Effects of Age, Gender, and Personality on Individuals' Behavioral Intention to Use Health Applications

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Keywords: Age, Gender, Personality, Technology Acceptance, Health Applications.

Abstract: Health applications, aimed at helping people with or without diseases to monitor their health, are attracting the interest of researchers and consumers. The use of health applications may have a short- and long-term impact on people's lives by creating early habits to use technology to monitor health, which may prompt the sustained use of this technology over time. This is especially important for elders as these applications offer them the possibility to manage their health autonomously. However, elders are resistant to use technology. One way to improve technology acceptance is by understanding how users' behavioral intention is influenced by personal characteristics, preferably before entering in the elderly stage of life. This was the main aim of this study: we explored the effects of age, gender, and personality on the behavioral intention to use health applications in younger and older adults (18-39 vs. 40-65 years). Results showed that the effects of personality on individuals' behavioral intention was moderated by age in older adults and by gender in younger adults. These findings seem relevant to promote the current and future use of health applications, helping people to improve their quality of life and stay healthy throughout the lifespan.

1 INTRODUCTION

During the past years, fast progress and mass dissemination of mobile devices influenced not only electronic industry but also consumers' behaviors and their life style (Huang and Kao, 2015). Currently, there are numerous applications for mobile devices. Many of them are offered for free and are easily accessible. A very popular group of applications are "mobile health applications", known as mHealth. These applications include several utilities that are useful to monitor health-related behaviors and diseases throughout lifetime.

Although one only needs a few seconds to find dozens of health applications to be used on a daily basis, little is known about the factors that lead people to use them. A key question is what makes people want to use such applications, namely people from different age groups. Understanding the determinants of technology acceptance and use is important. Indeed, the value of technology depends to some extent on it being used (one may say that technology is not useful if no one uses it).

Key factors that may influence technology acceptance are users' characteristics (Venkatesh et al., 2012). Factors such as age, gender, and personality traits may either facilitate or hinder the adoption of technology. Information on the nature of the relationship between users' personal characteristics and their behavioral intentions to use technology is useful both for designers and for marketers. This information may help them to create applications tailored to the characteristics of targeted groups (Boudreaux et al., 2014) that may not only prompt the use of mHealth in the present moment, but also increase the likelihood of sustained use over time.

The use of health applications may be especially valuable for elders. The continuous increase in life expectancy and the consequent growth of elderly population gave rise to models of positive ageing focused on promoting healthy, autonomous, and high-quality lifestyles (Demiris et al., 2004). MHealth seems to be very promising to that end by allowing elders to monitor their health autonomously, to promote their independent living, and to facilitate communication with doctors (Czaja, 2015). However, elders may be reluctant to use technology and may have difficulties in engaging with it (Young et al., 2014). Thus, it appears critical to have information on

Nunes, A., Limpo, T. and Castro, S.
Effects of Age, Gender, and Personality on Individuals' Behavioral Intention to Use Health Applications.
DOI: 10.5220/0006674101030110
In *Proceedings of the 4th International Conference on Information and Communication Technologies for Ageing Well and e-Health (ICT4AWE 2018)*, pages 103-110
ISBN: 978-989-758-299-8

key factors that influence the acceptance of technology before the elderly stage of life. Promoting the use of health applications in older and younger adults, who sooner or later will be in the elderly side of society, may have a long-term impact on their future lives by creating early habits to use technology and promoting their sustained use over time. Also, as noted by Charness and Boot (2009), the early use of technology may prevent age-associated impairments and facilitate a healthy entrance into old age.

Overall, it seems that one way to promote the use of mHealth applications by elders is by prompting their use from early on, and by tailoring them to relatively stable personal characteristics. Grounded on these ideas, we conducted the present study aimed to explore the effects of age, gender, and personality on the behavioral intention to use health applications in two age groups: younger (18-39 years of age) and older adults (40-65 years of age).

2 STATE OF THE ART

2.1 Technology Acceptance

Understanding the relationship between consumers' characteristics and technology use requires knowledge from multiple disciplines. Among these, psychology is a critical one. By focusing on the psychological functioning of consumers, psychology may help to create useful technologies tailored to users' individual needs and characteristics (Demiris et al., 2004).

Over the last twenty years, several models have been developed to explain factors influencing individuals' acceptance and use of technology (Venkatesh et al., 2003, Venkatesh et al., 2012, Davis, 1986). These models were inspired by psychological and sociological theories (e.g., Theory of Reasoned Action; Fishbein and Ajzen, 1975) aimed to explain why people behave in a certain way (Venkatesh et al., 2012), and were based on the premise that there is a strong relationship between behavioral intentions and actual behaviors. Two of the most studied technology acceptance models are the Technology Acceptance Model (TAM; Davis, 1989, Venkatesh and Davis, 2000, Venkatesh and Bala, 2008) and the Unified Theory of Acceptance and Use of Technology (UTAUT; Venkatesh et al., 2003). These models have been applied in several fields such as education, organizational settings, or systems engineering (Huang and Kao, 2015). In general, these models assume that behavioral intention to use, and effective use of technology, are influenced by a set of technology-acceptance determinants, namely performance expectancy, effort expectancy, social influence, and facilitating conditions (Venkatesh, 2000).

However, TAM and UTAUT models were more oriented to organizational settings and addressed mostly the non-voluntary use of technologies by workers (e.g., as part of a job task). Only recently did researchers focus on the acceptance of technology used by consumers on a voluntary basis (Venkatesh et al., 2012). To specifically target consumers, the UTAUT model was recently further developed. This newer model not only included motivation, price value, and habits as relevant dimensions to consumers' behaviors, but also highlighted the moderating role of personal characteristics such as age and gender in the association between technology-acceptance determinants (viz., performance expectancy, effort expectancy, social influence, facilitation conditions) and people's behavioral intentions (Venkatesh et al., 2012). However, the willingness to use technologies may also involve other users' characteristics, such as those captured by personality traits (Svendsen et al., 2013). Unfortunately, although users' personality has received increased interest from technology developers over the last years, there has been little effort to incorporate personality traits into a comprehensive approach to technology acceptance (Barnett et al., 2015).

2.2 Personality and Technology

In personality research, many trait models have been identified. One of the most widely accepted is the Big-Five personality model. In this model, personality characteristics are organized into five trait dimension: Extraversion, Agreeableness, Conscientiousness, Emotional Stability, and Openness (Costa and McCrae, 1992). Taken together, these dimensions capture the essence of personality with each dimension representing single and unique human characteristics (John and Srivastava, 1999). Extraversion refers to sociability, need for stimulation, and capacity for joy. Agreeableness refers to the quality of interpersonal orientation along a continuum from compassion to antagonism. Conscientiousness refers to the individual's degree of organization, persistence, and motivation in task- and goal-directed behaviors. Emotional Stability refers to the individual's disposition in being emotionally adjusted or not. Openness refers to the need for variety, novelty, and change.

Only a few studies examined the effects of the five personality traits on people's intention to use technologies (e.g., Svendsen et al., 2013; Nov and Ye, 2008; Barnett et al., 2015; Pocius, 1991). Individuals scoring high on extraversion seem to have a higher degree of interaction with computers (Pocius, 1991). Those with high scores on agreeableness tend to cooperate more with others in adopting and use a new technology (Devaraj et al., 2008). More conscientious people are more careful when they evaluate the opportunities offered by technology. Furthermore, whereas less emotionally stable people tend to be more reluctant to adopt technological novelties (Devaraj et al., 2008), those that are more open to experience are also more prone to accept new technologies (McElroy et al., 2007).

2.3 Age, Gender, and Technology

Prior models of technology acceptance have barely considered the direct impact of age and gender on technology use (Barnett et al., 2015). Instead, research has focused on how age and gender moderate the relationship between major determinants of technology acceptance and the behavioral intention to use technologies (Venkatesh et al., 2003).

In the UTAUT model, age was found to be a key moderator (Venkatesh et al., 2003). For example, the behavioral intention to use technology was more strongly determined by performance expectancy in younger people, and by effort expectancy and facilitating conditions in older people. Concerning gender, men's behavioral intention to use technology appeared to be more driven by performance expectancy, whereas women's intentions were more influenced by effort expectancy, facilitating conditions, social influence, and previous experience with technologies (Venkatesh et al., 2003; Venkatesh et al., 2012). These studies indicated that, like personality, age and gender should be taken into account when examining the role of individual differences in technology acceptance. As age and gender seem to display a moderating role in technology acceptance models, they seem potential moderators on the relationship between personality and behavioral intention to use technology. Indeed, age and gender differences in the big-five dimensions of personality have already been reported. For example, older adults were found to be more self-disciplined and agreeable than younger adults (Soto et al., 2011); and women scored higher on agreeableness and lower on emotional stability than men (Chapman et al., 2008).

2.4 Present Study

As reviewed above, there has been increasing interest in the study of factors underlying people's intention to use technology. Nevertheless, age, gender, and specially personality traits have received little attention. This is quite noticeable in the case of mHealth, despite the evident usefulness of this type of technologies to support people's autonomy and active living (Boudreaux et al., 2014). Here, we examine the effects of personality, age, and gender on people's behavioral intention to use health applications in two age groups: younger (18-39 years) and older (40-65 years) adults. We asked two major research questions. Do age, gender, and personality influence younger and older adults' behavioral intention to use health applications? And do age and gender moderate the effects of personality traits on younger and older adults' behavioral intention to use health applications?

3 METHODOLOGY

3.1 Participants

Three-hundred eighty-five individuals took part in this study, all native speakers of European Portuguese. Forty-five participants were excluded because they did not respond to at least one item of the questionnaires, resulting in a total of 340 participants. They were aged between 18 and 65 years (M = 32.82, SD = 15.27) and 78% were women. Among all participants, 4% had completed primary education (4 years), 3% upper primary education (6 years), 5% middle education (9 years), 11% secondary education (12 years); 49% were attending university, and 28% held a university degree. In order to compare the effects of age, we split the sample into a group of younger adults (n = 205, age range: 18-39 years, M_{age} = 20.93, SD_{age} = 2.46; 86% women) and a group of older adults (n = 135, age range: 40-65 years, M_{age} = 50.87, SD_{age} = 6.00; 64% women).

3.2 Procedure and Measures

A booklet including a set of questionnaires was initially administered to undergraduates in classroom groups. After completing the questionnaires, undergraduates were asked to take one booklet and have it filled by an acquaintance or family member aged between 40 and 65 years within 15 days. This booklet included several questionnaires that were part a larger study on personality and health literacy. Only the measures relevant to the present study are described here.

To assess the Big-Five dimensions of personality we used the Ten-Item Personality Inventory (TIPI; Gosling et al., 2003). TIPI includes two items—a single word or phrase—per dimension (10 items in total), and participants are asked to rate the extent to which each trait applies to themselves using a 7-point scale (1 = *strongly disagree*; 7 = *strongly agree*).

To measure the behavioral intention to use health applications we used the Behavioral Intention sub-scale of the Questionnaire of Acceptance of Technology – Health Applications, adapted from Cimperman et al. (2016). Participants indicate their level of agreement with sentences on the potential use of health applications (e.g*., Assuming I had access to health apps, I would intend to use it.),* using a 7-point scale (1 = *strongly disagree*; 7 = *strongly agree*).

4 RESULTS

4.1 Descriptive Statistics and Correlations

Table 1 presents means and standard deviations for all predictors and outcome variables, along with the bivariate correlations between each other across age groups. In the group of younger adults, men tended to exhibit higher levels of emotional stability than women (*r* = .24), and women tended to show higher levels of conscientiousness (*r* = -.15) and more behavioral intention to use health applications (*r* = -.14) than men. In the group of older adults, older participants tended to exhibit higher levels of emotional stability (*r* = .19). Moreover, men tended to exhibit higher levels of agreeableness (*r* = .21) and emotional stability (*r* = .20) than women.

4.2 Regression Analysis

We conducted two hierarchical multiple regressions: one to examine the effects of age and personality on the behavioral intention to use health applications, and another to examine the effects of gender and personality on the behavioral intention to use health applications. Separate analyses were conducted for younger and older adults (see Table 2 and Table 3 for the unique contribution of each predictor).

4.2.1 Effects of Age and Personality on Behavioral Intention

In Step 1, we entered the main effects of age and of the five personality dimensions (viz., extraversion, agreeableness, conscientiousness, emotional stability and openness), which were previously mean centered. In Step 2, we added the two-way interactions between age and each personality dimension.

In the group of younger adults, Step 1 showed no main effects of age and personality on participants' behavioral intention to use health applications, R^2 = .01, $F < 1$. The inclusion of interactions between age and personality dimensions in Step 2 did not result in any increase in the amount of variance explained, ΔR^2 = .02, $F_{change} < 1$.

In the group of older adults, there were no main effects of age and personality in Step 1, $R^2 = .05$, $F(6, 128) = 1.15$, $p = .34$, but there was a significant increase in the prediction of behavioral intention to use health applications with the inclusion of interactions between age and personality dimensions,

Table 1: Means, standard deviations and correlations for all variables in younger (above the diagonal, n = 205) and older adults (below the diagonal, n = 135). [a]Dummy coded, 0 = female, 1 = male. E = Extraversion, A = Agreeableness, C = Conscientiousness, ES = Emotional Stability, O = Openness, BI = Behavioral Intention. *p < .05. **p < .01. ***p < .001.

	Correlations									
Measures	Age	Gender	E	A	C	ES	O	BI	M	SD
1. Age		.05	-.07	.02	.05	.08	.08	.04	20.93	2.46
2. Gender[a]	.14		.03	-.13	-.15*	.24**	.06	-.14*	0.14	0.34
3. Extraversion	-.05	-.04		-.14**	.02	.12	.38***	.04	4.38	1.53
4. Agreeableness	.004	.21*	.01		.29***	.16*	.18**	.03	6.02	0.83
5. Conscientiousness	-.03	-.07	.15	.30***		.13	.04	.01	5.48	1.20
6. Emotional Stability	.19*	.20*	.21*	.30***	.26**		.26***	-.02	3.59	1.21
7. Openness	-.17	.03	.33***	.15	.23**	.20***		.08	5.38	1.10
8. Behavioral Intention	-.14	.01	.05	.08	.08	-.01	.16		4.15	1.27
M	50.87	0.36	4.67	6.22	5.94	4.13	5.24	4.38		
SD	6.00	0.48	1.61	0.81	1.14	1.40	1.34	1.12		

ΔR^2 = .09, $F_{change}(5, 123) = 2.50$, p = .03. The final model including the main effects of age and personality dimensions, and their respective two-way interactions explained 14% of the variance in behavioral intention. Results showed that there was a significant interaction between age and openness (β = .20, p = .05). Because the moderator (age) is continuous, we used the Johnson-Neyman technique to decompose the interaction. Results revealed that among participants with 55.12 years or more (22% of the sample) higher levels of openness were associated with a stronger behavioral intention to use health applications, β = .17, t = 1.98, p = .05.

4.2.2 Effects of Gender and Personality on Behavioral Intention

As before, we conducted hierarchical multiple regression analysis separately for each age group to examine the contribution of personality to the behavioral intention to use health applications and the moderating role of gender. In Step 1, we entered the main effects of gender (0 = women, 1 = men) and of the five personality dimensions, which were previously mean centered. In Step 2, we added the two-way interactions between gender and each personality dimension.

In the group of younger adults, Step 1 results revealed no main effects of gender and personality on participants' behavioral intention to use health applications, R^2 = .03, $F(6, 198) = 0.91$, p = .49. Still, there was a significant increase in the prediction of behavioral intention to use health applications with the inclusion of interactions between gender and personality dimensions, ΔR^2 = .07, $F_{change}(5, 193)$ = 3.10, p = .01. The final model including the main effects of gender and personality dimensions, and their respective two-way interactions explained 10% of the variance in behavioral intention. Results indicated that there were significant interactions between gender and extraversion (β = .25, p = .002), as well as between gender and emotional stability (β = -.18, p = .04). Because the moderator (gender) is a dichotomous variable, we used simple slopes analyses to decompose the interaction. Results revealed that these two personality dimensions were associated with behavioral intention only for male participants. Specifically, a stronger behavioral intention to use health applications was found for men displaying higher levels of extraversion, β = .45, t = 2.75, p = .01, and lower levels of emotional stability, β = -.35, t = -1.91, p = .05.

In the group of older adults, neither Step 1, R^2 = .05, $F(6, 128) = 1.01$, p = .42, nor Step 2, ΔR^2 = .04, $F_{change}(5, 123) = 1.16$, p = .33, reached significance.

5 DISCUSSION

Our main research goal was to examine the effects of age, gender, and personality on the behavioral intention to use health applications in two age groups of younger (18-39 years) and older adults (40-65 years).

We formulated two research questions: Do age, gender, and personality influence younger and older adults' behavioral intention to use health applications? And do age and gender moderate the effects of personality traits in younger and older adults' behavioral intention to use health applications?

Table 2: Effects of age and personality on participants' behavioral intention to use health applications across age groups. *p < .05. **p < .01. ***p < .001.

	Younger adults				Older adults			
	B	SE	β	t	B	SE	β	t
Constant	3.21	1.18		2.73	3.42	1.25		2.75
Age	0.02	0.05	.04	0.44	0.00	0.02	.002	0.03
Extraversion	0.03	0.07	.03	0.39	0.01	0.06	.01	0.14
Agreeableness	0.01	0.12	.01	0.09	0.12	0.13	.09	0.95
Conscientiousness	-0.003	0.08	-.003	-0.04	0.03	0.09	.03	0.36
Emotional Stability	-0.04	0.08	-.03	-0.45	-0.10	0.08	-.13	-1.34
Openness	0.09	0.10	.07	0.86	0.07	0.08	.09	0.91
Age x Extraversion	0.003	0.04	.01	0.08	0.02	0.01	.18	1.95*
Age x Agreeableness	0.02	0.05	.03	0.36	-0.004	0.03	-.01	-0.16
Age x Conscientiousness	-0.05	0.04	-.10	-1.14	-0.02	0.02	-.12	-1.31
Age x Emotional Stability	0.02	0.03	.05	0.59	0.01	0.01	.10	1.13
Age x Openness	0.04	0.05	.09	0.91	0.02	0.01	.20	1.99*

Table 3: Effects of gender and personality on participants' behavioral intention to use health applications across age groups. [a]Dummy coded, 0 = female, 1 = male. *p < .05. **p < .01. ***p < .001.

	Younger adults				Older adults			
	B	SE	β	t	B	SE	β	t
Constant	4.14	0.85		4.85	3.26	1.11		2.95
Gender[a]	-0.28	0.31	-.08	-0.89	0.29	0.23	.12	1.25
Extraversion	-0.07	0.07	-.09	-1.03	-0.04	0.08	-.06	-0.56
Agreeableness	-0.02	0.13	-.01	-0.13	-0.01	0.17	-.01	-0.08
Conscientiousness	-0.07	0.09	-.07	-0.83	0.12	0.11	.13	1.09
Emotional Stability	0.07	0.09	.06	0.77	-0.07	0.10	-.09	-0.71
Openness	0.12	0.10	.11	1.27	0.18	0.10	.21	1.84
Gender x Extraversion	0.57	0.19	.25	3.08**	0.24	0.15	.20	1.61
Gender x Agreeableness	-0.02	0.30	-.01	-0.08	0.49	0.29	.21	1.67
Gender x Conscientiousness	0.19	0.22	.08	0.86	-0.15	0.21	-.09	-0.70
Gender x Emotional Stability	-0.42	0.20	-.18	-2.06*	-0.26	0.18	-.18	-1.40
Gender x Openness	-0.20	0.30	-.06	-0.67	-0.20	0.19	-.14	-1.04

5.1 Effects of Age, Gender, and Personality on Behavioral Intention

Concerning the first research question, we found no main effects of age, gender, and personality on individuals' behavioral intention to use health applications, neither in younger nor in older adults. This result should be read carefully as current research into technology acceptance has barely considered the unique effects of these variables to behavioral intention. Instead, age and gender have been mainly considered as antecedents of determinants of technology acceptance (e.g., ease of use) or as moderators of the relationship between these and behavioral intention (McElroy et al., 2007; Tarhini et al., 2014). Indeed, Venkatesh et al. (2003) considered age and gender as important moderators within the UTAUT model. As for personality, Svendsen et al. (2013) have already shown that it does not influence individuals' behavioral intentions to use technology directly. Instead, the effect of personality occurred through other technology-acceptance determinants, such as perceived usefulness, ease of use and social norms.

Concerning the second research question, we did find that age and gender moderated the effects of personality traits on the behavioral intention to use health applications. These moderating effects were different across age groups.

In younger adults, age did not moderate personality effects on behavioral intention, but it did in older ones. Specifically, we found that for older participants (i.e., above 55 years), a higher degree of openness to experience was associated with a stronger behavioral intention to use health applications. These findings are aligned with prior research, showing that people are more predisposed to accept new technologies when they report to be more open to new experiences (McElroy et al., 2007). As shown here, this relationship seems to be particularly important as people get older, mainly after 55 years of age.

Gender did not moderate personality effects on behavioral intention in older adults, but it did in younger ones. Results showed that men were more willing to use health applications when they showed higher levels of extraversion and lower levels of emotional stability. Previous studies in the technology domain have already showed that the effects of personality traits on technology-related outcomes are moderated by participants' gender. For example, such an interaction was reported by Saleem et al. (2011) in a study focused on computer self-efficacy. However, few studies have addressed the moderating role of gender on the relationship between personality and use of mobile applications in the health domain. Further studies are needed to corroborate our findings and deepen knowledge on their implications to the acceptance of mHealth.

Overall, our results suggest that personal characteristics are worthy to consider when studying technology acceptance. Indeed, users' intention to use technology seems related to the affinity that they have for certain types of technology, which is influenced by personal characteristics such as those here examined, that is, age, gender, and personality (Svendsen et al., 2013). As technology acceptance research suggests that individual differences may affect the adoption of new technologies (Tsourela and Roumeliotis, 2015), these findings bring implications to the design and development of health applications. The development of new technological solutions should therefore be tailored to particular segments of the population. This alignment between applications and these groups should, at the very least, take into consideration not only age and gender, but also the behavioral patterns typical of those groups. Future studies should continue to pursue this research avenue, by exploring how other personal characteristics influence technology acceptance as people get older and approach the elderly stage of life.

5.2 Limitations and Future Directions

The previously discussed findings should be considered in view of at least two methodological limitations, which may guide future research. A first limitation is that there were more participants in the younger group. The sample was split at the age of 40 to achieve a relatively large difference between the mean ages of younger and older groups. However, this resulted in an unequal sample size per group. Moreover, due to the recruitment procedure, there was a larger representation of women than men in our sample. Future studies should aim to collect larger samples, with an equivalent number of younger and older adults, as well as men and women. This would also allow researchers to use more sophisticated techniques, such as multiple-group structural equation modeling, to test and compare different models of technology acceptance across age groups and gender. Additionally, because ageing brings changes in diverse aspects, such as physical health, perception, cognition, and psychological functioning (Charness and Boot, 2009), it would be important to control for these aspects, particularly in older samples. Along with age, gender and personality, these personal characteristics may also play a role in the way that people use or intend to use mHealth. A second limitation was the lack of measurement of previous knowledge and actual use of mobile devices and health applications. This seems to be an important factor to take into account in future studies. The previous experience with technologies was also proposed to influence individuals' behavioral intention to use technologies (Venkatesh et al., 2012; Venkatesh et al., 2003), showing the relevance of considering this variable when testing technology acceptance models.

6 CONCLUSIONS

Despite the increased attention to factors influencing technology acceptance, research examining the role of personal characteristics is still scarce. Our study provided additional knowledge on the role of age, gender, and personality in younger and older adults' behavioral intention to use mHealth. This knowledge is useful to develop and adjust technologies to key characteristics of target groups. With elders displaying a marked resistance in accepting technology (Charness and Boot, 2009), the promotion of mHealth in earlier stages of life seems particularly important to create habits to use technology. These habits may promote the sustained use of technology throughout the lifespan and, at the same time, act as preventive measures to negative health outcomes.

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