

Exploring Factors Influencing Older Adults' Willingness to Use Robo-Advisors

Completed research paper

Shangjun Wang

Information Systems & Business Analytics
Florida International University
Miami, Florida, United States of America
Email: shawang@fiu.edu

Sojen Pradhan

School of Professional Practice and Leadership
University of Technology Sydney
Sydney, New South Wales, Australia
Email: Sojen.Pradhan@uts.edu.au

Abstract

This exploratory study investigated factors that influence older adults' (aged 50 or above) willingness to use robo-advisor, a type of financial technology ("FinTech"). In recent years, it has been receiving increasing attention from users because it is democratizing financial services. Many studies have been conducted on user adoption of robo-advisors. Only few empirical studies investigated how users' literacy skills and behavioural traits affect their intentions to adopt robo-advisors, but none focusing on older population. In this study we collected survey data from 154 older adults living across United States. Our data analysis showed that trust and anxiety are significantly related to older adults' willingness to use robo-advisors. Surprisingly, in contrast to many empirical findings, we found that e-literacy is negatively related to older adults' willingness to use this technology. Based on these findings, we offered discussion regarding future direction for FinTech development and research to benefit the older demographics.

Keywords Financial Technology, FinTech, Robo-Advisor, Older Adults, Technology Adoption

1 Introduction

Financial Robo-advisors vary by firm, but in general, they are the online services that “automate portfolios based on users’ preferences” (Schwab.com 2020). In contrast to traditional human financial advisory services, robo-advisory services reduce fees and provide 24/7 access to financial services (Park et al. 2016). In addition to automating investment portfolios, other functionalities that make robo-advisors unique are: lowering balance to start an account, trading fractional shares of securities (lowering barrier of entry), and minimizing tax on transactions (Agnew and Mitchell 2019). The top robo-advisory services on the market today are registered investment advisors, therefore, are subject to fiduciary standards (Agnew and Mitchell 2019). In other words, robo-advisors must act in the best interest of their users/clients.

These unique features of robo-advisors are expected to democratize the financial advisory services that used to be a privilege of the wealthy class (Sironi 2016). In 2019, robo-advisors managed more than \$880 million in assets globally, and this number is projected to continuously grow at over 30 percent annual rate (Belanche et al. 2019). While robo-advisors are gaining growing attention from users with various demographic and socioeconomic backgrounds, not much is understood regarding the factors that motivate individuals to adopt and use robo-advisors. Especially, studies on robo-advisor adoption among individuals in an older age group do not exist. A big challenge faced by older adults today is a financial one, that is, the challenge in personal finance and retirement planning (Stanford Centre on Longevity 2018; Loibl 2017; Sixsmith et al. 2014). A robo-advisor, due to its built-in financial expertise and automation, appears to be a viable solution to assist older adults in coping with this challenge. Therefore, to facilitate the diffusion of robo-advisors among an older demographic, we need to first understand what influences their attitudes towards the adoption of robo-advisors.

First and foremost, to use a robo-advisor, a person must be comfortable with its digital interface. However, this could be a challenge to people aged 50 and older because their digital skills can vary widely. In addition, they also use computers and mobile phones very differently from their younger counterparts. As a result of this variation, the majority of technological innovation does not target the older group as part of user base (Knowledge at Wharton 2018). Furthermore, many baby boomers face complex decisions in financial planning as they age. For instance, they need to be very careful about how much money to invest and withdraw due to the concern whether the money can last till they reach the end of life (Knowledge at Wharton 2018). However, in the recent time, financial markets have become more complex with the emerging new products that are difficult to understand. Essentially, the lack of financial literacy may potentially prevent the older population from recognizing the benefits of robo-advisors and thus makes them reluctant to use robo-advisors for help, delaying the landscape of financial digitalization (Lusardi 2012; Milani 2019). Information literacy, a set of skills that enables acquisition, evaluation, and use of information (Seminole State College Library), may also be an indicator for whether older adults would be willing to use robo-advisors. The information literacy of today is largely associated with the use of technology (Nelson et al. 2011); literature on information and communication technology (ICT) have suggested the terminology of “e-literacy” to integrate the use of technology in searching and making use of information (Klecun et al. 2014; Acharya et al. 2015). Because of the Internet, information technology has become a prevalent medium for individuals to acquire information (The Information Literacy Project). However, for adults in an older age, they have been seen encountering limitations in searching for information via Internet (Zadrazilová 2017). If such limitation is not addressed when designing a robo-advisor system, the older users would continue to encounter difficulty in searching information that they need within the user interface, thus discontinuing its services.

Liang et al. (2020) found that, among several age groups, seniors are more reluctant and even resist to adopt innovative technology, and trust in technology tends to decrease with age. Anxiety associated with the use of technology was found to be another factor that elicits user resistance against a new technology. Based on the ubiquitous technology acceptance model, researchers found that, among older adults, technology anxiety negatively affects perceived ease of use, making using the technology an unrelenting task for the older age group (Tsai et al. 2020; Nimrod 2018). Risk aversion, is a negative attitude towards risk; risk-averse individuals feel uneasy and nervous in an uncertain situation, and do not feel comfortable about taking risks (Riquelme and Román 2014). In addition, they tend to overestimate the risk inherent in a situation (Yoshino et al. 2020). Using a technology for the purpose of finance introduces new risks, for example, new types of scams, fraud, and data breaches, which can lead to significant financial losses (KPMG UK 2018). Older adults between the

ages of 61 and 80 years old were found to be significantly more averse for risky choices comparing to younger age groups (Kurnianingsih et al. 2015). Therefore, in general, older adults may refrain from using a new technological product for managing their personal finance because they cannot properly evaluate the nature and severity of a risk.

The rise of robo-advisors presents a research opportunity to investigate older adults' attitudes towards technological innovation. In this exploratory study, our goal is to identify factors that influence older adults' willingness to use robo-advisors. Older adults are particularly of interest, because comparing to a younger demographic, older adults have a very different attitude in connection with the use of technology (Arning and Ziefle 2007). Recently, financial technology (also known as "FinTech") has been receiving increasing attention in the financial world. FinTechs could be software, applications, and digital platforms that deliver financial services to consumers and businesses. They have been recognized as promising tools to encourage financial inclusion (Morgan et al. 2019). However, at the other end of spectrum, this also means, to use FinTech to fulfil and receive financial products and services, financial literacy and e-literacy skills are needed more than ever (Morgan et al. 2019). In this paper, we hypothesize a strongly positive relationship between each of the aforementioned literacy skills and older adults' willingness to use robo-advisors.

To understand older adults' mental process of adopting a FinTech, i.e. robo-advisors, we identify and hypothesize trust, anxiety, and risk aversion to be the determinants of their willingness to use the robo-advisors. Our proposed theoretical model provides insights for financial advisory services, brokerage firms, financial institutions, as well as their technology providers to develop and configure robo-advisors to be elder-friendly, thus enabling them to leverage new technology to build wealth as they are ageing. Meanwhile, the acceptance of robo-advisors of older age groups can bring a competitive advantage to many firms in the finance sector (Park et al. 2016).

This paper is organised as follows. The next section elaborates on the theoretical development and hypotheses to measure the relationship between factors influencing the willingness of older adults in US to use robo-advisor for their personal financial services. Research method used in this study is briefly explained the following section. Reliability and validity of survey data as well as hypothesis testing results are presented in Section 4. Next, the results are briefly discussed before drawing a conclusion with a brief future direction.

2 Theoretical Development and Hypotheses

Information literacy or e-literacy consists of the following skills: research and retrieval, information validation, social responsibility, and legal aspects (Nelson et al. 2011). Information research and retrieval enable a person to access information effectively and efficiently using computer database or internet search engines. Information validation is the skill to judge the quality of digital information sources. Having social responsibility allows individuals to understand ethical and social implications of technology use behaviour and digital information. Understanding legal aspects of digital information ensures the compliance with relevant laws and regulations when accessing and using digital information (Nelson et al. 2011). Among people in an older age group, we assume e-literacy to be a strong indicator of their willingness to use robo-advisors. Having e-literacy indicates the fluency in acquiring and using information by using technology. With higher level of e-literacy, older users will be able to take advantage of information (e.g. stock market news, portfolio performance, and tutorials) integrated in the robo-advisory application to improve personal finance. In contrast, lower level of e-literacy makes it difficult to grasp information presented in the app, thus frustration may arise and discourage older adults from attempting to use the robo-advisors. Therefore, we argue that,

H₁: The level of e-literacy of an older adult has a significantly positive effect on his/her willingness to use a robo-advisor.

Financial literacy, which is a combination of knowledge and skills in making informed and effective decisions with the available financial resources (Lusardi and Mitchell 2011). A study conducted in U.S. shows that most of older adults surveyed are not confident about their efficacy in saving for retirement, and around one-third of adults in their 50s have failed to develop any kind of retirement saving plan (Lusardi and Mitchell 2011). We further argue that, older adults who are less financially savvy, will not likely use robo-advisors because they do not understand what this type of technology can offer (Yoshino et al. 2020). Financial literacy has been found to have a positive effect on the adoption of financial technology services such as electronic money and mobile payment (Yoshino et al. 2020). In addition, it is also revealed by empirical evidence that, a person's willingness to use a robo-

advisor is positively associated with his/her level of financial experience (Hohenberger et al. 2019). Thus, we hypothesize that,

H₂: The level of financial literacy of an older adult has a significantly positive effect on his/her willingness to use a robo-advisor.

Trust has been found to significantly influence decisions of households to stay with or switch from traditional retail banking services to FinTech (Jünger and Mietzner 2020). Other researchers also revealed that users' trust in FinTech services has a very significant influence on their intention to adopt the FinTech (Hu et al. 2019). We therefore hypothesize that similar effect of trust will also be seen on older adults' willingness to use robo-advisors.

H₃: An older adult's trust in the robo-advisor has a significantly positive effect on his/her willingness to use it.

Anxiety influences older adults' motivation to engage in technology. For example, studies found that, among Medicare beneficiaries aged 65 years and older, "depression and anxiety were negatively related to Internet use" (Kuerbis et al. 2017; Choi and DiNitto 2013). Anxiety also prevents older adults from properly operating robo-advisors, hindering their chances in using the technology to complete the intended tasks. Because of that, robo-advisors may seem not be useful to them (Agnew and Mitchell 2019), further decreasing their intention to use (Davis 1989). Hence, it can be argued that,

H₄: An older adult's anxiety associated with the robo-advisor has a significantly negative effect on his/her willingness to use it.

Risk aversion, is another behavioural trait influencing the adoption of FinTech. More risk-averse individuals are less likely to adopt FinTech (Yoshino et al. 2020). When users are trying to make investments in the stock markets, robo-advisors can construct stock portfolios for them, saving time and effort from researching and contemplating on their own regarding how and what to invest. However, this also raises the question of how one can be sure whether robo-advisors are making right decisions when users are not given access to see the details of the portfolios (for a number of robo-advisors, building portfolios is automated, users cannot see the details of the investment included in the portfolios). Because the process of picking and choosing stocks is not that evident to users, it nonetheless increases their perception of risk related to the robo-advisory technology. Therefore, users may be reluctant to make up their minds about using this technology. Furthermore, outside trading stocks, individuals can be risk-averse in other business ventures. One such example is in farming, people with risk-averse traits are more likely to opt into traditional method, rather than using modern technology (Brick and Visser 2015). Therefore, based on the empirical finding and user experience, we hypothesize that,

H₅: The level of risk aversion of an older adult has a significantly negative effect on his/her willingness to use a robo-advisor.

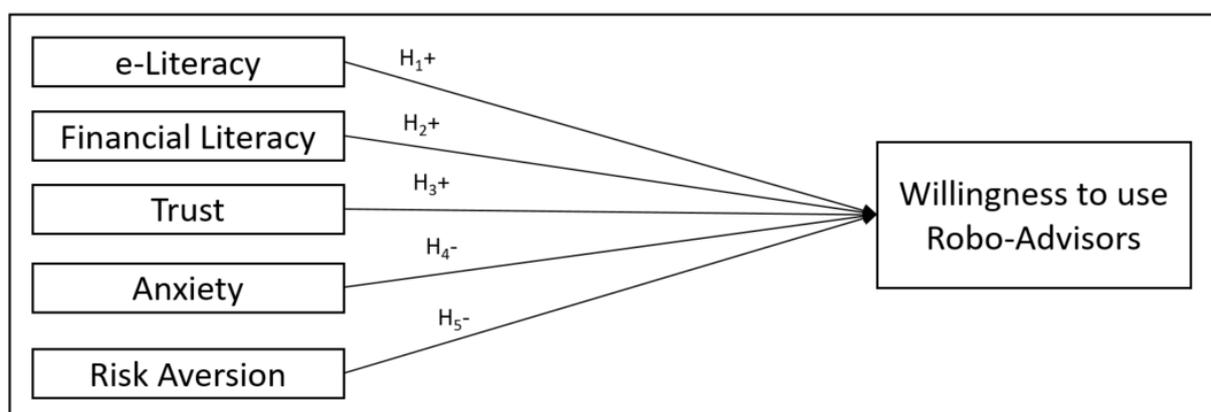


Figure 1. Research Model

3 Research Method

Based on a review of relevant literature, a research model (Figure 1) is developed to explore relationships of five factors with our dependent variable "willingness to use robo-advisors". A survey is designed to measure the above mentioned six constructs: e-literacy (EL), financial literacy (FL), trust (TR), anxiety (AN), risk aversion (RA), and willingness to use robo-advisors (WU). The measurement

scales are adopted from related studies, but modifications are made to ensure appropriate face validity in the current context. In terms of level of analysis, we focus on the perception towards the robo-advisor adoption at the individual level.

The survey instrument is incorporated with 7-point Likert scales with “7” indicating “Strongly Agree” and “1” indicating “Strongly Disagree”. Two criteria we have used to identify and sample participants are: (1) they must be 50 or above, referred as “older adult” in this paper. Cognitive changes begin to take place at the age of fifty, interfering with technology engagement (Hanson 2011). Therefore, targeting this age group increases the possibility to discover new insights pertaining to behavioural traits of users when they evaluate their decisions to use a technological innovation; (2) As addressed previously, financial challenges associated with ageing are a prominent issue in United States (Stanford Centre on Longevity 2018), thus, we focus our data collection in U.S., and all our participants reside across different states. Participants first answer questions related to their demographics, socioeconomic status, home ownership, and current financial planning activities. Next, they are presented two video clips retrieved from a video streaming channel run by the Charles Schwab Intelligent Portfolios® that explain what a robo-advisor is and how it works. Participants proceed immediately to the survey session after watching the videos. The survey was developed on Qualtrics and distributed via a crowdsourcing platform. There were total of 208 participants, out of which, 154 met the study criteria.

4 Data Analysis and Results

4.1 Survey Participants

The purpose of this study is to explore the factors that would be related to elderly people’s willingness to use robo-advisors for their financial affairs. The demographic characteristics of the participants are summarised as follows:

The average age of our sample in this study is 63.95 years old with a standard deviation of 5.36. From a total of 154 participants (who provided valid responses), 50.6% are females, and 49.4% are males. Participants’ ethnicities include: White (83.1%), Black or African Americans (7.8%), Hispanic or Latino (3.2%), Asian (1.9%), Mixed Ethnicity (2.6%), and other (0.6%). 0.6% of participants did not report their ethnicities. 64.0% of participants reported that they have received a college degree; for example, the majority (36.4%) reported to have a bachelor’s degree, followed by those with a master’s degree (15.6%), an associate degree (11.0%), and a doctorate degree (1.9%). The remaining participants reported to not have a college degree: 16.2% had received some college credits, but without a degree, 9.7% only have a high school diploma, 7.7% reported to receive educational training other than college; for instance, professional, trade, technical, or vocational training. 1.3% went to high school, but did not obtain a diploma. In terms of income level, more than half of participants reported to make \$40,000 or above annually (56.5%), the remainder (43.5%) reported to earn less than \$40,000 a year. Married individuals are accounted for 56.5% of the participants, the remaining 43.5% are accounted for the divorced or separated, single individuals, the widowed, and those who did not report their marital status. Only 29.2% of the participants own their home outright, the rest are either still paying their mortgage or renting a home. Just over 30% of participants have already used at least one technological application (FinTech) for their personal finance matters. The majority of participants who have not used any technological application for personal finance purpose, reported that they are unaware of those applications.

4.2 Reliability Analysis

Reliability refers to the measurement accuracy of participants who answer the same questions or close approximations the same way each time (Straub 1989). Cronbach’s alpha (α) reliability test analyses internal consistency of items or questions included for the same construct in a survey instrument. Generally, the value of Cronbach’s α should be above 0.60 for exploratory study (Straub et al. 2004). The value of Cronbach’s α for six constructs are shown in Table 1.

Constructs	Cronbach's alpha (α)
E-Literacy (EL)	0.896
Financial Literacy (FL)	0.733
Trust (TR)	0.905
Anxiety (AN)	0.908
Risk Aversion (RA)	0.739
Willingness to Use Robo-advisors (WU)	0.877

Table 1. Cronbach's alpha Reliability Analysis of Survey Instrument

4.3 Factor Analysis and Validity

An exploratory factor analysis has been conducted to validate the factors and items grouping and combine correlated items of the survey data. Principal axis factoring was used as the extraction method and direct oblimin (a type of non-orthogonal rotation, where the underlying factors are allowed to be correlated) was used as the rotation method. The cut-off value for factor loadings was set to be 0.40 (Yong and Pearce 2013). Therefore, any loading below this threshold was omitted from showing in the result. Through this analysis, six constructs and items within those constructs emerged as shown in Table 2 below. The factor loadings suggested that an adequate construct validity level has been achieved (Straub 1989).

Factor Analysis Result						
Factor						
Pattern Matrix	1	2	3	4	5	6
EL4	-0.945					
EL5	-0.809					
FL1		-0.713				
FL2		-0.705				
FL3		-0.655				
TR1			0.750			
TR2			0.868			
TR3			0.841			
TR4			0.404			
TR5			0.467			
AN1				0.868		
AN2				0.834		
AN3				0.800		
RA1					0.586	
RA2					0.764	
RA3					0.590	
RA4					0.700	
WU1						0.840
WU2						0.669
WU3						0.450

Table 2. Factor Analysis Result

4.4 Hypothesis Testing

Hypotheses were formulated to validate and test the relationship between five different factors and willingness to use Robo-advisors by elderly people in U.S., as shown in Figure 1. The five factors are independent variables and the willingness to use Robo-advisors is the dependent variable. Multiple regression has been used to analyse the relationships between independent and dependent variables, and shown the results in Table 3.

	Unstandardized Coefficients		Standardized Coefficients (Beta)	t	Sig (p-value)	Result
	β	Std. Error				
Constant	1.345	0.690		1.948	0.053	
E-Literary (EL)	-0.161	0.084	-0.120	-1.921	0.057 (=0.057)	Marginally Supported
Financial Literacy (FL)	-0.019	0.075	-0.016	-0.254	0.800 (>0.05)	Not supported
Trust (TR)	0.944	0.080	0.703	11.759	0.000 (<0.05)	Supported
Anxiety (AN)	-0.183	0.060	-0.185	-3.052	0.003 (<0.05)	Supported
Risk Aversion (RA)	0.033	0.085	0.023	0.391	0.696 (>0.05)	Not supported

Table 3. Multiple Regression (Dependent variable – Willingness to use Robo-advisors (WU))

The *p* value measures the significance of the variables for the proposed model. Generally, *p*-value less than 0.05 is statistically significant to reject the null hypothesis. As shown in the above table, two factors (Trust and Anxiety) appeared to be significant for elders' willingness to use Robo-advisor for their personal finances (supported H_3 and H_4). E-literacy appeared to have a weakly significant effect on willingness to use although this relationship is negative (marginally supported H_1). Surprisingly, financial literacy and risk aversion trait appeared to not influence elders' willingness to use the robo-advisors (H_2 and H_5 are not supported), as shown in Figure 2.

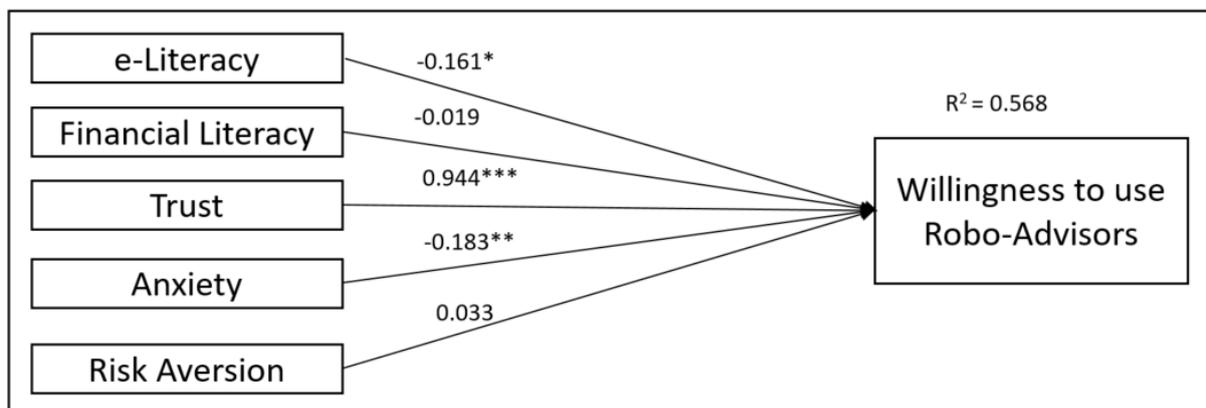


Figure 2. Proposed model of Willingness to use Robo-advisors by Elders
(* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$)

5 Discussion

FinTech began to emerge as the popularity of the mobile phone usage for payments grew (Pradhan 2003; Lawrence et al. 2007). Increasingly new technologies is delivered to support greater quality of life, however the cohort of elderly population have been disadvantaged in their ability to uptake and adopt digital skills. Demographic characteristics such as income, education, geographic location, possible disabilities (Roupa et al. 2010) coupled with social isolation, retirement from workforce,

security issues in terms of exposure to risks such as fraud etc. (Munteanu et al. 2019) make it challenging for older adults to utilise and navigate the technology.

Traditionally, personal financial services market has been used by wealthier older adults because human financial advisors are considered to be expensive. Recently, a new technological application robo-advisors is supposedly replacing those human advisor interactions for personal financial services. Robo-advisors have been gaining popularity due to its ubiquitous nature of greater availability to support users, lower barrier to entry and cost-effectiveness in comparison to the traditional human advisors (Agnew and Mitchell 2019). The ability to embrace the fast paced digital disruption has made this popular amongst the millennials. This type of technological application also has a huge potential to assist older adults.

Although the first and second hypothesis in this study was formed based on the literature, for the older adults from our sample, level of e-literacy is negatively related to their willingness to use robo-advisors. Although the second hypothesis was not supported, inevitably, the statistical result suggested that, higher the financial literacy, older users' willingness to use the robo-advisory tool seems to decrease. These findings reveal that, the more the elders are financially and digitally savvy, they are more sceptical about using robo-advisors for their personal financial activities. In addition, the findings from Dobrovolskaya et al. (2019) supports that the higher the financial literacy of a population, the more often they feel the need for help to understand the investment market. The majority of the older adults we studied revealed that, they are more comfortable working with a human financial advisor rather than using a robo-advisor.

The relationship between trust in robo-advisors and willingness to use robo-advisors is strongly correlated and supported the hypothesis, aligned with the studies by Junger and Mietzner (2020) and Hu et al. (2019). The trust among the older people could be improved if the design of the technology is focused to attract those cohorts. Hasan and Linger (2016) found that the technology enhance seniors' abilities to remain productive as long as it meets their social needs.

On the other hand, anxiety of older people negatively correlates with their willingness to use robo-advisors for their personal finances. The anxiety could be related to their level of confidence to use technology or exposure to technological related risks including frauds (Munteanu et al. 2019; Glaser et al. 2019). Is there a way to reduce older adults' concerns of using technological financial application (FinTech) for their personal finances? While the answer to this questions is not 'absolutely yes', co-designing the robo-advisors with the seniors could be one of the ways to attract and continue engagement with a larger population of older adults.

6 Conclusion and Future Directions

FinTech is gaining popularity amongst the younger age groups in comparison to older adults. Although robo-advisor has a potential to help older people with their personal financial activities, its uptake is very limited. Complexity of technological design is not always inclusive enough to support the needs of the older users. Consideration of human factors is minimal in designing of products and services and there is inadequate focus in such innovative solutions to help overcome barriers for this group of vulnerable population.

In this study, we explored five factors (E-Literary, Financial Literacy, trust, anxiety, and risk aversion) that influence older adults' willingness to use robo-advisors. Two of them (Trust and Anxiety) appeared to be significant for elders' willingness to use Robo-advisor for their personal finances, however, E-literacy appeared to have a weak effect on willingness to use although this relationship is negative. Two others (Financial literacy and risk aversion) were appeared to be not influencing older adults' willingness to use the robo-advisors.

We will continue to explore other factors that either enhance or deter older adults to use robo-advisors. All three factors from the proposed model (E-Literacy, Trust, and Anxiety) will be extended to understand their concerns in relation to the design (human centred design) and perceived usefulness of robo-advisor to that age group. We recommend the financial institutions and robo-advisor providers to revisit their usability and implement participatory design methodology by involving older adults in future.

7 References

- Acharya, K. R., Bautista, J. R., Wilson, J. R., Nahachewsky, J., Briere, J. L., Flanagan, S. and Pilgrim, J. 2015. "Aging, E-literacy, and Technology: Participatory User-Centered Design for Older Adults' Digital Engagement," *Journal of Literacy and Technology* (16:2), pp. 3-32.
- Agnew, J. and Mitchell, O. S. 2019. *The Disruptive Impact of Fintech on Retirement Systems*. United Kingdom: Oxford University Press.
- Arning K. and Ziefle M. 2007. "Understanding Age Differences in PDA Acceptance and Performance," *Computers in Human Behavior* (23), pp. 2904-2927.
- Belanche, D., Casaló, L. V. and Flavián, C. 2019. "Artificial Intelligence in FinTech: Understanding Robo-advisors Adoption among Customers," *Industrial Management & Data Systems* (119:7), pp. 1411-1430.
- Brick, K. and Visser, M. 2015. "Risk Preferences, Technology Adoption and Insurance Uptake: A Framed Experiment," *Journal of Economic Behavior & Organization* (118), pp. 383-396.
- Choi N.G. and DiNitto D.M. 2013. "Internet Use among Older Adults: Association with Health Needs, Psychological Capital, and Social Capital," *Journal of Medical Internet Research* (15:5).
- Davis F. 1989. "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology," *MIS Quarterly* (13:3), pp. 319-340.
- Dobrovolskaya, D., Kartasheva, U., Zulina, M., Briginya, D., and Tussupbaeva, B. 2019. *Global Economics and Management: Transition to Economy 4.0: Prospects of Fundamental Science Development International Conference 2018 (PFSD 2018): Economics and Management Session*. Springer Nature. pp. 129-138.
- Glaser, F., Iliewa, Z., Jung, D. and Weber, M. 2019. "Towards designing Robo-advisors for unexperienced investors with experience sampling of time-series data," Davies et al. (eds.) *Information Systems and Neuroscience*, Lecture Notes in Information Systems and Organisation 29, https://doi.org/10.1007/978-3-030-01087-4_16
- Hanson V. L. 2011. "Technology Skill and Age: What Will be the Same 20 Years from Now?" *Universal Access in the Information Society* (10), pp. 443-452.
- Hasan, H. and Linger, H. 2016. "Enhancing the wellbeing of the elderly: Social use of digital technologies in aged care," *Educational Gerontology* (42:11), pp 749-757. <http://dx.doi.org/10.1080/03601277.2016.1205425>
- Hohenberger, C., Lee, C., and Coughlin, J. F. 2019. "Acceptance of Robo-Advisors: Effects of Financial Experience, Affective Reactions, and Self-Enhancement Motives," *Financial Planning Review* (2:2).
- Hu, Z., Ding, S., Li, S., Chen, L., and Yang, S. 2019. "Adoption Intention of Fintech Services for Bank Users: An Empirical Examination with an Extended Technology Acceptance Model," *Symmetry* (11:3).
- Jünger, M., and Mietzner, M. 2020. "Banking Goes Digital: The Adoption of FinTech Services by German Households," *Finance Research Letters* (34).
- Klecun E, Lichtner V, and Cornford T. 2014. "E-Literacy in Health Care," *Studies in Health Technology & Informatics* (205), pp. 843-847.
- Knowledge at Wharton. 2018. "The Rise of the Robo-Advisor: How Fintech Is Disrupting Retirement". Wharton School of the University of Pennsylvania. <https://knowledge.wharton.upenn.edu/article/rise-robot-advisor-fintech-disrupting-retirement/>
- KPMG UK Centre for Financial Inclusion Analysis. 2018. "Consumer Risks from Fintech." <https://home.kpmg/xx/en/home/insights/2018/12/consumer-risks-from-fintech.html>
- Kuerbis, A., Mulliken, A., Muench, F., Moore, A. A., and Gardner, D. 2017. "Older Adults and Mobile Technology: Factors that Enhance and Inhibit Utilization in the Context of Behavioral Health," *Mental Health and Addiction Research* (2:2), pp. 1-11.

- Kurnianingsih, Y. A., Sim, S. K., Chee, M. W., and Mullette-Gillman, O. 2015. "Aging and Loss Decision Making: Increased Risk Aversion and Decreased Use of Maximizing Information, with Correlated Rationality and Value Maximization," *Frontiers in human neuroscience*, (9:280).
- Lawrence, E., Zmijewska, A. and Pradhan, S., 2007. Mobile Payments: Partner or Perish?. In *Innovative Applications Of Information Technology For The Developing World* (pp. 240-247).
- Liang, D., Lau, N., Baker, S. A., and Antin, J. F. 2020. "Examining Senior Drivers' Attitudes toward Advanced Driver Assistance Systems after Naturalistic Exposure," *Innovation in aging* (4:3), pp. 1-12.
- Loibl, C. 2017. "Living in Poverty: Understanding the Financial Behaviour of Vulnerable Groups," In R. Ranyard (ed.), *Economic Psychology*, Hoboken, NJ: John Wiley & Sons, Inc. pp. 421-434.
- Lusardi, A. 2012. "Financial Literacy and Financial Decision-Making in Older Adults," *Generations* (36:2), pp. 25-32.
- Lusardi, A., and Mitchell, O. S. 2011. "Financial Literacy and Planning: Implications for Retirement Wellbeing," *National Bureau of Economic Research Working Paper*.
- Milani, A. 2019. "The Role of Risk and Trust in the Adoption of Robo-Advisory in Italy: An Extension of the Unified Theory of Acceptance and Use of Technology," *PricewaterhouseCoopers Publications*. <https://www.pwc.com/it/it/publications/assets/docs/Report-robo-advisors.pdf>
- Morgan, P. J., Huang, B., and Trinh, L. Q. 2019. "The Need to Promote Digital Financial Literacy for the Digital Age," G20's Research and Policy Advice Network Chaired by Asian Development Bank Institute.
- Munteanu, C., Axtell, B., Rafih, H., Liaqat, A. and Aly, Y. 2019. "Designing for Older Adults: Overcoming Barriers to a Supportive, Safe, and Healthy Retirement," Agnew and Mitchell (ed.) *The disruptive impact of FinTech on retirement systems*, Oxford Scholarship, DOI: 10.1093/oso/9780198845553.001.0001
- Nelson, K., Courier, M., and Joseph, G. W. 2011. "An Investigation of Digital Literacy Needs of Students," *Journal of Information Systems Education* (22:2), pp. 95-106.
- Nimrod, G. 2018. "Technostress: measuring a new threat to well-being in later life," *Aging and Mental Health*, (22:8), pp. 1086-1093. DOI: 10.1080/13607863.2017.1334037
- Park, J. Y., Ryu, J. P., and Shin, H. J. 2016. "Robo Advisors for Portfolio Management," *Advanced Science and Technology Letters* (141), pp. 104-108.
- Pradhan, S., 2003, May. Mobile commerce for online investors. In *International conference on Information Technology* "Prospects and challenges in the 21st Century". Kathmandu, Nepal.
- Riquelme, I. P., and Román, S. 2014. "The Relationships among Consumers' Ethical Ideology, Risk Aversion and Ethically-Based Distrust of Online Retailers and the Moderating Role of Consumers' Need for Personal Interaction," *Ethics and Information Technology* (16:2), pp. 135-155.
- Roupa, Z., Nikas, M., Gerasimou, E., Zafeiri, V., Giasyrani, L., Kazitori, E., and Sotiropoulou, P., 2010. *The use of technology by the elderly*. Health Science Journal, 4(2), p.118.
- Schwab.com 2020 Charles Schwab. "Robo-Advisors an Introduction". <https://www.schwab.com/automated-investing/what-is-a-robo-advisor>, Accessed 22 July 2020
- Seminole State College Library. "Research Foundations: Information Literacy". <https://libguides.seminolestate.edu/researchfoundations/informationliteracy>
- Sironi, P. 2016. *FinTech Innovation: From Robo-Advisors to Goal Based Investing and Gamification*. Wiley, Chichester.
- Sixsmith, J., Sixsmith, A., Fänge, A. M., Naumann, D., Kucsera, C., Tomsone, S., Haak, M., Dahlin-Ivanoff, S., and Woolrych, R. 2014. "Healthy Ageing and Home: The Perspectives of Very Old People in Five European Countries," *Social Science & Medicine* (106), pp. 1-9.
- Stanford Centre on Longevity. 2018. "Special Report: Seeing Our Way to Financial Security in the Age of Increased Longevity," The Sightlines Project. Longevity.stanford.edu.
- Straub, D. W. 1989. "Validating Instruments in MIS Research," *MIS Quarterly* (13: 2), pp. 147-169.

- Straub, D., Boudreau, M.-C. and Gefen, D. 2004, "Validation guidelines for IS positivist research", *The Communications of the Association for Information Systems* (13:1), p. 63.
- The Information Literacy Project. "What is Information Literacy?" Thomas Jefferson University. <https://www.philau.edu/infolit/>
- Tsai, T. H., Lin, W. Y., Chang, Y. S., Chang, P. C., and Lee, M. Y. 2020. "Technology Anxiety and Resistance to Change Behavioral Study of a Wearable Cardiac Warming System Using an Extended TAM for Older Adults," *Plos one* (15:1), pp. 1-24.
- Yong, A. G. and Pearce, S. 2013. "A Beginner's Guide to Factor Analysis: Focusing on Exploratory Factor Analysis," *Tutorials in Quantitative Methods for Psychology* (9:2), pp. 79-94.
- Yoshino, N., Morgan, P. J., and Long, T. Q. 2020. "Financial Literacy and Fintech Adoption in Japan," *Asian Development Bank Institute Working Paper Series*.
- Zadrazilová, I. 2017. "Information Literacy of Elderly People: Bridging the Digital Gap," *European Conference on Information Literacy*, pp. 545-554.

Copyright © 2020 authors. This is an open-access article licensed under a [Creative Commons Attribution-NonCommercial 3.0 New Zealand](https://creativecommons.org/licenses/by-nc/3.0/), which permits non-commercial use, distribution, and reproduction in any medium, provided the original author and ACIS are credited.