anxiety and Perceived Ease of Use (PEoU). Cenfetelli (2004) has acknowledged that emotions function as cognition drivers under the scope of initial technology usage. Also, positive and negative emotions have been found to be significant antecedents of PEoU, with the negative ones (such as worry, unhappiness, nervousness, fear, etc.) having a stronger effect than the positive ones. Additionally, people's loneliness is positively correlated with the tendency to believe that their decisions are determined by factors beyond their control (Ye & Lin, 2015). O'luanaigh et al. (2012) found that loneliness has been significantly associated with cognition impairments in older people, specifically with psychomotor processing and delayed visual memory. Under this

scope, as PEoU encloses users' cognitive beliefs about usability issues, we claim that:

H12. Loneliness has a negative effect on Perceived Ease of Use of the web 2.0 storytelling application.

3. Research methodology

3.1. Participants

Gerontologists have emphasized that old age is a social construct and a cultural phenomenon rather than a biological state (Jönson, 2012; Victor, 2013). The retirement period in one's life seems to play a crucial role in Laslett's (1987) theory of life stages and particularly during the third stage, also known as the Third Age, which has been broadly acknowledged within the field of HCI (Durick et al., 2013). Older people are usually defined in HCI research as the individuals whose age is 60 or more (Righi et al., 2017). Thus, in the rest of this paper, we use the term 'older adult' as a definition that denotes one's chronological age and the state of having retired from work.

The sample of our study has been recruited through different approaches: (i) snowball sampling and word-of-mouth, (ii) e-mail messages to pensioners' clubs and older adults' service centers, and (iii) posts to social networking sites accounts. Our participants were (1) people aged 60 years or older, (2) who were living in Greece, (3) had retired from work, and (4) could use the Internet. The final sample consisted of 112 older adults (47 men, 65 women) from 21 different regions in Greece and their ages ranged from 60 to 80 years.

3.2. Constructing the questionnaire

The questionnaire comprised of four parts: The demographics, the technology acceptance section (Perceived Usefulness, Perceived Ease of Use, Behavioral Intention), the loneliness section and the Future Time Perspective section. The constructs for Perceived Usefulness (4 questions, 5-point Likert scale), Perceived Ease of Use (4 questions, 5-point Likert scale), and Behavioral Intention (3 questions, 5-point Likert scale) have been based mainly on previous studies (Dogruel et al., 2015; Ngai et al., 2007; Park, 2009; Svendsen et al., 2013; Wu & Wang, 2005). For the time perspective construct we implemented Carstensen's and Lang's Future Time Perspective scale (10 questions, 7-point Likert scale) (Carstensen & Lang, n.d.). The aforementioned questions have been translated into Greek and reviewed by three English literature scholars. The Greek version of the UCLA Loneliness Scale (Kafetsios & Sideridis, 2006; Russell et al., 1980) was applied for the loneliness construct (20 questions, 4-point Likert scale). Details about the constructs are presented in Table 1.

In order for us to check the clarity and validity of the measurement tool, the questionnaire was reviewed by a researcher with expertise in questionnaire surveys and it was further pre-tested on five subjects, which were not included in the final sample. Based on the comments that we collected, we performed minor revisions on specific items of the tool to enhance comprehension and effectiveness.

3.3. Procedure

The current approach was inspired by Svendsen et al.'s (2013) research upon TAM in which the participants read a text description of a software before submitting their answers to a questionnaire. In our project, the respondents who opened the survey link were brought into the thematology of the research through a written introduction and then they were prompted to follow a linear step-by-step presentation of the web application. In each step, a text description of the analogous application function was presented, followed by static and moving images as examples. The participants could navigate backward and forward within the demonstration segment of the survey at their own pace and as many times as they wanted until they had a clear conception of the storytelling platform. The presentation contained four main explanatory texts (total length: 284 words), three static pictures, and five detailed moving images (total duration: 262 seconds). The time needed to complete the presentation relied on each participant's choice. At the end of this process, they were asked to answer the questionnaire. The survey was online from April 2019 to July 2019.

Even though the respondents did not use the particular technology by themselves, their perceptions about this tool

Table 1. The basic questionnaire constructs.

Construct	Item Code	Item	Based on
Perceived Usefulness (PU)	PU1	Using this platform would improve my performance in recording my personal memories	Wu and Wang (2005)
	PU2	Using this platform would help me increase the number of my recorded memories	Wu and Wang (2005)
	PU3	Using this platform would ensure that my recorded memories will not be lost	Svendsen et al. (2013)
	PU4	Using this platform would help me communicate better my memories to younger generations	Alexandrakis et al. (2019)
Perceived Ease of Use (PEoU)	PEoU1	It seems to me that this platform is easy to use	Dogruel et al. (2015)
	PEoU2	It seems to me that learning how to use this platform is easy	Park (2009)
	PEoU3	I think becoming skillful at using this platform is easy	Wu and Wang (2005)
	PEoU4	The process of using this platform is clear and understandable	Ngai et al. (2007)
Behavioral Intention (BI)	BI1	Assuming I had access to this platform, I would use it	Wu and Wang (2005)
	BI2	If I had access to this platform, I would use it regularly	Svendsen et al. (2013)
	BI3	I intend to be a user of this system in order to record my memories.	Park (2009)
Loneliness	Loneliness	(Structured questionnaire)	Russell et al. (1980)
Future Time Perspective (FTP)	FTP	(Structured questionnaire)	Carstensen and Lang (n.d.)
Chronological Age	Age		

could still form their intentions for actual use, even without having any concrete experience with it (Mitzner et al., 2016). Obviously, viewing a technology is different from using it. Nevertheless, according to participants' feedback during the pretests, the presentation was thorough enough for evaluating the usefulness, ease of use, and usage intention of the platform. Furthermore, since the purpose of this research was not to draw conclusions upon technology usage, but to explore the correlations between respondents' attributes (age, future time perspective, loneliness) and their beliefs/intentions (TAM constructs), the negative effects of this approach are limited. Notably, similar approaches have been utilized even in usability studies (e.g., Bonfim et al., 2017).

The presented web 2.0 storytelling application is a prototype that has been designed and built in the course of our preliminary study on older adults and it contained ten autobiographical stories (Alexandrakis et al., 2019). The platform was the result of Participatory Design sessions that had been contacted with five Greek older adults aged from 59 to 73 years. The participants in those sessions had different levels of technology literacy and none of them had any prior experience with design procedures. With this platform, a user can interact with a timeline or a map that contains all users' memories (initial page), read and/or comment on a selected story (narration page), and post new stories (creation page). Respectively, the online presentation of the survey put emphasis on (a) the initial page (Figure 3), (b) pages of specific narrations (e.g., Figure 4), and (c) the story creation page (Figure 5).

Based on the feedback that we collected from many respondents in the current study, it seems that the survey dropout rate was high. Although it cannot be calculated accurately, it was estimated that more than 60% of the individuals who received the survey link did not eventually submit the questionnaire. According to some of them, the survey duration (20 minutes) was critical and specific questions, concerning loneliness and Future Time Perspective, have been perceived as too personal to answer. Notably, similar difficulties when recruiting older adults for HCI research are documented in the literature (Dickinson et al., 2007).

3.4. Data analysis

In order for us to analyze the collected data under the scope of the model shown in Figure 2, we implemented Partial Least Squares Structural Equation Modeling (PLS-SEM), a second-generation multivariate data analysis method (Hair et al., 2016), using SmartPLS 3 software (Ringle et al., 2015). PLS-SEM was adopted for data analysis in the current research because (i) it is suitable for examining the relationship between hard-to-observe latent variables in high-complexity models, (ii) it is appropriate for exploratory research, and (iii) it can facilitate different item scale types, small samples, and non-parametric data.

4. Results

4.1. Descriptive statistics

According to the results, the majority of the respondents (75%) did not use to record their personal stories. However, some participants answered that they made use of the computer or the Internet (Social Media) for depicting their memories (12.5% and 5% respectively). The average chronological age of the participants was 66.96 years (s.d.: 4.98), the average Future Time Perspective score was 37.43 (minimum value: 10, maximum value: 67) and the average loneliness score was 36.96 (minimum value: 21, maximum value: 64). Further information can be found in our recent article (Alexandrakis, Chorianopoulos, & Tselios, 2020). Regarding Perceived Usefulness (PU1: 3.33, PU2: 3.28, PU3: 3.72, PU4: 3.78) and Perceived Ease of Use (PEoU1: 3.36, PEoU2: 3.46, PEoU3: 3.50, PEoU4: 3.43), the mean of each item response was above the middle value (3). Nevertheless, this was not the case for all Behavioral Intention items (BI1: 3.07, BI2: 2.84, BI3: 2.57) (Table 2).

4.2. Reliability and validity

The reflective measurement model of our study has been evaluated under the scope of the indicated reliability and validity measurements (Hair et al., 2011). Due to Table 3, all Composite Reliability results and indicator loadings are

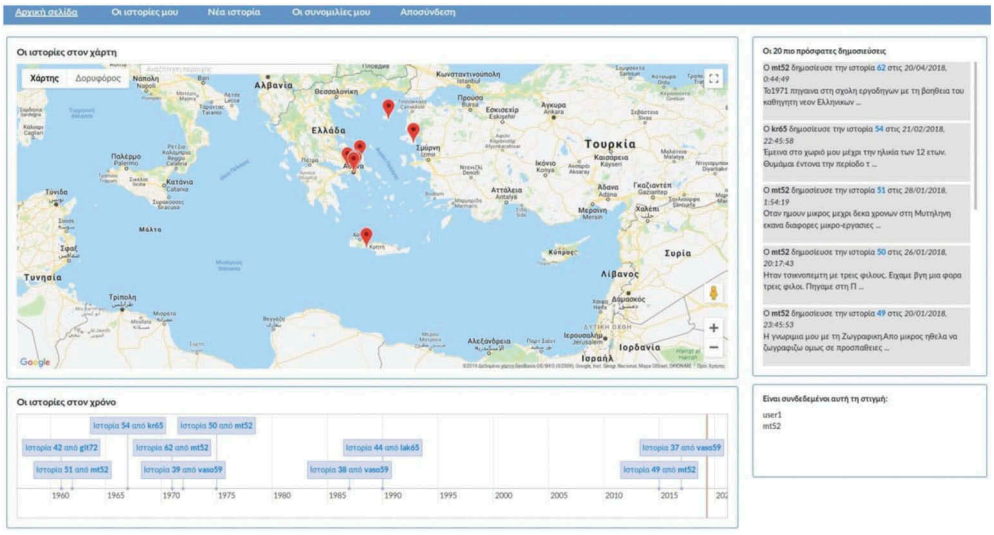

Figure 3. The initial page of the storytelling platform.

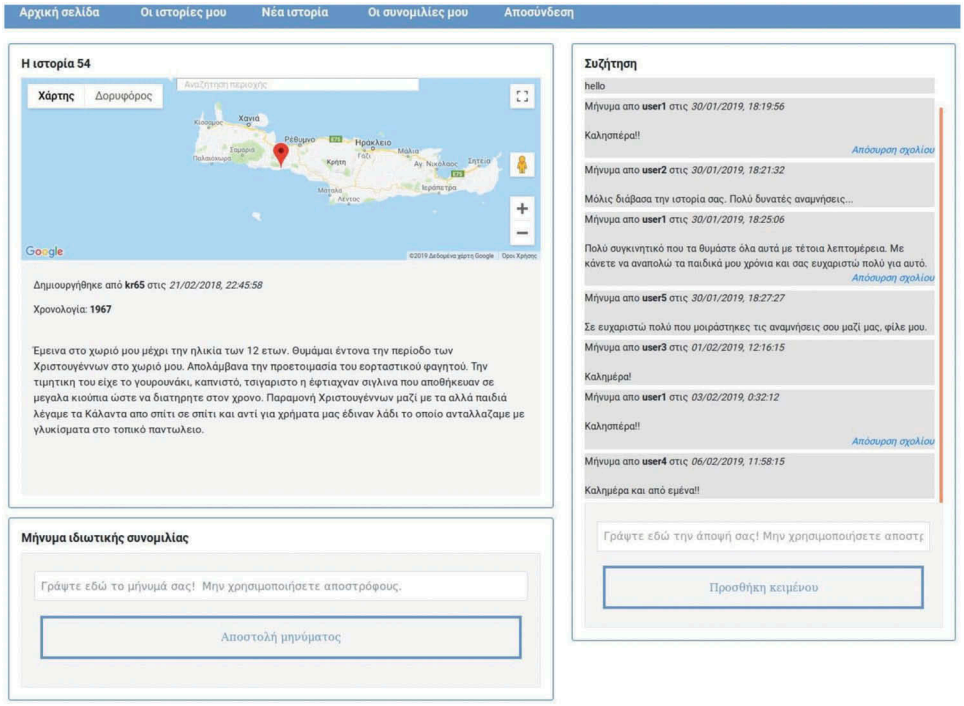

Figure 4. The page that contains story 54, users' comments, and the private messaging field.

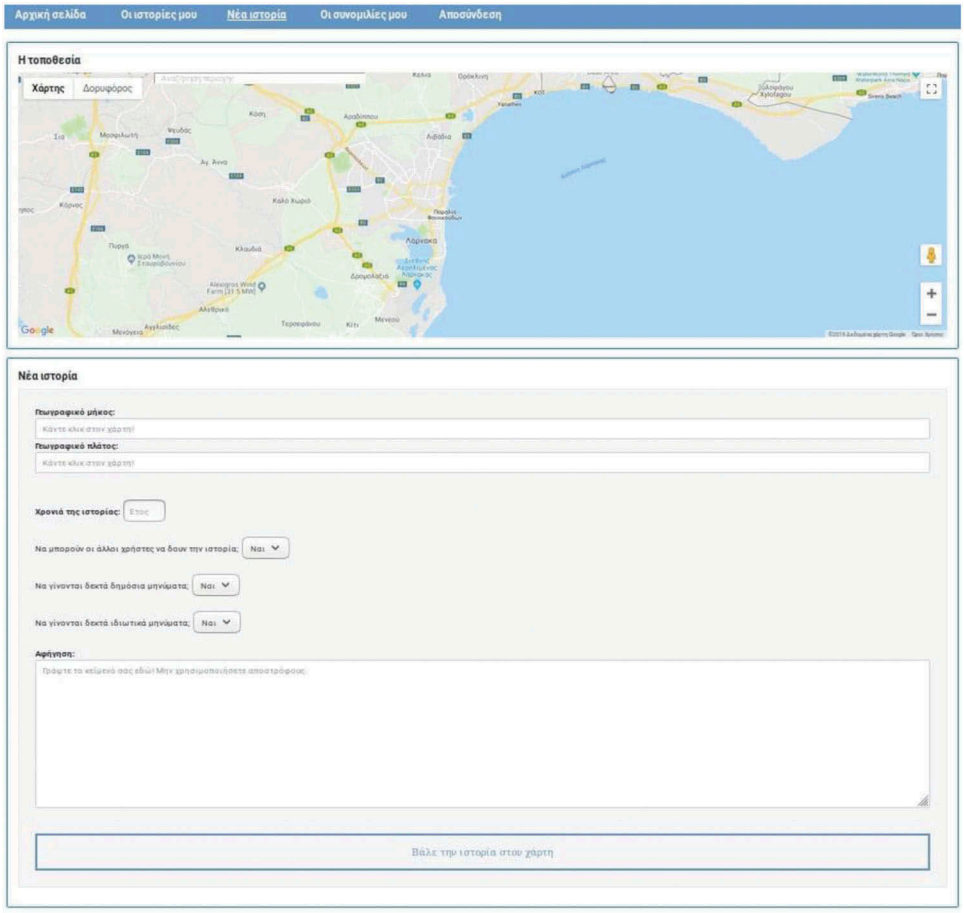

Figure 5. The story creation page.

Table 2. Descriptive statistics of the questionnaire responses for all participants.

Construct	Item	Item Value Range	Mean	S.D.
Perceived Usefulness (PU)	PU1	1–5	3.33	1.32
	PU2		3.28	1.32
	PU3		3.72	1.36
	PU4		3.78	1.33
Perceived Ease of Use (PEoU)	PEoU1	1–5	3.36	1.29
	PEoU2		3.46	1.29
	PEoU3		3.50	1.31
	PEoU4		3.43	1.33
Behavioral Intention (BI)	BI1	1–5	3.07	1.35
	BI2		2.84	1.25
	BI3		2.57	1.36
Loneliness	UCLA Loneliness Scale	20–80	36.96	8.77
Future Time Perspective (FTP)	FTP	10–70	37.43	14.20
Chronological Age	Age	60+	66.96	4.98

Table 3. Reliability and convergent validity of the measurement model constructs.

Construct	Item/ Indicator	Outer Loadings	Item/ Indicator Reliability	Composite Reliability	Average Variance Extracted (AVE)
Perceived Usefulness (PU)	PU1	0.878	0.771	0.918	0.736
	PU2	0.880	0.774		
	PU3	0.875	0.765		
	PU4	0.798	0.637		
Perceived Ease of Use (PEoU)	PEoU1	0.927	0.859	0.969	0.887
	PEoU2	0.954	0.910		
	PEoU3	0.954	0.910		
	PEoU4	0.933	0.870		
Behavioral Intention (BI)	BI1	0.922	0.850	0.945	0.852
	BI2	0.960	0.922		
	BI3	0.885	0.783		
Loneliness (single item construct)	Loneliness	1.000	1.000	1.000	1.000
Future Time Perspective (FTP) (single item construct)	FTP	1.000	1.000	1.000	1.000
Chronological Age (single item construct)	Age	1.000	1.000	1.000	1.000

higher than 0.70. The square of each outer loading is more than 0.70, which is the preferred threshold value, except for PU4 (0.637) which is an acceptable indicator reliability value for exploratory studies (Wong, 2013). Also, the Average Variance Extracted (AVE) values are above 0.50, denoting high internal reliability and convergent validity for every construct (Hair et al., 2011). Based on the Fornell and Larcker (1981) criterion, the discriminant validity of the constructs has been confirmed; the square root of AVE of each construct is greater than its correlations with the other constructs of the model (Table 4), indicating that each construct explains more of the variation in its measures than in the others. Thus, having reliability and validity established, the model is acceptable for hypothesis testing.

Table 4. Discriminant validity of the measurement model constructs.

Construct	Age	BI	FTP	Loneliness	PEoU	PU
Age	**1.000**					
BI	(-) 0.215	**0.923**				
FTP	(-) 0.137	0.223	**1.000**			
Loneliness	0.014	(-) 0.100	(-) 0.410	**1.000**		
PEoU	(-) 0.182	0.523	0.314	(-) 0.157	**0.942**	
PU	(-) 0.116	0.686	0.197	(-) 0.162	0.517	**0.858**

4.3. Hypotheses & structural model

In this section, we present the results of our study regarding the hypotheses and the structural model. In order to test the significance of the relationships among the constructs, we implemented a bootstrapping procedure (5000 subsamples, one-tailed). The outcomes of the PLS-SEM algorithm implementation have been illustrated in Figure 6 and the evaluation results of the model are summarized in Table 5.

Regarding the core structure of the TAM, the results confirm the statistically significant positive effect of Perceived Ease of Use (PEoU) on Perceived Usefulness (PU) (H1, $p < .001$), as well as the effect of Perceived Ease of Use on Behavioral Intention (BI) (H2, $p < .05$) and the effect of Perceived Usefulness on Behavioral Intention (H3, $p < .001$). The effect size (f^2) for each of these pairs of constructs is 0.301 (for PEoU->PU), 0.058 (for PEoU->BI), and 0.491 (for PU->BI), which indicate a medium-to-large, small-to-medium, and large effect, respectively (Cohen, 2013). On the contrary, the negative impact of age on Perceived Usefulness (H4, n.s.), Perceived Ease of Use (H5, n.s.), and Behavioral Intention (H6, n.s.) was not confirmed. Even though Future Time Perspective did not have any significant causal relationship with Perceived Usefulness (H7, n.s.) or Behavioral Intention (H8. n.s.), it was found to have a positive effect on Perceived Ease of Use (H9, $p < .01$) with a small-to-medium effect size ($f^2 = 0.071$). As for the loneliness variable, the hypotheses regarding Perceived Usefulness (H10, n.s.), Behavioral Intention (H11, n.s.), and Perceived Ease of Use (H12, n.s.) were not confirmed.

Concerning the predictive strength of the model, the Behavioral Intention R^2 value was found to be 0.524, explaining 52.4% of the variance in older adults' intention to use the web 2.0 storytelling platform. Additionally, the Perceived Ease of Use R^2 value was 0.120 (explaining 12.0% of the variance of the platform Perceived Ease of Use) and the Perceived Usefulness R^2 value was 0.274 (explaining 27.4% of the variance of the platform Perceived Usefulness). Based on Standardized Root Mean Square Residual (SRMR), its value was found to be 0.051, confirming a fair fit of the measurement (Hu & Bentler, 1998).

The aforementioned results confirm the significance of the TAM model, indicating that Greek older adults who perceive the usefulness and ease of use of storytelling technologies tend to make use of them. Also, the Perceived Usefulness of such platforms is influenced by their Perceived Ease of Use, which is affected by users' Future Time Perspective. These findings are further discussed in the next section.

5. Discussion

The main purpose of our study was to explore an extension of the Technology Acceptance Model through three specific variables (chronological age, Future Time Perspective, loneliness) which have been broadly utilized in older people's literature. To this end, a web 2.0 storytelling platform has been presented online to 112 older adults in Greece who were afterward asked to answer a questionnaire survey. In this section, we discuss our findings with respect to the related literature.

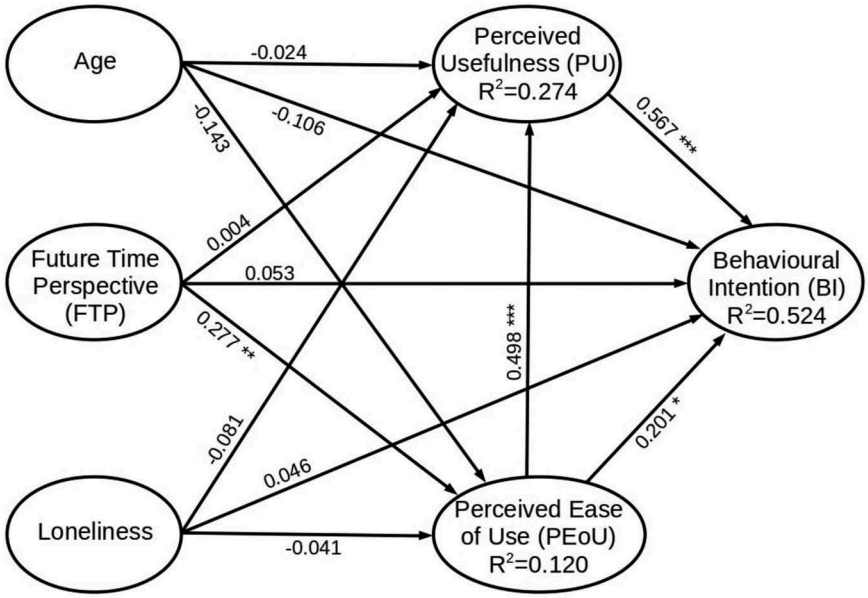

Figure 6. The research model path coefficients.
* $p < .05$, ** $p < .01$, *** $p < .001$.

Table 5. The evaluation results of the structural model.

Hypothesis	Path	Path Coefficient	f^2 effect size	t-value	p-value	Hypothesis confirmed
H1	PEoU->PU	0.498	0.301	6.072	0.000	**Yes**
H2	PEoU->BI	0.201	0.058	2.253	0.012	**Yes**
H3	PU->BI	0.567	0.491	7.515	0.000	**Yes**
H4	Age->PU	−0.024	0.001	0.294	0.385	No
H5	Age->PEoU	−0.143	0.023	1.481	0.069	No
H6	Age->BI	−0.106	0.022	1.547	0.061	No
H7	FTP->PU	0.004	0.000	0.034	0.487	No
H8	FTP->BI	0.053	0.004	0.647	0.259	No
H9	FTP->PEoU	0.277	0.071	2.658	0.004	**Yes**
H10	Loneliness->PU	−0.081	0.008	0.855	0.196	No
H11	Loneliness->BI	0.046	0.004	0.667	0.252	No
H12	Loneliness->PEoU	−0.041	0.002	0.421	0.337	No

The results support 4 out of 12 research hypotheses (H1, H2, H3, H9). More specifically, Perceived Ease of Use positively affects Perceived Usefulness (H1) and Behavioral Intention (H2), while Perceived Usefulness has also a positive influence on Behavioral Intention (H3). Motivated by the fact that culture can impact people's technology adoption (Tedre et al., 2006), as well TAM's effectiveness (Straub et al., 1997), in our case, the TAM has been confirmed as a useful model for predicting usage intention for pensioner older adults in Greece. This outcome is in accordance with King and He (2006) conclusions, as well as several other literature reviews on the field (e.g., Chen & Chan, 2011; Legris et al., 2003).

Users' chronological age did not have any statistically valid correlation with any of the main TAM components, Perceived Usefulness (H4), Perceived Ease of Use (H5) or Behavioral Intention (H6). Although it follows previous findings on technology acceptance (e.g., Morton & Wiedenbeck, 2010), it contradicts others (e.g., Escobar-Rodriguez & Bartual-Sopena, 2013; Jimoh et al., 2012; Martins et al., 2014; Porter & Donthu, 2006). An explanation can be supported by Hauk et al.'s (2018) meta-analysis. Despite their initial findings regarding the negative relationship between age and technology acceptance, they noticed that the type of technology, denoting whether it addresses older adults' needs or not, is a crucial moderator for the effect of age on technology acceptance. Notably, digital storytelling has been illustrated in the literature as a significant activity that responds to older users' needs (e.g., Harley & Fitzpatrick, 2011; Hausknecht et al., 2019; Morganti et al., 2013). Conclusively, the age-related stereotype that older adults and new technologies do not get along (Knowles & Hanson, 2018), has not been confirmed in our study.

The hypotheses concerning Future Time Perspective effects on Perceived Usefulness (H7) and Behavioral Intention (H8) were rejected. Participants' future time perceptions did not have any statistically significant effect on Perceived Usefulness of the web 2.0 storytelling application and their Behavioral Intention to use it. However, our results revealed a positive relationship between Future Time Perspective (independent variable) and Perceived Ease of Use (dependent variable), which implies that potential users with broader future time horizons, tend to rate higher the perceived usability of online technologies. Although this finding could be regarded as trivial because of the relationship that often takes place between chronological age and Future Time Perspective (Lang & Carstensen, 2002), in our study, there was no significant correlation between individuals' Perceived Ease of Use and their age (H5 was rejected). So we assume that the

main explanation for this effect resides in the core concept of Socioemotional Selectivity Theory, according to which, when people regard their time left in life as limitless, they tend to focus on knowledge-based motives (Lang & Carstensen, 2002). Apparently, usability issues of ICT are more likely to be closer to the knowledge-based goals rather than the emotional-based ones on their motivation spectrum. Likewise, users with short time horizons may tend to perceive the usability of new technology as less satisfying. The relationship between Future Time Perspective and Perceived Ease of Use corresponds to many researchers' suggestions regarding possible interactions between technology acceptance and socioemotional factors (Charness & Boot, 2009; Chen & Chan, 2011; Legris et al., 2003).

As for the feelings of loneliness and their potential effects on technology acceptance, hypotheses H10 (Loneliness->Perceived Usefulness), H11 (Loneliness->Behavioral Intention), and H12 (Loneliness->Perceived Ease of Use) have not been confirmed. These results do not appear to align with Cacioppo et al.'s (2006) argument that loneliness motivates people to communicate and socialize with others, or Baltes and Baltes's (1990) model of Selection, Optimization, and Compensation. However, older adults' motivation to use a technology, that they are already familiar with, to overcome his/her loneliness may still be significant (Amichai-Hamburger & Ben-Artzi, 2003; Brewer & Piper, 2016; Harley & Fitzpatrick, 2011), but the acceptance of novice technologies may not be, perhaps, a priority for them.

In conclusion, extending TAM through the implementation of Future Time Perspective as an external variable responds successfully to other researchers' recommendations (e.g., Chen & Chan, 2011; Legris et al., 2003) who have previously proposed embedding psychosocial factors that could further enhance the effectiveness of the model. The results of this research can contribute to a better understanding of the factors that can influence older adults' acceptance of digital technologies related to reminiscing, storytelling, online collective activities, and social interactions.

6. Conclusions, limitations, future work

Digital storytelling is a meaningful and essential activity for older adults' well-being. Based on the fact that end-users' cultural context has a significant impact on their technology acceptance and usage, as well as the scarcity of the relative literature concerning older adults in Greece, in this study we explored the impact of three factors (chronological age, Future Time Perspective, loneliness) on the Technology Acceptance Model, regarding an online storytelling application. Those factors have been broadly mentioned in the literature focused on older people's attributes, motives, health, and quality of life. Due to our findings, the Technology Acceptance Model can be successfully extended within the scope of human development and life-span by including Future Time Perspective in its structure. Moreover, neither our respondents' chronological age had any statistically significant impact on technology acceptance, which challenges the stereotype that older adults and new technologies do not get along, nor did their feelings of loneliness. To the best of our knowledge, there is no similar study reported in the field.

At this point, we should mention some important limitations of our study. First, the size of the sample, as well as the sampling method, do not allow us to make any safe generalization of our findings. Second, the responses that have been collected concerned a specific technology, the web 2.0 storytelling platform, and, third, the respondents of our survey were already ICT users by the time of the research. Furthermore, the participants did not use the tool, but only read its description and viewed its online demonstration. However, while this approach could limit the applicability of the results, it does not invalidate them. Besides, technology acceptance research often utilizes hypothetical product descriptions (Svendsen et al., 2013) and similar methodologies have been implemented even in usability evaluations (e.g., Bonfim et al., 2017).

The aforementioned limitations outline our suggestions for future work: (i) additional studies should be carried out on larger samples under probability sampling, (ii) more technologies should be examined and, (iii) qualitative and quantitative research including technology users' and non-users' feedback should be undertaken. Also, we believe that further research on both younger and older populations in Greece could enrich our knowledge regarding the potential effect of age on technology acceptance.

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Data availability

The data that support the findings of this study are available from the corresponding author (D.A.) on request.

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