



Article

Connections between Older Greek Adults' Implicit Attributes and Their Perceptions of Online Technologies

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Abstract: Older Greek adults make use of web technologies much less than the majority of their peers in Europe. Based on the fact that psychosocial attributes can also affect technology usage, this exploratory quantitative research is an attempt to focus on the implicit factors related to older Greek adults' perceived usability, learnability, and ease-of-use of web technologies. For this aim, a web 2.0 storytelling prototype has been demonstrated to 112 participants and an online questionnaire was applied for data collection. According to the results, distinct correlations emerged between older adults' characteristics (chronological age, loneliness, future time perspective) and the perceived usability, learnability, and ease-of-use of the presented prototype. These outcomes contribute to the limited literature in the field by probing the connections between older people's implicit attributes and their evaluative perceptions of online technologies.

Keywords: older adults; loneliness; future time perspective; chronological age; usability; learnability; ease-of-use

1. Introduction

Human actions are mediated by tools, which can be external (e.g., a hammer or a computer) or internal (e.g., concepts and plans) [1]. Likewise, our experiences are neither independent of the tools we use nor of our perceptions. According to Heidegger [2], for example, technology is connected with the revelation of reality and truth. Nevertheless, the mediating nature of technology also bears drawbacks. Ihde [3] declared that technology usage is not neutral and depicted that there is also a concealed transformation of users' experience and perceived reality for each enhancement the mediating technologies provide. Several internal factors can affect the experience, hence influence the way people value, accept, or reject technologies. As it becomes apparent from Plato's cave allegory [4] and Indirect Realism [5], there is a continuous discussion going on about how our conceptions of the world are mediated by perception.

Human-Computer Interaction (HCI) is constantly evolving. Starting from the First Wave, based on the science of cognition and human factors, through the Second Wave and its focus on groups of users, it further advanced during the Third Wave to include issues of culture, emotions, experiences, and meaning-making [6,7]. During that course, philosophical foundations have been embedded in technology orientation and design, embracing users' needs for personal development. Existentialism, for instance, based on the axiom that every human is responsible for himself/herself, thus having almost unlimited potentials for self-actualization, has been proposed as a visionary framework for understanding individuals and their relationship with technology [8].

Self-actualization and personal development are related to one's recollections. Older adults' personal memories help them build a sense of identity and continuity to the self [9]. Due to literature, identity construction and maintenance are further promoted by sharing memories with others, storytellers' narratives can vary across different cultures, and people constantly revise their life stories, which makes identity formation a life-long procedure [10]. Notably, healthy individuals sometimes recollect memories of events that never happened. This malfunction of our memory system perhaps addresses our needs related to the self as well as to our social interactions [11]. From a technological perspective, it has been proposed that memory recording interventions should promote users' creativity and active engagement instead of passively capturing segments of their activities for remembering [12]. Going a step further, digital platforms related to reminiscence and storytelling are apparently beneficial for older adults' well-being (e.g., [13,14]).

During the last decades, the older adults' population has been increasing worldwide. It has been estimated that in 2050, the number of people aged 65 years and older will have doubled compared to the current demographics. At that time, according to the World Health Organization [15], Japan, the Republic of Korea, Spain, and Greece will be the countries with the greatest proportions of older inhabitants within their adult populations. However, digital technology usage by older people still remains low compared to younger generations and, also, Internet use by older Greek adults is one of the lowest within the European Union [16]. This digital inequality within society excludes technology non-users from essential resources considering information, communication, and personal growth.

Technology is not culturally neutral [17,18] and older adults' choice of adopting or rejecting a new technology is not always due to usability issues [19,20]. During the last years, studies about older adults and memories (e.g., [21,22]), loneliness (e.g., [23]), and Socioemotional Selectivity Theory (e.g., [24]) have been common in the HCI field. Hence, in this exploratory paper, which is an extension of our previous article [25], we try to gain further insights into the implicit factors that might correlate with older Greek adults' conceptions upon learnability, usability, and ease-of-use of online technologies by focusing on a web 2.0 platform for reminiscing and storytelling. The research questions that guide this work are as follows:

RQ1. Which implicit factors correlate with older Greek adults' perceived ease-of-use of web 2.0 storytelling technologies?

RQ2. Which implicit factors correlate with older Greek adults' perceived learnability of web 2.0 storytelling technologies?

RQ3. Which implicit factors correlate with older Greek adults' perceived usability of web 2.0 storytelling technologies?

The findings of this project contribute to the field of HCI by probing the relationships between older Greek adults' psychosocial attributes and their perceptions that determine technology adoption. To the best of our knowledge, there is no similar research in literature.

The rest of the paper is organized as follows: Section 2 provides an overview of the related literature and the research hypotheses. Section 3 describes the methodology and the procedure that was followed. The results are presented in Section 4 and are discussed in Section 5. Limitations and future work are proposed in Section 6, followed by the conclusion section (Section 7).

2. Related Literature and Research Hypotheses

2.1. Implicit Factors Affecting People's Behavior

Socioemotional Selectivity Theory is a theoretical framework that provides valuable insights into human motives and preferences [26]. Due to this theory, a person's future time perspective (FTP), denoting the perceived time that has been left in life, has an effect on his/her choices. Individuals who feel that their future is open-ended tend to prioritize knowledge-based activities, whereas when they regard it as limited, they tend to prefer emotionally meaningful interactions.

Under this scope, learning how to use an Internet tool can be identified as a knowledge-based behavior. Further in the literature, considering the connection between the subjective estimation of time and technology use, older adults' evaluative perceptions of their age are related to their positive attitudes towards information and communication technologies [27] and technostress [28], which in turn affects user's satisfaction. It is worth noting that satisfaction is a broad term that contains, among others, the ease-of-use dimension [29].

Feelings and emotions are an integral part of technology use [17]. Chen and Chan [30] indicated that psychosocial attributes, such as fear of death or loneliness, may have an intrinsic effect on older adults' motives for technology usage. Loneliness is an issue that often troubles older populations. It has been generally described as an unpleasant state, which is caused by people's asymmetry between their desirable social relationships and the relationships they believe that they have. There are cultural differences in older adults' perceived loneliness. Southern Europeans, for example, tend to feel lonelier than the elderly in the northern European countries [31]. Although there are contradictory findings in the literature regarding the effect of loneliness on motivation, it has been argued that loneliness affects the person's will to complete tasks [32] or learn new skills [33]. Furthermore, according to O'Lunaigh et al. [34], loneliness is associated with older people's cognition deficits, considering visual memory and psychomotor processing. As it seems, emotions act as cognitive drivers under the context of initial technology use [35] and perceived loneliness, among other psychosocial and emotional variables, is related to different web 2.0 usage patterns [36]. Still, the mechanism through which loneliness affects cognitive abilities remains rather unknown [37].

Chronological age is also related to cognition deficits. Working memory effectiveness and processing speed, among others, are negatively affected by higher age [38]. In addition, there are visual, hearing, and haptic impairments related to older peoples' physical states and manipulating digital technologies usually depends on users' aforementioned abilities [39]. There are different usage patterns of digital applications [40] and other online tools [36,41] related to users' age. It is noteworthy that age is not only a construction defined on the basis of time, but also a social construct that reflects the norms, the expectations, and the roles of each individual in the community that he/she lives in [42].

2.2. Users' Evaluative Perceptions towards Technology

Perceived ease-of-use is a critical predictor of users' technology acceptance. As a cognitive construct, it refers to the extent to which someone believes that using a particular tool will be free of effort [43]. Perceived ease-of-use is a core determinant in several models of technology acceptance and use, both for the general population (e.g., [44–46]) and the population of older adults (e.g., [47–49]). Nevertheless, it has been reported that the effectiveness of acceptance models may vary across different cultures [47,50,51]. Likewise, there are contradictory research outcomes regarding the effect of age on ease-of-use. For instance, Porter and Donthu [52] reported a negative relationship between these two structures, based on a USA sample, while Jimoh, Pate, Lin, and Schulman [53] found that older participants' scores on perceived ease-of-use were higher than younger participants' scores, in a study conducted in Africa.

Ease-of-learning may affect the acceptance or rejection of new technologies by older adults, as well [49,54]. In the current project, the term 'learnability', which has been used to denote ease-of-learning, is defined as the easiness of learning how to use technology and acquiring information from it [55]. According to the literature, despite cognitive declines, people's learning abilities can remain efficient as they age. However, older adults need more time to complete training in computer-based systems than younger learners [56,57]. Notably, there is also a relationship between learnability and culture [58,59], as well as between life-long learning abilities and family loneliness [60].

Perceived barriers related to usability often impact technology adoption by older adults [36]. Usability is another concept that involves cognitive processes and derives from a web of qualities, such as complexity, learnability, and ease-of-use [61]. Usability is defined as the degree to which a system can be used in a certain context to achieve specific goals effectively, efficiently, and with satisfaction [62]. As for perceived usability, which is adapted in this study, it is a personal assumption of the usability of a system that can be formed independently of its use. Although actual usability is a fundamental concept in HCI, perceived usability seems to be more influential on users' motivation to obtain a product [63]. Similarly to what has been observed in other studies, culture affects usability [64] and according to Bangor, Kortum, and Miller [65], there is a variety of factors that could further influence people's usability ratings, such as the type of the interface being evaluated and the age of the users.

2.3. Research Hypotheses

Based on the information presented above, there appears to be an essential link connecting users' implicit attributes with their evaluation of technology. Hence, since older Greek adults use the Internet much less, compared to the vast majority of their peers in Europe [16], in the current exploratory study we try to focus on the relationship between two sets of variables: (1) older Greek adults' chronological age, loneliness, and FTP on the one hand and (2) factors that affect online technology adoption and usage (perceived usability, learnability, and ease-of-use) on the other hand. As a result, in order to answer RQ1, the following hypotheses have been tested:

Hypothesis 1 (H1). *Older adults' chronological age has a negative relationship with perceived ease-of-use.*

Hypothesis 2 (H2). *Older adults' loneliness has a negative relationship with perceived ease-of-use.*

Hypothesis 3 (H3). *Older adults' future time perspective has a positive relationship with perceived ease-of-use.*

Regarding RQ2, the following hypotheses have been proposed:

Hypothesis 4 (H4). *Older adults' chronological age has a negative relationship with perceived learnability.*

Hypothesis 5 (H5). *Older adults' loneliness has a negative relationship with perceived learnability.*

Hypothesis 6 (H6). *Older adults' future time perspective has a positive relationship with perceived learnability.*

Regarding RQ3, the hypotheses that have been put forward are:

Hypothesis 7 (H7). *Older adults' chronological age has a negative relationship with perceived usability.*

Hypothesis 8 (H8). *Older adults' loneliness has a negative relationship with perceived usability.*

Hypothesis 9 (H9). *Older adults' future time perspective has a positive relationship with perceived usability.*

A visual representation of the research hypotheses is given in Figure 1.

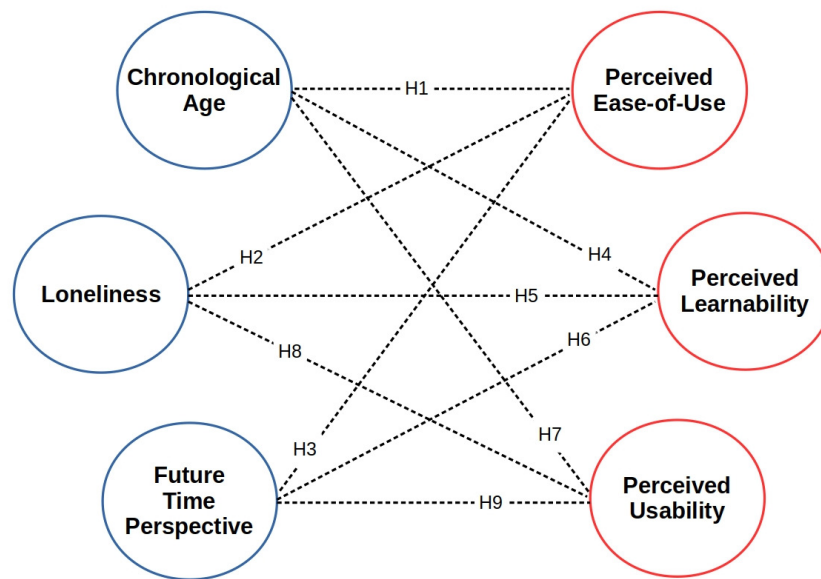


Figure 1. Visual representation of the research hypotheses.

3. Materials and Methods

3.1. Sampling and Data Collection Tool

The participants were recruited through snowball sampling. An online questionnaire was designed and distributed for data collection and covered four categories: (a) demographics, (b) usability, learnability, and ease-of-use (c) loneliness, and (d) future time perspective.

A popular tool for collecting users' subjective assessment of product usability is the System Usability Scale (SUS), developed by Brooke [66]. It comprises of ten statements that sum up to a single number that represents the participant's views upon a technology. In this study, the Greek translation of the SUS [67] was implemented for the usability category. Furthermore, based on Lewis [61], perceived ease-of-use was measured with a single item, SUS question 3, and learnability appeared in the questionnaire with SUS question 7. The Greek version of the UCLA Loneliness Scale [68] was embedded for the loneliness category. Regarding the FTP construct, Carstensen and Lang's [69] scale was translated into Greek and further reviewed by three English literature scholars. The questionnaire was checked by an academic expert on quantitative research and was pre-tested on five older adults, which were not included in the final sample.

3.2. Procedure

The survey was online for 3 months, starting in April 2019. Each respondent who entered the survey was informed about the project through a written introduction. Then a step-by-step presentation of the platform took place. In every step, the demonstration included texts and static images describing the platform interface, as well as screen recordings of the platform manipulation. The participants could control the presentation by repeating specific parts of it or moving backward or forward until they were completely aware of how to use the platform. At the end of the presentation, they were prompted to answer the questionnaire. Similar methodologies combining the evaluation of a product using SUS after its demonstration, have been followed in other studies (e.g., [70,71]).

It has been previously described that sharing personal memories online can be a beneficial and meaningful activity for older adults. Other fields that are affected by culture are technology design and use [17,18] and they should address end-users' needs. Thus, the web technology that was evaluated in the current study is a prototype of a digital storytelling platform that has been previously constructed using participatory design methods with five older Greek adults [21]. With this platform, users can write and edit their stories, as well as read and comment on others' narratives (Figure 2).

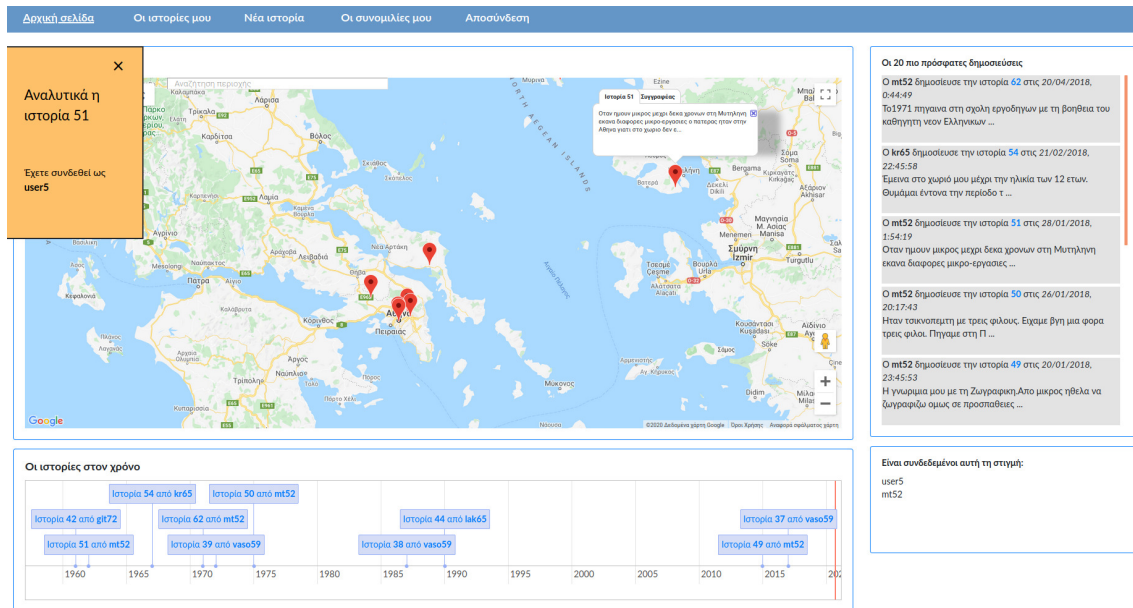


Figure 2. Initial page of the digital storytelling platform [21].

3.3. Statistical Analysis

According to the Shapiro–Wilk test, participants' age, their loneliness and FTP scores, along with their perceived ease-of-use and perceived learnability of the presented prototype, were not normally distributed (Table 1). Hence, the correlations between the variables were analyzed using a non-parametric test, Spearman's rank correlation coefficient [72].

Table 1. Shapiro–Wilk normality test.

Variable	Type	Statistic	Sig.
Age	Scale	0.941	0.000
Loneliness	Ordinal	0.974	0.030
FTP	Ordinal	0.968	0.009
Perceived Ease-of-Use	Ordinal	0.895	0.000
Perceived Learnability	Ordinal	0.913	0.000
Usability	Ordinal	0.980	0.098

4. Results

4.1. Descriptive Statistics

The final sample comprised of 112 older adults (42% male, 58% female) whose age ranged from 60 to 80 years (mean: 66.96, SD: 4.98). Regarding the highest level of formal education received, data showed that 10 (9%) had rounded Primary Education, 6 (5%) and 15 (13%) had graduated from Lower and Upper Secondary Education respectively, 32 (29%) had a vocational training certificate, and 47 (42%) had at least one University degree. As for the hardware they had been using to access the Internet, 46 (41%) respondents mentioned using their desktop PC, 65 (58%) their laptop, 56 (50%) their tablet, and 89 (79%) their smartphone.

Their loneliness scores were between 21 and 64 (initial scale range: 20–80, mean: 36.96, SD: 8.77) and their scores on the FTP scale were between 10 and 67 (initial scale range: 10–70, mean: 37.43, SD: 14.20). Perceived ease-of-use (initial scale range: 1–5, mean: 3.17, SD: 1.35) and learnability (initial scale range: 1–5, mean: 3.25, SD: 1.15) values ranged from 1 to 5. As for the SUS scores, they ranged from 0 to 100 (initial scale range: 0–100, mean: 57.34, SD: 21.69).

4.2. Correlations between Variables

According to the results, there was a negative relationship between perceived ease-of-use and users' chronological age (H1, $r = -0.160$, $p < 0.05$). There was also a statistically valid negative relationship with loneliness (H2, $r = -0.210$, $p < 0.05$) and a positive relationship with future time perspective (H3, $r = 0.355$, $p < 0.001$).

Regarding H2, participants' perceived learnability negatively correlated with their chronological age (H4, $r = -0.269$, $p < 0.01$). Additionally, a positive relationship was found with future time perspective (H6, $r = 0.216$, $p < 0.05$), but not with loneliness (H5, $r = -0.119$, n.s.).

As for H3, perceived usability was negatively associated with loneliness (H8, $r = -0.234$, $p < 0.01$) and positively related to future time perspective (H9, $r = 0.329$, $p < 0.001$). However, no valid correlation was observed with chronological age (H7, $r = -0.125$, n.s.).

The findings are presented in detail in Table 2 and the statistically valid correlations can be seen in Figure 3.

Table 2. Variables' correlations.

Hypothesis	Research Question	Variables	Correlation Coefficient	Sig. (1-Tailed)	Accepted
H1	RQ1	Age and Ease-of-Use	-0.160	0.046	Yes
H2	RQ1	Loneliness and Ease-of-Use	-0.210	0.013	Yes
H3	RQ1	FTP and Ease-of-Use	0.355	0.000	Yes
H4	RQ2	Age and Learnability	-0.269	0.002	Yes
H5	RQ2	Loneliness and Learnability	-0.119	0.106	No
H6	RQ2	FTP and Learnability	0.216	0.011	Yes
H7	RQ3	Age and Usability	-0.125	0.094	No
H8	RQ3	Loneliness and Usability	-0.234	0.007	Yes
H9	RQ3	FTP and Usability	0.329	0.000	Yes

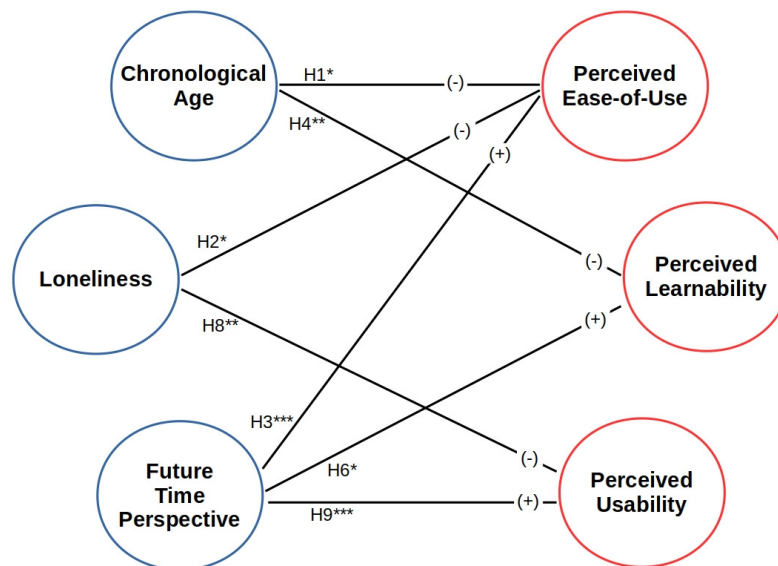


Figure 3. Visual representation of the statistically valid relationships between the variables (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$).

5. Discussion

In general, the outcomes of this study focus on the relationships between two groups of variables: users' chronological age and specific psychosocial perceptions on the one hand and perceived usability, learnability, and ease-of-use on the other hand. Analogous research prompts have been suggested within the multidisciplinary field of Gerontechnology [30] and the broader discipline of HCI [6,7].

The results obtained suggest that users' chronological age does not affect their perceived usability, which contradicts Bangor et al. [65] findings. This outcome opposes the stereotype that new technologies and older people do not get along and is congruent with Hauk et al. [39] suggestions that age-effects are present only for technologies that do not respond to older people's needs. Another possible explanation for the aforementioned contradiction could be related to the cultural differences between the research samples, which is a factor that often affects usability [64]. However, in contrast to the study of Jimoh et al. [53], in the current project chronological age is negatively related to perceived ease-of-use, confirming Porter and Donthu's [52] findings. Similarly, the negative correlation found between age and learnability seems to come along with the outcomes of Baldi's [56] and Kelley and Charness's [57] studies.

Loneliness correlated with older users' SUS scores, denoting that the lonelier the user is, the lower his/her score is on perceived usability. Though from a different perspective, this relationship is consistent and extends Cenfetelli's [35] conclusions regarding the role of emotions on technology usage, as well as Díaz-Prieto and García-Sánchez's [36] findings regarding older adults' feelings of loneliness and web 2.0 usage patterns. Additionally, loneliness correlation with ease-of-use supports similar findings in the literature (e.g., [34,37]) regarding the link between loneliness and older adults' cognition deficits. Nevertheless, in contrast to the connection of loneliness with older adults' motivation to learn [33], as well as Berduzco-Torres et al. [60] reported a link between loneliness and learning, the relationship between older adults' loneliness and learnability was not valid in the current project.

As for the FTP and its relationship with usability, ease-of-use, and learnability, the confirmation of the analogous hypotheses supports previous findings related to users' subjective evaluation of time [27,28] and, most importantly, it seems to extend Socioemotional Selectivity Theory. In particular, the subjective estimation of time left in someone's life is positively associated not only with his/her motives towards knowledge-based activities but also with the results of knowledge-based processes, such as the perceived usability, learnability, and ease-of-use of a technology. Despite the connection that often appears in the literature between FTP and chronological age [26], only FTP was related to the SUS scores in the current study.

6. Limitations and Future Work

This study has some limitations due to its exploratory nature. First, this project focused on a specific technology and the participants did not use the technology itself. Second, the sample was limited and non-parametric. Third, there was no feedback from older people who do not use web technologies. As a result, the findings cannot be generalized to the broader population, but can be used for further research: (i) carry out usability measurements on different web tools and with older users that have previously used those technologies, (ii) gather a broader sample under probability sampling, and (iii) collect qualitative and quantitative feedback from non-users. An experiment that could lead to safe conclusions upon causality is also suggested.

7. Conclusions

The discussions taking place in the field of HCI have implied an intersection between technology, philosophy, personal development, and emotions [2,3,6–8,17]. Furthermore, the needs and preferences of distinct groups of users, such as the elderly population, increasingly gain significant attention from designers and scholars (e.g., [21,22]).

During the last decades, the older adults' population has constantly been growing [15]. However, technology adoption still lacks compared to younger generations and, notably, older Greek adults are one of the groups that are the least connected to the Internet compared to their European peers [16]. Based on the literature, it appears that culture [47,50,51,64] and psychosocial attributes [30,32,34,37] can affect users' perceptions upon several issues, ranging from feelings of loneliness to technology usability and acceptance. Thus, this project aimed at exploring the potential relationship between (i) older Greek adults' age, feelings of loneliness, and future time perspective and (ii) their perceived usability,

learnability, and ease-of-use of a web application, in order to gain further insights into the elements that might affect technology adoption and usage. For this purpose, a digital storytelling prototype was demonstrated to 112 participants and an online structured questionnaire was implemented for data collection. According to the results, participants' chronological age negatively correlated with learnability and ease-of-use, their feelings of loneliness negatively correlated with their perceived usability and ease-of-use, whereas future time perspective positively correlated with usability, learnability, and ease-of-use.

These findings could help technology designers, adult educators, and caregivers better understand the implicit interactions between older adults and web 2.0 tools, in order to promote the privileges derived from the acceptance and use of these innovations.

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