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Predicting Older Adults' Perceptions about a Computer System Designed for Seniors

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Abstract

Purpose.—Although computer technology may be particularly useful for older adults (e.g., for communication, information access), they have been slower adopters than their younger counterparts. Perceptions about computers such as perceived usefulness and perceived ease of use can pose barriers to acceptance and universal access [1]. Therefore, understanding the precursors to these perceptions for older adult non-computer users may provide insight into the reasons for their non-adoption.

Methods.—We examined the relationship between perceived usefulness and perceived ease of use of a computer interface designed for older users and demographic, technology experience, cognitive abilities, personality, and attitudinal variables in a sample of 300 non-computer using adults between the ages of 64 and 98, selected for being at high risk for social isolation.

Results.—The strongest correlates of perceived usefulness and perceived ease of use were: technology experience, personality dimensions of agreeableness and openness to experience, and attitudes. The emotional stability personality dimension was significantly correlated with perceived ease of use but not perceived usefulness. Hierarchical regression analysis revealed that attitudes (i.e., self-efficacy, comfort, interest) remained predictive of perceptions of usefulness and ease of use when technology experience and personality variables were accounted for.

Conclusion.—Given that attitudes are more malleable than other variables, such as demographic and cognitive abilities, these findings highlight the potential to increase technology acceptance through positive experiences, appropriate training, and educational campaigns about the benefits of computers and other technologies.

Keywords

aging; technology acceptance; computers usefulness; ease of use; personality

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1. Introduction

Computer technology has the potential to provide support for the rapidly growing older adult population[2]. The number of adults 65 and older is expected to more than double between 2012 and 2060, from 43.1 million to 92.0 million [3]. Computers can foster social connections for this growing segment of the population by facilitating communication, for example. In the AARP Grandparent Study[4], 45% of respondents reported that they have grandchildren who live more than 200 miles away. Email and video conferencing can provide additional opportunities for these long-distance families to stay connected beyond a telephone call. Computers can also provide access to information, such as community and national resources, enable financial management from home, and provide prospective memory support[5]. Moreover, despite the challenges that have been documented regarding cognitive exercise[6], there is some promising evidence and increasing interest in computer-based programs designed to afford cognitive exercise[7].

Despite the potential benefits that computer technologies offer, older adults are typically considered part of the “have nots” in the digital divide, a term used to describe the inequity in computer and internet adoption between certain population groups[8–10]. Non-adopters of the internet tend to be less educated and have lower incomes, in addition to being older [11]; they are also more likely to have a disability [12]. With respect to age, data from the Pew Internet and American Life Project showed that only 53% of adults 65 and older use the Internet as compared to 97% of 18–29 year olds [13]. Nevertheless, research suggests that older adults can use and integrate computers into their lives [14], be proficient users[15], and be just as active online as younger users [16, 17].

2. Related work

It is critical to understand the factors contributing to seniors’ lower computer adoption rates to ascertain how to facilitate adoption for those who have remained non-users. The technology acceptance literature provides models that give direction about the variables that have been shown to be involved in adoption. In particular, the technology acceptance model (TAM)[1], one of the most widely used models in the information systems literature, has been shown to be a valid and robust model for predicting behavioral intention [18]. Behavioral intention is a precursor to actual behavior and is significantly correlated with actual behavior [1, 19]. Behavioral intentions serve a critical role in acceptance. Although intentions may be formed in the absence of experience with a particular technology, they can still impact actual use. That is, even nonadopters of a particular technology may hold intentions about adopting that technology based on their perceptions (rather than actual use).

Given that behavioral intention is significantly correlated with actual behavior, predictors of intention can be particularly insightful for understanding why individuals do not adopt a technology. The two primary predictors in the TAM are perceived usefulness and perceived ease of use. The TAM has evolved (for TAM3, see [20]) to enable it to account for individual differences, such as age, education, income, race/ethnicity [21], gender [22], experience [22, 23], self-efficacy [24, 25], as well as system or technology characteristics [26], such as compatibility [27] and objective usability [28], as moderating variables of perceived usefulness and perceived ease of use. There is a particular need to investigate further the individual differences that drive these perceptions for the older adult population, such as personality characteristics [29–31] and cognitive abilities [32–34] as there is a lack of data on the influence of these variables on older adult perceptions of usefulness and ease of use.

Recently, there has been increased interest in using personality as a predictor to technology adoption [29, 31, 35, 36]. In particular, research has found that individual differences in the big-five personality traits[37–39] significantly impacts technology acceptance and adoption. The big-five personality traits are [40]:

1. Agreeableness: characterized by good-naturedness, cooperativeness, and trust.
2. Emotional stability/neuroticism: neuroticism is characterized by upsetability; emotional stability is the opposite end of this dimension.
3. Extraversion: characterized by talkativeness, assertiveness, and energy.
4. Openness: characterized by originality, curiosity, and ingenuity.
5. Conscientiousness: characterized by orderliness, responsibility, and dependability.

Individuals who scored lower in agreeableness and higher in neuroticism were less likely to perceive mobile commerce as useful [31]. Those who scored higher on extraversion had higher levels of initial acceptance of a business management software [35], and those who scored lower on extraversion and emotional stability were less likely to endorse positive attitudes toward monitoring technology in the workplace [41]. These findings suggest raise the question of whether personality traits may impact technology acceptance, in general, and whether they impact computer acceptance of older adults.

Cognitive abilities and computer attitudes (i.e., computer self-efficacy and computer anxiety) have also been shown to influence technology use. Czaja et al [32] examined predictors of technology use in a sample of 1,204 participants (18–91 years of age) and found the following factors predicted general technology use: age, education, ethnicity, fluid intelligence, crystallized intelligence, computer self-efficacy, and computer anxiety. Greater technology use was associated with younger ages and those who were better educated, and White/European Americans and Hispanic/Latino Americans used more types of technology than Black/African Americans. Higher fluid and crystallized intelligence, higher computer self-efficacy, and lower computer anxiety were also associated with greater technology use. Furthermore, the relationship between age and *technology use* was mediated by cognitive abilities, computer self-efficacy, and computer anxiety, whereas the relationship between age and *computer use* was mediated by education, ethnicity, fluid intelligence, and computer anxiety.

Further evidence of the importance of experience with computers and technologies on older adults' perceptions about technology was demonstrated in a series of focus groups conducted with a total of 113 older adults. Participants frequently mentioned liking technologies because they provided support for activities (i.e., they were perceived as useful) and they reduced effort or did not require effort (i.e., they were easy to use; [42]). A study with 281 older adults who were experienced computer users explored precursors to perceived usefulness for communication activities [43]. The results showed that the most important predictor of perceived usefulness was the amount of experience individuals had with a computer; their ratings of importance for communication activities was also a strong predictor. These findings suggest that older adults need to perceive that activities performed on a computer are relevant to their needs and interests, in addition to feeling that computers are useful for performing those activities. That is, if older adults are not trying to expand their social network, they may not perceive a computer as being useful for that activity regardless of the objective usefulness of computers for social networking.

While the aforementioned findings provide insight into computer and Internet adoption, less is known about the variables that predict perceptions about the usefulness and ease of use of computers. Moreover, very little is known about these perceptions from the perspective of computer non-users. Computer non-users may be a diverse population, including those who have tried and failed to use the technology, those who have no current interest in using such technology, and those who have interest but lack self-efficacy about their ability to learn to use computers. Focusing on non-users can provide useful insights into the factors that may impact future use and can point to potential interventions that could encourage future use. Computers and software are continually improving, and seniors develop perceptions about these technologies before they even interact with them. Understanding the attitudes of computer non-users may also provide insight about perceived barriers to other currently available technologies (e.g., smartphones, tablets), as well as future technologies that individuals are first introduced to in later life.

3. Evaluating predictors of perceived usefulness and perceived ease of use

The goal of the present study was to asses for older adults who have not adopted computers: 1) their perceptions of usefulness and ease of use of a computer system designed for seniors; and 2) the relative contributions of precursor variables that influence their perceived usefulness and perceived ease of use. We explored variables hypothesized to be relevant based on previous literature. In particular, we explored how age, education, income, and ethnicity, are related to perceived usefulness and perceived ease of use, given that these variables are most frequently associated with demographic-based differences in Internet use and technology use [11, 32, 44] (see Figures 1 and 2; [21]). We also examined how the big five personality traits as well as cognitive ability measures and attitudes (e.g., computer anxiety and self-efficacy; see Figure 2), influence perceptions of usefulness and ease of use.

The computer system for which we assessed perceptions of usefulness and ease of use was a system designed specifically for seniors [45]. By using such a system, we attempted to reduce some of the barriers associated with specific characteristics of typical computers. Moreover, this system was designed to highlight functions that would be applicable to seniors (e.g., access to information about aging and aging resources, calendaring software with personal reminders, software to facilitate communication with family and friends, games, access to resources).

Our findings provide insights into how to facilitate adoption of computers and other information and communication technologies by seniors by elucidating the variables that predict their perceptions of usefulness and ease of use. Our findings also provide specification for models of technology acceptance, particularly specification for predictors of perceived usefulness and ease of use, and increase the applicability of technology acceptance models to older adults. Understanding computer acceptance may also provide insight into older adults' acceptance of other new technologies, such as smartphones and tablets. Hence, computers can be thought of as an exemplar for any technology that is new to the older adult population.

3.1. Method

3.1.1. Participants—Participants were community-dwelling, independent-living older adults recruited from the Miami (n = 140), Atlanta (n = 116), and Tallahassee (n = 44) sites of the Center for Research and Education on Aging and Technology Enhancement (CREATE; total N = 300; ClinicalTrials.gov Identifier: NCT01497613). Participant demographic information is presented in Table 1. All participants reported English as their primary language, had at least 20/60 vision with or without correction and were able to read at the 6th grade level. Participants had minimal or no computer and Internet use in the past three months of participation; 46% reported having no computer experience at all.

Prescreening criteria included: being age 65 or older and having no computer or Internet experience within the past three months. Participants were disqualified if they reported having a working computer at home and if they reported "yes" to using email or the Internet frequently over the past 3 months. Participants were also classified as being at risk for social isolation based on the following criteria: they did not work more than 5 hours per week (including volunteer work) and did not attend a senior center or another type of formal organization more than 10 hours per week. They were recruited as part of the PRISM clinical trial examining the effect of a computer intervention on well-being (ClinicalTrials.gov Identifier: NCT01497613). The data presented here are baseline data before intervention administration for the clinical trial.

3.1.2. Materials

Mail Questionnaire.: This set of questionnaires included demographic (e.g., age, education, gender, education) and health questions [32], and assessments of computer attitudes (i.e., comfort, efficacy, interest; [32]; [53]), technology and computer experience [32], personality [40], and technology acceptance (i.e., perceived usefulness and ease of use; adapted from Davis, 1989[1]. The same wording was used as in Davis (1989)[1], with the exception of the name of the technology, which was changed to refer to a computer system designed for seniors. We used the generic label 'computer system' rather than desktop, laptop, or tablet computer, to try to reduce system specific perceptions and increase the generalizability of our findings. The technology acceptance questions were preceded by an introduction to this computer system. The description stated that the system would provide access to information and services related to aging, access to health care services, opportunities for social interaction, recreational and educational opportunities, and support for memory. We described the system as providing access to senior relevant resources to ensure the system would be explicitly relevant to them. Participants were asked to imagine they had received appropriate personalized training for its use to encourage them to think beyond any initial barriers that would be related to learning a new system and that might dissipate after training. Response options were Likert-type for which 1 = extremely unlikely, 4 = neither, and 7 = extremely likely.

In person assessment.: A variety of measures were administered in person, including assessments of fluid and crystallized abilities (see Table 1).

3.1.3. Procedure—

Participants first provided informed consent over the phone to participate in a telephone pre-screening interview.

Participants were mailed the questionnaire packet and asked to complete it prior to the in person assessment, which was scheduled for a date approximately 1–2 weeks in advance. When assessors arrived at each participant's home they collected informed consent and proceeded to administer the in person assessment. Participants were paid $25 for participation.

3.2. Results

Descriptive statistics summarizing the participant characteristics are presented in Table 1. Missing data accounted for 1.5% of the data used in these analyses. The participants' ratings of usefulness and ease of use were $M = 5.78$, $SD = 1.23$ and $M = 5.75$, $SD = 1.08$, respectively (1 = extremely unlikely, 4 = neither, 7 = extremely likely). Participants' ratings of usefulness and ease of use were strongly correlated (Pearson's r = .76, $p < .001$).

Correlations were computed between all of the variables to examine the relationships between precursor variables and perceived usefulness and ease of use, as well as to assess whether individual test scores could be combined into composite ability factor scores. Spearman's Rho was used for categorical data and Pearson's r for continuous data. Factor scores were created (i.e., regression data reduction) from individual test scores to use as composite factors when the individual test scores were significantly correlated with one another (i.e., fluid abilities, crystallized abilities, attitudes) to provide more stable measures of the underlying constructs for subsequent analyses. Factor scores also have greater reliability given multiple indicators of a construct and improve statistical power. If a factor score was created it was used in all subsequent regression analyses. The correlations of all of the variables, including the factor scores, with perceived usefulness and perceived ease of use are presented in Table 3. Bonferroni correction was used given the multiple comparisons (significance level set to $p < .002$).

Demographics.—With respect to the demographic variables, education, ethnicity, gender, and age were not significantly correlated with either perceived usefulness or perceived ease of use.

Experience.—Technology experience had significant positive correlations for both perceived usefulness and ease of use. Participants who reported having more technology experience were more likely to rate computers as useful and easy to use.

Personality.—Openness to experience had the strongest relationship of all of the personality dimensions, with significant positive correlations for both perceived usefulness and perceived ease of use. Agreeableness was also positively correlated with both of these perceptions. Emotional stability was positively correlated with perceived ease of use but not with perceived usefulness. Extroversion and conscientiousness personality dimensions were not significantly correlated with either perceived usefulness or ease of use. In sum, participants who had higher scores for openness to experience and agreeableness were more likely to rate computers as useful. In addition, participants who had higher scores for emotional stability were more likely to rate computers as easy to use.

Attitudes.—Computer self-efficacy, comfort, and interest all had significant positive correlations for both perceived usefulness and ease of use, as did the (composite) attitude factor score. The higher the self-efficacy, comfort, and interest related to computers, the more likely participants were to rate computers as useful and easy to use. The directionality of this relationship needs to be investigated further. However, given that we assessed self-efficacy, comfort, and interest before we introduced the computer system that we used as a context for the usefulness and ease of use ratings, it seems likely that preconceived notions about computer self-efficacy, comfort, and interest drove the ratings of perceived usefulness and ease of use for our computer system that was customized for older adults.

Cognitive abilities.—There were no significant correlations with any of the individual cognitive ability measures or the corresponding factor scores.

Summary.—The correlation analyses showed that higher ratings of perceived usefulness and ease of use were associated with more positive computer attitudes (i.e., self-efficacy, comfort, interest), more technology experience, and personalities that were more open to experiences and more agreeable. Moreover, individuals with personalities that were more open to experiences and more emotionally stable were more likely to perceive the computer as easy to use.

To examine the relative contributions of the variables to participants' ratings of perceived usefulness and perceived ease of use, multiple hierarchical regression analyses were performed with perceived usefulness and perceived ease of use as the dependent variables. Technology experience was entered first. Personality variables (i.e., openness to experience, agreeableness, emotional stability) and the attitude factor score were then entered to examine the additional variance explained by these variables.

Models for perceived usefulness are presented in Table 4. For Model 1 technology experience was a significant. In Model 2 technology experience, openness to experience, and agreeableness were significant. In Model 3 only the attitude factor score was significant. Therefore, attitudes accounted for additional unique variance, over and above technology experience and personality characteristics in the prediction of individual perceptions of usefulness.

The corresponding models for perceived ease of use are presented in Table 5. The findings were similar to the pattern observed for perceived usefulness. However, in Model 2, when personality variables were entered, only openness to experience was significant along with technology experience. As with perceived usefulness, in model 3, only the attitude factor score was a significant predictor ($p < .001$). In sum, the regression analysis revealed that general computer attitudes remained predictive of perceptions of ease of use and usefulness, even after the other significant correlations were accounted for.

3.3. Discussion

We explored older adults' perceptions of the usefulness and ease of use of a hypothetical computer designed for older users. Participants were not current computer users, and had very little if any past experience with computers. Evaluating these perceptions has been an important tool in the information systems literature and industry [54]. Perceptions of usefulness and ease of use have been shown to be valid predictors of technology acceptance, a precursor to behavioral adoption [55] . Individuals' technology acceptance opinions, however, can be assessed before individuals have acquired experience with a technology (i.e., non-users; [1]), and these opinions predict actual use [1, 19]. Therefore, perceptions of usefulness and ease of use can be used to estimate future adoption for current non-users. This study investigated the relationship between perceptions of usefulness and ease of use and a range of variables (i.e., demographic, experience, cognitive abilities, personality, attitudes).

The TAM and its evolutions show the importance of including prior factors, such as experience [22] and self-efficacy [24], as well as contextual factors, such as technology characteristics [26] as moderating variables of perceived usefulness and perceived ease of use. We investigated a wide range of these variables, in addition to personality and cognitive ability variables, to understand their relationship between older adults' perceptions of the usefulness and ease of use of a hypothetical computer designed for older users.

The correlation analyses revealed that the strongest relationships for perceived usefulness were the computer attitude factor score and individual attitude measures of self-efficacy, comfort, and interest; the technology experience score; and the personality dimensions of openness to experience and agreeableness. These findings are consistent with previous research on the relationship between computer attitudes in predicting computer use [32]. Therefore, there is a parallel between factors that influence non-users' perceptions about computers and those that are predictive of how much an individual uses a computer. In the current study, attitudes about computers, in general, that participants brought to the table such as "I don't feel confident about my ability to use a computer" (self-efficacy), "Computers make me nervous" (comfort), and "I don't care to know more about computers" (interest), had a strong impact on how they perceived usefulness and ease of use of the system we described to them, despite being told that it was designed specifically for older adults and that they would receive appropriate training.

Correlation analyses showed the strongest relationships for perceived ease of use to be the computer attitude factor score; individual attitude measures of self-efficacy, comfort, and interest; the technology experience score; and the personality dimensions of openness to experience, agreeableness, and emotional stability. Similar to the findings for perceived usefulness, the results are also consistent with large-scale survey data on the relationship between computer attitudes and computer use [32] and the relationship between personality characteristics and technology adoption.

With respect to personality characteristics, individuals who scored higher on the agreeableness dimension were more likely to rate the computer system as more useful and easier to use, a finding that is consistent with previous research [31]. Those who scored higher on the emotional stability dimension were more likely to rate the computer system as easier to use, which is also consistent with previous research [41]. Furthermore, individuals who scored higher on the openness to experience dimension were more likely to rate the computer system as more useful and easier to use, which is a novel finding. Together, we found evidence of a strong relationship between personality characteristics and perceived usefulness and ease of use, which suggests that the addition of a personality construct may increase technology acceptance models' predictive ability. This hypothesis should be tested with more representative model of older adults, given this sample was characterized by being at risk for social isolation, as well as with adults with a wider age range (e.g., including middle-aged adults).

We did not find significant correlations between perceptions of usefulness and ease of use and some measures that might have been expected based on the literature. For example, we would have expected significant correlations between perceived usefulness and ease of use with age and education based on previous research [32, 56, 57]. However, the present sample reported less education and a restricted age range compared to most other samples in the literature. Large-scale survey data on the digital divide has also shown education to be associated with computer adoption [11]. Moreover, income has been shown to be associated with computer use [11]. However, our participants could be categorized as primarily low income (i.e., 86.6% reported <$30,000). Lastly, we did not find a significant relationship between cognitive abilities and perceived usefulness and ease of use, a finding that suggests cognitive abilities may be more predictive of actual computer use than perceptions about computers. It is interesting to note that this finding is somewhat surprising given that metacognitive theory would predict that individuals with higher cognitive abilities would also have higher self-efficacy [58].

We conducted hierarchical analyses to assess the predictive power of the variables we measured. This analysis showed that computer attitudes were the most predictive of perceptions of usefulness and ease of use. The present findings provide evidence similar to Czaja et al. (2006)[32] of the importance of computer attitudes. However, as the sample in the current study were all non-users of computers, this finding further establishes the importance of older adults' attitudes on technology acceptance by extending the significance of this factor to those with limited or no experience.

There will always be new technologies and there will always be new users of these technologies. Two current examples of relatively recent technologies introduced to older adults include computers and smartphones. Just as older adults lag behind younger adults in computer adoption, they also lag behind in smartphone adoption. Younger adults' smartphone adoption rates are high (80% of 18–34 year olds report smartphone ownership), whereas those of older adults are much lower (18% of adults 65 and older report owning a smartphone; [59]), despite the most older adults (77%) own a cellular phone. For future older adults who have grown up with computers, the technology that is new to them could be a robot. In the present study we used computers as an exemplar of a technology that was introduced in individuals' adult lives. An understanding of current older adults' acceptance of computers may apply more broadly to other current technologies with low adoption rates by seniors, as well as future older adults and the future technologies that are introduced in their lives.

Given that information technology systems are evolving rapidly, it is important to consider the implications of our findings for increasing technology adoption, in general. Technology acceptance influences many pathways toward adoption (e.g., willingness to take a class, willingness to persevere, willingness to buy). Some potential barriers are more malleable than others. For example, age, income, and cognitive ability are less malleable than attitudes. Our sample was diverse with respect to education and ethnicity, yet education was not correlated with perceptions of usefulness and ease of use and ethnicity was not predictive in the final regression model. Attitudes were the most predictive factor in the final regression model and attitudes are more changeable and, therefore, should be considered a ripe opportunity for increasing technology acceptance and adoption by non-users when deploying new technologies.

Deployment strategies might include advertising and marketing campaigns and experience with the technology itself [60]. For example, use cases demonstrating how and why other older adults use particular technologies may also be helpful in illustrating the potential benefits of those technologies to non-users. If older adults see more positive images of their peers using a technology, become more educated on what the technology has to offer, and receive appropriate training, their attitudes may improve. Moreover, efforts to influence older adults' perceptions in a positive way in addition to system design and training that considers older adults' limitations and capabilities (e.g., perceptual, cognitve) could have an even greater effect on their acceptance and adoption of technology.

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5. References

1. Davis FD, Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly, 1989 13(3): p. 319–340.
2. Czaja SJL, C. C., Older Adults and Information Technology: Opportunities and Challenges, in The Human Computer-Interaction Handbook, Jacko JA, Editor. 2012, CRC Press: Boca Raton, FL p. 825–840.
3. Bureau, U.S.C., Projections of the Population by Selected Age Groups and Sex for the United States: 2015 to 2060, 2012: Washington, D.C.
4. The grandparent study 2002 report, 2002, American Association for Retired Persons
5. Charness N, & Boot WR, Aging and information technology use potential and barriers. Current Directions in Psychological Science, 2009 18(5): p. 253–258.

6. Green CSB, D., Exercising your brain: A review of human brain plasticity and training-induced learning. Psychology and Aging, 2008 23(4): p. 692–701. [PubMed: 19140641]

7. Boot WR, Blakely DP, & Simons DJ, Do action video games improve perception and cognition? Frontiers in Psychology, 2011 2: p. 226. [PubMed: 21949513]

8. Falling through the net: A survey of the "Have Nots" in rural and urban America 1995, National Telecommunications and Information Administration [NTIA]: Washington, D.C.

9. Falling through the net: Toward digital inclusion. A report on Americans' access to technology tools, 2000, National Telecommunications and Information Administration [NTIA]: Washington, D.C.

10. A nation outline: How Americans are expanding their use of the internet, 2002, National Telecommunications and Information Administration [NTIA]: Washington, D.C.

11. Project, P.I.A.L., Demographics of internet users, 2013.

12. Fox S, Americans living with disability and their technology profile, 2011, Pew Research Center.

13. Zickuhr K, & Madden M, Older adults and internet use, 2012, PEW Research Center.

14. Morrell RW, Dailey SR, Stoltz-Loike M, Mayhorn CB, & Echt KV, Older Adults and Information Technology: A Compendium of Scientific Research and Web Site Accessibility Guidelines, 2005, National Institute on Aging: Washington, D.C.

15. Boot WR, Charness N, Czaja SJ, Sharit J, Rogers WA, Fisk AD, Mitzner TL, Lee CC, & Nair S, The Computer Proficiency Questionnaire (CPQ): Assessing low and high computer proficient seniors. The Gerontologist, Submitted

16. Fox S, Older Americans and the internet, 2004, Pew Internet & American Life Project: Washington, D.C.

17. Morrell RW, Mayhorn CB, & Bennett J, A survey of World Wide Web use in middle-aged and older adults. Human Factors, 2000 42: p. 175–182. [PubMed: 11022878]

18. King WR, & He J, A meta-analysis of the technology acceptance model. Information and Management, 2006 43: p. 740–755.

19. Davis FD, Venkatesh V, Toward preprototype user acceptance testing of new information systems: Implications for software project management. IEEE Transactions on Engineering Management, 2004 51(1): p. 31–46.

20. Venkatesh V, & Bala H, Technology Acceptance Model 3 and a research agenda on interventions. Decision Sciences, 2008 39(2): p. 273–315.

21. Porter CD, N., Using the Technology Acceptance Model to Explain How Attitudes Determine Internet Usage: The Role of Perceived Access Barriers and Demographics. Journal of Business Research, 2006 9: p. 999–1007.

22. Venkatesh V, Morris MG, Why don't men ever stop to ask for directions? Gender, social influence, and their role in technology acceptance and usage behavior. MIS Quarterly, 2000 24(1): p. 115–139.

23. Dishaw MTS, D.M., Extending the technology acceptance model with task-technology fit constructs. Information and Management, 1999 36(1): p. 9–21.

24. Davis FD, Venkatesh V, A critical assessment of potential measurement biases in the technology acceptance model: Three experiments. International Journal of Human-Computer Studies, 1996 45(1): p. 19–45.

25. Venkatesh V, Morris MG, Davis GB, & Davis FD, User acceptance of information technology: Toward a unified view. MIS Quarterly, 2003 27(3): p. 425–478.

26. Plouffe CR, Hulland J, & Vandenbosch M, Richness versus parsimony in modeling technology adoption decisions: Understanding merchant adoption of a smart card-based payment system. Information Systems Research, 2001 12(2): p. 208–222.

27. Karahanna E, Agarwal R and Angst C, Reconceptualizing Compatibility Beliefs in Technology Acceptance. Mis Quarterly, 2006 30(4): p. 781–804.

28. Venkatesh V.a.D., F.D., A Model of the Antecedents of Perceived Ease of Use: Development and Test. Decision Sciences, 1996 27: p. 451–481.

29. Nov OY, C., Users' Personality and Perceived Ease of Use of Digital Libraries: The Case for Resistance to Change. Journal of the American Society for Information Science and Technology, 2008 59(5): p. 845–851.
30. Wixom BT, P., A theoretical integration of user satisfaction and technology acceptance. Information Systems Research, 2005 16(1): p. 85–102.
31. Zhou TL, Y., Examining mobile instant messaging user loyalty from the perspectives of network externalities and flow experience. Computers in Human Behavior, 2011 27(2): p. 883–889.
32. Czaja SJ, Charness N, Fisk A, Hertzog C, Nair S, Rogers W, & Sharit J, Factors predicting the use of technology: Findings from the Center for Research and Education on Aging and Technology Enhancement (CREATE). Psychology and Aging, 2006 21(2): p. 333–352. [PubMed: 16768579]
33. De Haan J, A multifaceted dynamic model of the digital divide. IT & Society, 2004 1(7): p. 66–88.
34. Freese JR, Cognition S, Personality, and the Sociology of Response to Social Change: The Case of Internet Adoption. in Gerontological Society of America 2005 Orlando, Florida.
35. Pratt RMC, Extraversion KM, The Predictor of System Adoption? The Effect of Personality Traits on Acceptance. in the Academy of Management (AOM) Meeting 2006 Atlanta, GA.
36. Punnoose A, Determinants of Intention to Use eLearning Based on the Technology Acceptance Model. Journal of Information Technology Education: Research, 2012 11(1): p. 301–337.
37. Digman JM, Personality structure: Emergence of the Five-Factor Model. Annual Review of Psychology, 1990 41: p. 417–440.
38. Goldberg LR, The development of markers for the Big-Five Factor structure. Psychological Assessment, 1992 4(1): p. 26–42.
39. John OPS, S., The Big-Five trait taxonomy: History, measurement, and theoretical perspectives. Handbook of personality: Theory and research, 1999 2: p. 102–138.
40. Gosling SD, Rentfrow PJ, & Swann WB, A very brief measure of the Big-Five personality domains. Journal of Research in Personality, 2003 37: p. 504–528.
41. Zweig DW, J., Personality as a moderator of monitoring acceptance. Computers in Human Behavior, 2003 19: p. 479–493.
42. Mitzner TL, Boron JB, Fausset CB, Adams AE, Charness N, Czaja SJ, Dijkstra K, Fisk AD, Rogers WA, & Sharit J, Older adults talk technology: Technology usage and attitudes. Computers in Human Behavior, 2010 26(6): p. 1710–1721. [PubMed: 20967133]
43. Burnett JS, Mitzner TL, Charness N, & Rogers WA Understanding predictors of computer communication technology use by older adults. in the Human Factors and Ergonomics Society 55th Annual Meeting. 2011 Santa Monica, CA: Human Factors and Ergonomics Society.
44. Madden M, America's online pursuits-the changing picture of who's online and what they do, 2003, The pew internet and American life project
45. Czaja SJ, et al., The Personalized Reminder Information and Social Management System (PRISM) Trial: Design, Methods and Sample Characteristics. Under review
46. Reitan RM, The validity of the Trail Making Test as an indicator of organic brain damage. Perceptual and Motor Skills, 1958 8: p. 271–276.
47. Ekstrom RB, French JW, Harman HH, & Dermen D, Manual for kit of factor-referenced cognitive tests, 1976, Education Testing Service: Princeton, NJ.
48. McCabe DP, Robertson CL, & Smith AD, Age differences in Stroop interference in working memory. Journal of Clinical and Experimental Neuropsychology, 2005 27: p. 633–644. [PubMed: 16019640]
49. Rosen W, The UCLA Loneliness Scale (Version 3): Reliability, validity, and factor structure. Journal of Personality Assessment, 1980 66: p. 20–40.
50. Shipley WC, A self-administering scale for measuring intellectual impairment and deterioration. Journal of Psychology, 1940 9(371–377).
51. Zachary RA, Shipley Institute of Living Scale: Revised Manual, 1986, Western Psychological Services: Los Angeles.
52. Wilkinson GS, Wide Range Achievement Test Administration Manual, 1993, Wide Range, Inc: 15 Ashley Place, Suite 1A, Wilmington, DE.

53. Loyd BH, & Gressard C, Reliability and factoral validity of computer attitude scale. Educational and Psychological Measurement, 1984 44(2): p. 501–505.
54. Chesney T, Measuring the context of information systems use. Journal of Information Technology Management, 2008 29(3): p. 9–20.
55. Szajna B, Empirical evaluation of the revised Technology Acceptance Model. Management Science, 1996 42(1).
56. Cresci MK, Yarandi H & Morrell RW, Pro-Nets versus No-Nets: Differences in urban odler adults' predilections for Internet use. Educational Gerontology, 2010 36: p. 1–21.
57. Cresci MK, Yarandi H, & Morrell RW, Digital Divide and urban older adults. Computers, Informatics, Nursing, 2010 28(2): p. 88–94.
58. Stolp SZ, K., Contributions of metacognitive and self-regulated learning theories to investigations of calibration of comprehension. International Electronic Journal of Elementary Education, 2009 2(1): p. 7–31.
59. Older Adults and Technology Use, 2014, Pew Research Center.
60. Jay GMW, S. L., Influence of direct computer experience on older adults' attitudes towards computers. Journal of Gerontology, 1992 47(4): p. 250–257.

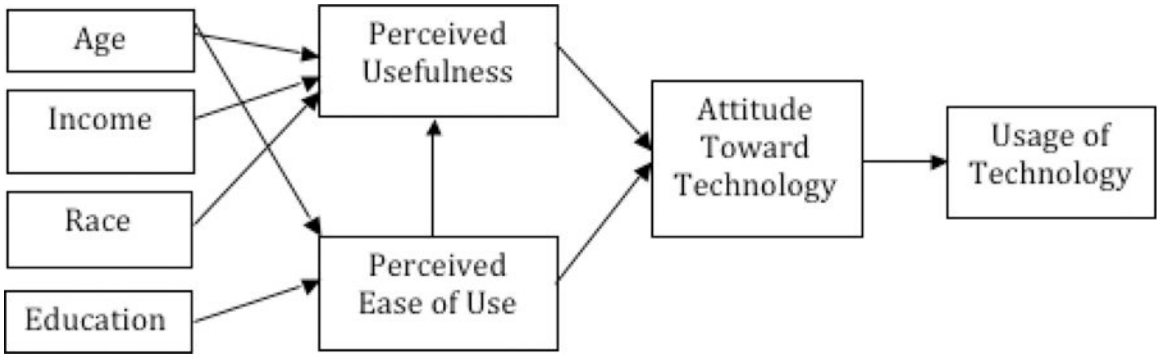

Figure 1.
Model of the influence of demographic variables on perceived usefulness and perceived ease of use in an extended version of the TAM [21].

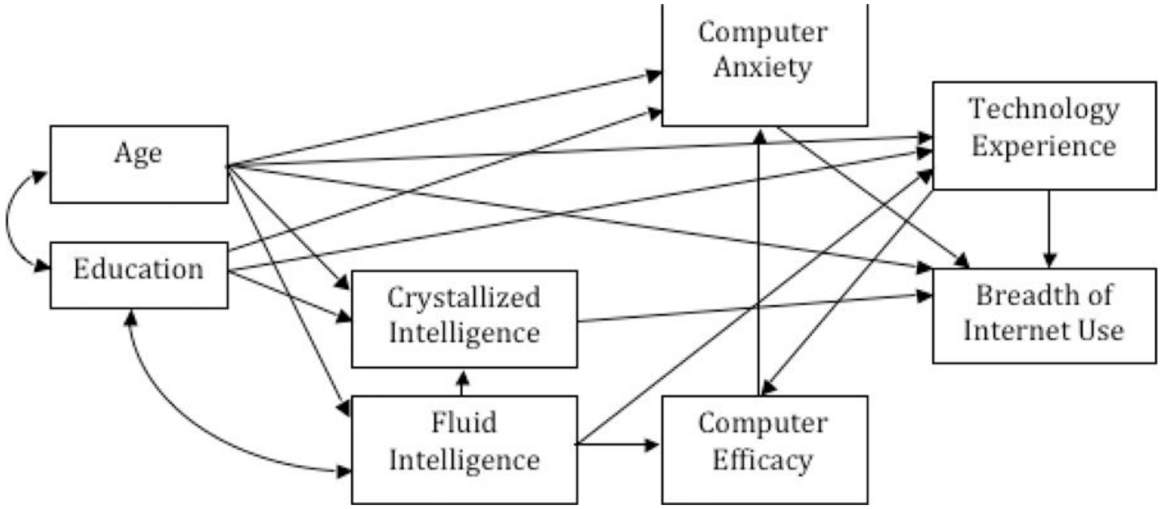

Figure 2.
Model of the influence of demographic variables, cognitive abilities, technology experience, and computer attitudes on breadth of Internet use [32].

Table 1.

Participant Characteristics

Factor	Variable	M	SD	Range
Age		76.15	7.37	64–98
Education (%)				
	High school or less	39.00		
	Some college	38.70		
	College graduate	13.00		
	Post graduate	9.30		
Ethnicity (%)				
	White Non-Hispanic	54.00		
	Black Non-Hispanic	32.70		
	Hispanic	9.00		
	Non-Hispanic Other	4.30		
Gender (%)				
	Female	78.0		
	Male	22.0		
Income (%)				
	Less than $30,000	86.60		
	30,000 to $59,999	11.90		
	$60,000+	1.50		
General Health				
	In general, would you say your health is: (1 = poor, 5 = excellent)	3.03	.86	1–5
Technology experience		11.27	4.00	4–23
Personality (TIPI)				
	Extroversion	8.89	2.81	2–14
	Agreeableness	12.10	2.02	5–14
	Conscientiousness	12.10	2.22	2–14
	Emotional stability	10.92	2.84	2–14
	Openness to experience	11.13	2.45	2–14
Computer attitude				
	Computer self-efficacy	20.25	3.06	10–25
	Computer comfort	16.69	4.21	8–25
	Computer interest	20.53	3.30	8–25
Fluid ability				
	Trails B-A [46]	114.39	85.15	−2–529
	Letter sets [47]	8.59	5.22	0–23
	Stroop span [48]	55.53	10.60	4–63
	Animal fluency [49]	16.39	4.54	5–33
Crystallized ability				
	Shipley vocabulary [50, 51]	29.82	6.32	10–40
	WRAT-3 [52]	48.11	5.36	19–57

Table 2.

Perceived Usefulness and Perceived Ease of Use Items Adapted from Davis (1989)[1].

Perceived Usefulness Items	Perceived Ease of Use Items
I would find this computer system useful in my daily life. Using this computer system would enhance my effectiveness in my daily life. Using this computer system in my daily life would increase my productivity. Using this computer system would make my daily life easier. Using this computer system would improve my daily life. Using this computer system in my daily life would enable me to accomplish tasks more quickly.	My interaction with this computer system would be clear and understandable. I would find this computer system easy to use. I would find this computer system to be flexible for me to interact with. It would be easy for me to become skillful at using this computer system. I would find it easy to get this computer system to do what I want it to do. Learning to operate this computer system would be easy for me.

Table 3.

Correlations of Perceptions of Usefulness and Ease of Use with Individual Characteristics

Factor	Perceived Usefulness		Perceived Ease of Use	
	Spearman Rho	N	Spearman Rho	N
Education	−.07	298	.00	298
Ethnicity	.09	298	.09	298
Gender	−.09	298	−.04	298
	Pearson r	N	Pearson r	N
Age	−.15	298	−.17	298
Income	−.07	269	−.10	269
Technology experience	.28*	297	.26*	297
Personality				
Extroversion	−.08	296	−.04	296
Agreeableness	.20*	296	.19*	296
Conscientiousness	−.01	295	.06	295
Emotional stability	.11	295	.21*	295
Openness to experience	.25*	295	.28*	295
Attitudes factor score	.51*	297	.58*	297
Computer self-efficacy	.34*	297	.44*	297
Computer comfort	.28*	297	.41*	297
Computer interest	.58*	297	.51*	297
Fluid abilities factor score	−.04	252	.11	252
Trails B-A (log)	.08	294	−.03	294
Letter sets	−.01	275	.13	275
Stroop	.08	282	.09	282
Animal fluency	−.09	292	.01	292
Crystallized abilities factor score	−.04	298	.06	298
Shipley vocabulary	−.05	298	.03	298
WRAT	−.02	298	.05	298

*$p < .002$ (Bonferroni correction)

Table 4.

Predictive Regression Models for Perceived Usefulness

Variable	Model 1		Model 2		Model 3	
	Standardized β	***p***	**Standardized β**	***p***	**Standardized β**	***p***
Technology experience	.28	.01	.23	.01	.09	.10
Openness to experience			.17	.01	.08	.16
Agreeableness			.14	.02	.06	.30
Emotional stability			−.01	.90	−.07	.20
Attitudes					.45	.01
R^2	.08		.13		.28	
ΔR^2	.08		.05		.14	
F for ΔR^2	25.13	.01	5.88	.01	57.03	.01

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Table 5.

Predictive Regression Models for Perceived Ease of Use

Variable	Model 1		Model 2		Model 3	
	Standardized β	*p*	Standardized β	*p*	Standardized β	*p*
Technology experience	.26	.01	.20	.01	.03	.54
Openness to experience			.18	.01	.08	.15
Agreeableness			.09	.13	−.01	.92
Emotional stability			.11	.06	.04	.46
Attitudes					.53	.01
R^2	.07		.14		.34	
ΔR^2	.07		.07		.20	
F for ΔR^2	20.51	.01	8.32	.01	85.80	.01