Journal of Education and Educational Research
ISSN: 2957-9465 | Vol. 16, No. 2, 2025

The Role of Informal Learning: A Path Analysis of Factors Impacting Older Adults' Information Security Behaviors in Internet Use

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Abstract: The current study examined older adults' information security behavior and explored factors that impacted and mediated their information security behavior. Older adults (N = 492) were recruited from the China General Social Survey (CGSS) and participated in a survey. Results of the path analysis indicated that personal traits (such as financial status, education, and health), emotion, and perceived threat factors were significant predictors of the outcome, namely, the information security behavior of older adults. Meanwhile, this predicting-outcome relationship was mediated by the mediators such as learning habits and self-efficacy. The findings underscore the importance of developing tailored educational interventions and supportive learning environments that address both the personal traits and the psychological mediators to effectively enhance older adults' capabilities in navigating the digital world safely. The study is significant in that it contributes to the research and practicing community the understanding of the relationship between older adults' information security behavior and the factors that predict and mediate older adults' self-efficacy in computer use.

Keywords: Older Adults; Informal Learning; Information Security Behaviors; Path Analysis.

1. Introduction

Computer has become an important part in our daily life. Meanwhile, internet use has arisen steadily among older adults[1]. The development of the internet contributes to a constant change in the ways of life. Internet use has become a worldwide trend and integrated into common life definitely. Compared to the traditional way of searching information, internet can help older adults expand their ways and minimize the time to find information which they want[2].

While existing research has illuminated the benefits and general patterns of internet use among older adults, their security-specific behaviors remain underexplored. Prior studies have primarily focused on adoption, benefits, and barriers[3,4], often overlooking the secure and risk-aware use of digital technologies. Therefore, it is essential to comprehensively understand the factors that influence the information security behaviors of the elderly, design effective educational programs and policy initiatives, alleviate the digital risks confronted by the aging population, and encourage the safe online behaviors of the elderly.

2. Theoretical Backgrounds

2.1. Factors Impacting Older Adults' Information Security Behavior

Many researchers have explored how age-related changes in cognitive and physical functions affect the abilities of older adults' internet use. Echt, Morrell and Park conducted multi-group studies by comparing young-old adults and old-old adults in the experiment[5] and found that the old-older participant group made more performance errors than the young-older participants group. Similar finding was also found in one study where the older adults who had a positive perception of usefulness and efficacy of the Internet frequently used the Internet[6]. While these studies establish a foundation for understanding older adults' digital engagement, information security behavior constitutes a specific dimension requiring distinct knowledge and risk perception. Research more directly pertinent to security indicates that age is correlated not only with security awareness but also with security behavior itself.

Besides the above factors, health plays an important role in influencing older adults' information security behavior. Through in-home and phone interviews, Mann et al. discovered that lack of knowledge and available training, regard of the computer as a complicated thing, and physical pain, were the main reasons for computer nonuse[7]. According to the research of Gatto and Tak[3], health is one of the factors that affect older adults' information behavior. They pointed out in the article that physical and mental limitations prevented these older adults from using the computer more often or for longer periods of time.

Not only did research document the relations between information security behavior and age and health, but also there are evidence that education counts for, to some extent, the variances in information security behavior. Tak and Hong discovered that people with more years of education were more likely to use the Internet[8], which was based on a convenience sample of 71 older persons obtained from participants in programs of local chapters of the Arthritis Foundation, members of senior centers, and visitors to grocery stores in Virginia. Peggy and Sarah collected the data through a nation-wide random sample of landline phone numbers in New Zealand as part of a six-year research program on Enhancing Well-being in an Ageing Society[9] and discovered that Internet use was highest among respondents who had gained a university qualification and lowest among those with an education at primary school level. Janet Chang et al collected data from 567 persons, who were aged 60 years or older, residing in Southern California[10], also point out that persons with higher levels of education were more likely to work in an environment demanding

computer and Internet use. These results are also proved by Calhoun and Lee[11]. Meanwhile, Zhang, Li and Deng studied an empirical analysis of the behavior of smartphone users in China in relationship to information security and found that there was a significant difference between different groups of users on information security in smartphone use[12].

A significant relationship was found between Internet use and household income: greater usage with increasing income assets were found for total personal income, total assets[9]. Further research found that in a longitudinal study (2000–2010) on socio-demographic factors and computer use[13], Zhang discovered that among the social-demographic factors, income was correlated with and regressed on many computer-related behaviors. Meanwhile, in the context of the current study, income and financial factors are seen as the driving factors that form the older adults' behavioral intention toward computer use that leads to digital participation and engagement [14]. For example, poor financial status leads to a non-internet environment and stable income can stimulate information behavior. Also, in the study of Jones and Heinrichs[15], they found that those students who used their smartphones for financial transactions were less likely to click on a website link received in an email or text from an unknown source. This finding got a conclusion that students who use their phone for financial purposes, as opposed to simply seeing their phone as a communication device, would adhere to a higher level of security precautions. Jones and Chin discovered that there were no differences with 2014's study[16]. However, on several other questions those who use their phones for financial purposes admit to behaviors that are actually more risky than their counterparts. Recent research emphasizes understanding older adults' cybersecurity within the broader "digital inclusion" framework, examining the interplay between access, use, skills, and perceived safety [17].

Besides the above personal trait factors, emotion and life satisfaction are also factors impacting the older adults' information security behavior. WeChat users' behavior is relevant with their well-being. For example, the users portray high subjective emotion when they have a willingness to share [18]. Similarly, Kabasakal collected 663 samples[19] and demonstrated that there was also a significant relationship between university students' life satisfaction and total Internet use. Samaha and Hawi also pointed that there was a zero order correlation between smartphone addiction and satisfaction with life[20]. However, these impacting factors were found in young adults' group, few researches were in older. So, this research will consider these factors into older adults.

Although above factors address behavior in internet use, it can also be applied to the security behavior in internet. This study investigated how these factors associated with information security behavior in internet, in contrast to most studies on behavior in internet use for older adults that doesn't focus on their security behavior when they use internet.

2.2. Mediating Factors

The above literature suggests that personal traits, emotion and life satisfaction as well as perceived threats can significantly contribute to older adults' information behavior. Based on this, we hypothesize that their influence on information security behavior may not be entirely direct but could be mediated by shaping older adults' internal cognitive and behavioral patterns. Specifically, learning habits and self-efficacy are proposed as two key mediating variables. However, these contributing factors, as suggested by researchers[14,21], may be mediated by the learning habits and self-efficacy.

2.3. Learning Habit

Education, health, age, financial status, and income can affect one's learning habit[21]. Subsequently, different learning habits will lead to different behaviors. According to the habitual domain theory[22-24], such a domain can significantly affect people's behavior and decision-making processes. Habitual domains have four sub-concepts, including potential domain (PD), actual domain, activation propensity and reachable domain[25]. Based on this theory, the internet use behavior of older adults is the result of habitual domain. The evidence reveals that lack of knowledge or computer skills limited older adults' enjoyment of internet technology. For older computer users with disabilities, the reasons for not using computers usually often include the lack of requisite computer knowledge, not having available training opportunities, feeling that computer use is too complicated, and personal pain[7]. Knowing the role of individual habit for influencing the computer use, especially learning habit, the variable of individual habit should be included to understand its mediating effect between education, health, age and behavior in computer use. Furthermore, the concept of learning habit in the context of digital security should be understood to encompass more than the traditional information consumption measured (e.g., reading newspapers) . It critically includes informal learning activities that are embedded in daily life, such as learning to identify scam messages within family social media groups, acquiring privacy setting skills through video tutorials, or exchanging experiences on safe online practices with peers. Specifically, in the realm of information security, older adults' informal learning encompasses a range of everyday practices. These include, but are not limited to: learning to identify phishing scams and fraudulent messages within family WeChat groups; acquiring skills to adjust privacy settings on social media or payment apps through video tutorials or help from grandchildren; exchanging experiences and strategies about safe online shopping with peers; and discussing news stories about cyber fraud during community gatherings. These unstructured, socially embedded learning processes are pivotal in shaping the habitual domains that ultimately influence their security practices. These unstructured, spontaneous learning processes are pivotal in shaping the habitual domains that ultimately influence security behavior.

2.4. Self-efficacy

Self-efficacy refers to people's subjective judgment on whether they can successfully carry out a certain behavior. People's behavior is not only influenced by behavior result factors, but also influenced by individual cognitive factors' expectation of results. For instance, Johnston and Warkentin discovered that Self-efficacy have a significantly positive effects on behavior intent[26]. Concretely, it positive effects on end user intentions to adopt recommended individual computer security actions with respect to spyware.

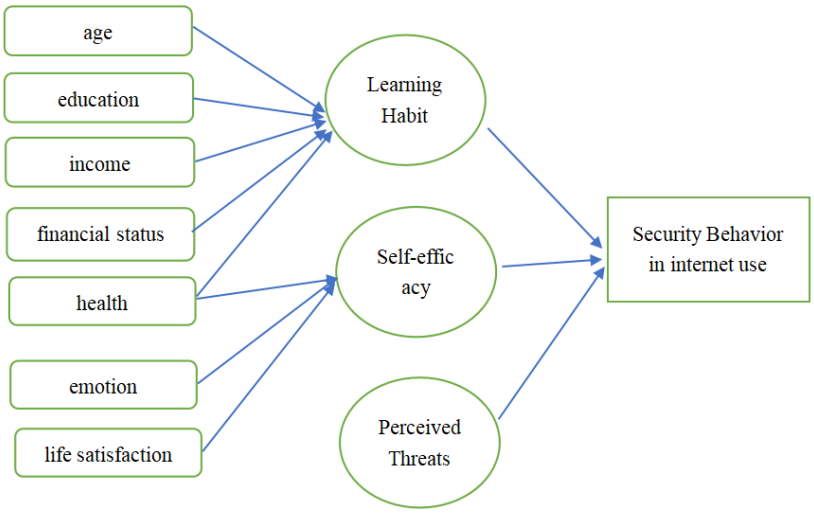

Figure 1. The path model

The literature has demonstrated the relationship among information behavior, personal traits, emotion, life satisfaction, perceived threats as well as the mediating factors that mediate between self-efficacy and the variables previously mentioned. It is therefore hypothesized that (1) personal traits, emotion, life satisfaction and perceived threats variables can influence older adults' information security behaviors and (2) the influence of variables (except for perceived threats) above mentioned on older adults' information security behaviors may be mediated by older adults' learning habits and self-efficacy.

3. Methods

3.1. Participants

The current study was based on the data from the CGSS 2017 (China General Social Survy). This study took the section dedicated to the Internet and daily use that included security behavior in computer use, health condition, income, financial status, education, age and well-being. The study sample included 492 respondents with an average reported age of 63.13 (SD = 6.60). Among them, 226 were females and 266 were males. Out of the 492 valid responses, 55 reported an excellent health condition, 172 reported a very good health condition, 169 reported a fair health condition, 79 reported a not - very - good health condition, and 17 reported a poor health condition.

3.2. Measurements

3.2.1. Dependent Variables

Dependent variable was information security behavior. Information security behavior was measured by a scale with 3 items, including "I can download and install App in the legal App store;" "when someone relays the message through Wechat, Weibo, etc., I will approve it first;" "When paying or trading online, I will observe the using environment to determine whether to use it or not." Each item was measured from "1 = strongly agree" to "5 = strongly disagree". Sum scores were calculated for final analyses with lower scores indicating better information security behavior (range = 3 to 15). The reliability score on this scale was 0.8.

3.2.2. Independent Variables

Independent variables included: 1) personal traits; 2) learning habits; 3) self-efficacy 4) perceived threats.

Learning habits was measured by a scale with 6 items that asked participants' frequency with the statements of "I always read newspaper;" "I always read book;" "I always read magazine;" "I always listen to the radio at home;" "I always study online;" "I always subscribe news from mobile phone." Each item was measured form '1= *everyday*' to '5 = *never*.' Sum scores were calculated for final analyses with lower scores indicating better learning habits (range = 6 to 30). The reliability score on this scale was 0.7.

Self-efficacy was measured by a scale with 4 items that asked participants whether they agreed with the statements of "I can correctly use the mobile payment app;" "I can protect my internet personal privacy;" "I can protect my online privacy." Each item was measured from '1= *strongly disagree*' to '5 = *strongly agree*.' Sum scores were calculated for final analyses with higher scores indicating better self-efficacy (range=4 to 20). The reliability score on this scale was 0.7.

Perceived threats were measured by a scale with 3 items that asked participants whether they agreed with the statements of "I'm worried that my personal privacy will be revealed online;" "I'm worried that the app company will check my internet behavior in the internet;" "I'm worried the government will check my internet behavior in the internet" Each item was measured from '1= *strongly disagree*' to '5 = *strongly agree*.' Sum scores were calculated for final analyses with higher scores indicating better consciousness of perceived threats (range=3 to 15). The reliability score on this scale was 0.8.

4. Results

To test personal traits, the path analysis was employed to determine whether the personal traits like age, education, health, income, financial status variables would significantly impact the older adults' information security behavior in computer use. Next, the path analysis would determine whether the learning habits, self-efficacy and perceived threats would significantly affect the outcome. A family-wise alpha level of .05 was adopted for all analyses.

4.1. Path Analysis

The result of correlation analysis show information security behavior is significantly correlated with personal traits (financial, education and health), learning habits, self-efficacy and perceived threats (Table 2). Based on the results of correlation analysis, multiple regression analyses were run to determine the relations between factors and outcome.

Table 1. Variables and questionnaire

Variables	Questionnaire
Age	Continuous variable
Income	Continuous variable
Financial status	1-5 over-high average level to over-low average
Education	1-13 no education experience to master
Health	1-5 excellent to bad
Learning habits	I always read newspaper
	I always read books
	I always read magazine
	I always listen to the radio at home
	I always study online
	I always subscribe news from mobile phone
	I always annoy because of trivialities
Emotion	When something unhappy happens, I can't get up for a long time
	I often feel like I'm just fooling around.
Self-efficacy	I can correctly use the mobile payment app
	I can protect my internet personal privacy
	I can protect my online privacy
	I can use e-payment correctly
Perceived threats	I'm worried that my personal privacy will be revealed online
	I'm worried that the app company will check my internet behavior in the internet
	I'm worried the government will check my internet behavior in the internet
	I can download and install App in the legal App store
Information security behavior	when someone relays the message through Wechat, Weibo, ect, I will approve it first
	When paying or trading online, I will observe the using environment to determine whether to use it or not

Table 2. Results of correlation analysis among the variables

	1	2	3	4	5	6	7	8	9	10	12
age	1.000	-.016	-.157**	.020	.048	.071	-.109*	.073	-.053	.031	.055
income		1.000	-.050	-.053	-.169**	.008	-.054	-.067	.127**	.003	.022
financial			1.000	.163**	.305**	.102*	.291**	.181**	.057	.141**	.152**
education				1.000	.146**	.053	.159**	.267**	.181**	.423**	.414**
health					1.000	.166**	.279**	.166**	.095*	.192**	.191**
emotion						1.000	.188**	.088	.097*	.093*	.105*
life-satisfaction							1.000	.144**	.044	.139**	.133**
leaning habits								1.000	.192**	.336**	.340**
self-efficacy									1.000	.515**	.687**
perceived threats										1.000	.935**
Information security behavior											1.000

**Correlation is significant at.01 level (2-tailed)
**Correlation is significant at.05 level (1-tailed)

4.2. Regression Analyses

The purpose of regression analysis is to determine the predicting powers of (1) personal traits factors on older adults' information security behavior, (2) personal traits factors on learning habits, and (3) other factors such as self-efficacy and perceived threats on older adults' information security behavior. Figure 2 shows the paths in regression analyses:

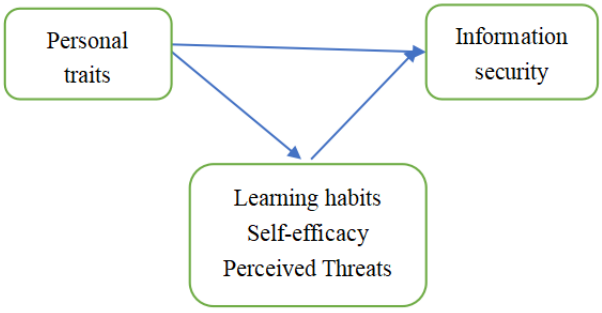

Figure 2. Paths in regression analysis

Three regression analysis were tested with learning habits, self-efficacy as mediators and respectively. The first model includes personal traits and learning habits. The second model includes health, emotion, life satisfaction and self-efficacy. The last one is perceived threats.

In model 1, age, financial status, education and health were significant for the information security behavior. On the other hand, financial status, education and health were significant for both the learning habit ($t = 3.625$, $p<0.000$; $t = 3.977$, $p<0.000$; $t = 2.084$, $p<0.05$) and information security behavior ($t = 2.728$, $p<0.01$; $t = 8.997$, $p<0.000$; $t=3.727$, $p<0.000$). The variable of age and income was not significant for learning habit ($t = -1.525$, $p = .128$; $t = -.966$, $p = .335$), thus was eliminated from further analyses.

In model 2, only health was significant for the information security behavior ($t=3.512$, $p<0.000$). Similarly, both health and emotion were significant for the self-efficacy ($t=2.208$, $p<0.05$; $t=2.380$, $p<0.05$). Although the variable of emotion was not significant for information security behavior ($t = .807$, $p = .420$), but it was significant for self-efficacy and further affect information security behavior. Thus, it cannot be eliminated from further analyses. The variable of life satisfaction was not significant for self-efficacy ($t = 1.253$, $p = .211$), thus was eliminated from further analyses.

Table 3. The summary of regression analysis

Models	Predictors	β	Std Error	Standardized Coefficients Beta	t	sig	Dependent Variables
Model1	age	-.013	.009	-.069	-1.525	.128	Learning habit
	age	.015	.007	.090	2.051	.041	Information security behavior
	Learning habits	.192	.038	.222	5.040	.000	
	income	-1.70	.000	-.044	-.966	.335	Learning habit
	income	7.04	.000	.033	.748	.455	Information security behavior
	Learning habits	.188	.038	.217	4.920	.000	
	Financial status	.283	.078	.162	3.625	.000	Learning habit
	Financial status	.184	.067	.121	2.728	.007	Information security behavior
	Learning habits	.170	.038	.196	4.421	.000	
	Education	.085	.021	.177	3.977	.000	Learning habit
	Education	.156	.017	.374	8.997	.000	Information security behavior
	Learning habits	.130	.036	.150	3.605	.000	
	Health	.120	.058	.094	2.084	.038	Learning habit
	Health	.181	.049	.163	3.727	.000	Information security behavior
	Learning habits	.174	.038	.201	4.587	.000	
Model2	Health	.073	.033	.099	2.208	.028	Self-efficacy
	Health	.128	.036	.115	3.512	.000	Information security
	Self-efficacy	1.018	.050	.671	20.458	.000	behavior
	Emotion	.100	.042	.107	2.380	.018	Self-efficacy
	Emotion	.038	.047	.027	.807	.420	Information security behavior
	Self-efficacy	1.10	.050	.680	20.460	.000	
	Life satisfaction	.076	.061	.057	1.253	.211	Self-efficacy
	Life satisfaction	.182	.067	.089	2.721	.007	Information security behavior
	Self-efficacy	1.03	.050	.677	20.620	.000	
Model3	Perceived threat	.810	.014	.934	57.875	.000	Information security behavior

In model 3, perceived threat was significant for the information security behavior (t = 57.875, p<0.000).

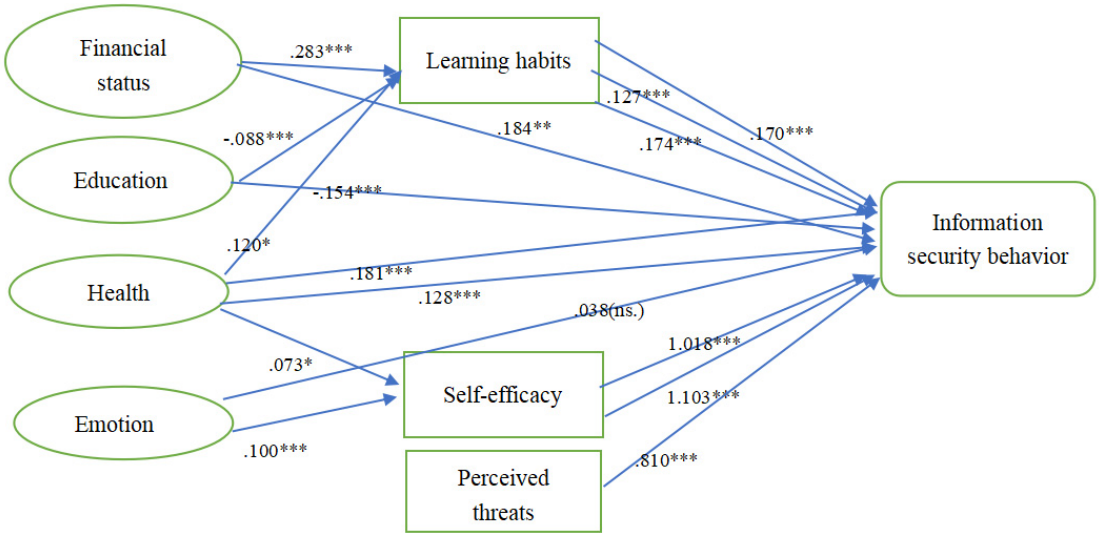

Figure 3. Path coefficient and significance

Through the path analysis, except the perceived threat, learning habit and self-efficacy variables were all affected by other variables and they further affected information security behavior. Table 4 shows these variables' direct and indirect effect to the information security behavior. It clear shows that financial status, education, health and emotion not only have the direct effects to the information security behavior, but also have the indirect effect. Considering the indirect effect, the total effect got a significant change. If don't consider the indirect effect, and only consider direct effect, the relationship between the different independent variables between and dependent variable will be underestimated.

4.3. Sobel Test

Based on the results of regression analyses, Sobel tests were conducted to determine the strength of paths among predictors and mediators. Results showed that learning habit was a significant mediator between financial status and older adults' information security behavior (effect M=20.8%), mediating effect explains the variance variation of dependent

variable: squrt=19%. Learning habit was a significant mediator between education and older adults' information security behavior (effect M=6.8%), mediating effect explains the variance variation of dependent variable: squrt=14.1%. learning habit was a significant mediator between health and older adults' information security behavior (effect M=10.4%), mediating effect explains the variance variation of dependent variable: squrt=19.5%. Further, self-efficacy was found to be a significant mediator between health, emotion and older adults' information security behavior (effect M= 36.5%, effect M= 73.5%), mediating effect explains the variance variation of dependent variable: squrt=66.8%, squrt=67.5%.

Table 4. Table of path coefficient decomposition

Causal variable	outcome variable	Direct effect	Indirect effect	Total effect
Financial status	Information security behavior	.184	.048	.232
Education		-.154	-.011	-.165
Health1		.181	.021	.202
Health2		.128	.081	.209
Emotion		ns	.110	.110

5. Discussions

In recent years, with the fast increase of digital devices, users' information security behaviors have been gaining increasing attention from different research area, while most studies have focused on teenagers' information security behavior or older adults' internet usage. With the growing number of digital devices using in older group, this study considers the older adults' older adults' information behaviors. The goal of this study is to understand the effect of personal traits, learning habits, self-efficacy and perceived threats to the older adults' information security behavior.

Results revealed that with learning habit as mediator, personal traits like financial status, education and health significantly impacted older adults' information security behavior. Well-being and life satisfaction were shown to significantly influence older adults' information security behavior with self-efficacy as a mediator. And perceived threat was shown to impact older adults' information security behavior.

First, the personal trait of income was not a significant associate of older adults' information security behavior. However, contrary to some initial expectations, age demonstrated a significant direct effect in the model.

This suggests that, even when controlling for factors such as education and health, generational or life-stage differences represented by age may still uniquely influence security practices. This finding corresponds with previous research[27], which showed that the age variable had a significant influence on the information behavior of older adults. However, it does not corroborate previous research findings[28,29], which identified income as the major and most significant concern for older adult participants in information behavior. A possible reason may be that all older adult participants in the study had already had computer or digital experience and knew the basic information security knowledge. On the other hand, the participants' age positions on 55-69 years old which have not significant difference.

Furthermore, learning habits did not serve as a significant mediator for the effects of age and income on security behavior. This suggests that the influence of these demographic factors, if any, operates through pathways other than the general learning routines measured here (e.g., reading newspapers or books). It is plausible that the learning habit scale, which captured common leisure activities, may not fully tap into the specific, security-focused informal learning that more directly shapes protective online behaviors. Future research could benefit from incorporating measures of informal learning that are explicitly tied to digital security practices.

This study contributes to existing research by overcoming a key shortcoming of previous studies, which didn't concern the age and income as the variables for older adults' information security behavior and made up the ignorance of the mediator like leaning habits. Previously, most of studies researches the relationship between the age/income and internet usage as well as information behavior and few concern the relationship between the above two variables and older adults' information behavior.

Second, personal traits like education, financial status and health had positively affected with older adults' information behavior directly. These findings corroborate prior studies[27] by showing that a small of variables, such as health status and education, have a significant influence in older adults' information security behavior. From above research, it can obviously demonstrate that the variable of education, financial status and health is not only influence older adults' information behavior but also their information security behavior. The possible reason is that more educated and healthier older adults will watch out something on internet, for example, the fake advertisement.

Learning habit was found to be a significant mediator when the predictors involved financial status, education and health. It means that not only do the education, health and financial status influence older adults' information security behavior, but also they can directly affect older adults' leaning habit and further indirectly influence their information security behavior deeply. For instance, when an older adult learns from a family member how to verify a suspicious link, or when a community group discusses a recent phone scam tactic, these are informal learning moments directly building 'digital self-defense' capabilities. Educational interventions should therefore aim to seed and support these natural learning conversations with accurate and actionable security information. Similarly, the elders with good physical and mental condition and stable financial status will have enough energy to concentrate on leaning and collecting information about internet so that they can safely use internet.

By this new study, it also contributes to existing research by overcoming a key shortcoming of previous studies, which didn't concern the education, financial status and health predicted as the factors for information security behavior in previous research. And importantly, the variable leaning habit as a mediator to affect older adults' information security behavior cannot be ignored.

Third, the study also revealed that self-efficacy was a significant mediator between emotion and health and information security behavior. It is interesting while emotion failed to impact directly on older adults' information security behavior, it still impacted information security behavior via the mediation of self-efficacy, which is corroborates with Spears and Zheng' research [14] concluding emotion can influence older adults' self-efficacy in computer use. In other words, emotion impacts older adults' self-efficacy which in turn influenced their information security behavior.

Additionally, it is important to note that life satisfaction, which was included as a predictor of Self-efficacy in the initial theoretical path model, was found to have a non-significant effect on self-efficacy (t=1.253, p=.211) and was thus eliminated from the final empirical model. This indicates that for older adults, confidence in performing specific technical tasks related to online security may be more directly influenced by immediate emotional states and health perceptions than by broader evaluations of overall life satisfaction. The older adults with high self-efficacy who have high confidence in computer use have the ability to distinguish the complex information or advertisement on internet. That means the older adults with higher self-efficacy can more carefully watch out their information security behavior.

Similarly, it also contributes to compensate the existing gap of previous research, which didn't concern the emotion variable predicted as the factors for information security behavior. In addition, the variable self-efficacy as a mediator to affect older adults' information security behavior cannot be ignored.

Last but not least, the stronger the perception of internet security threats, the more motivated the older adults are to take information security actions, which is correspondent to previous research showing that when older adults perceived security threats, they will be more willing to take actions to protect their online safety. Especially, they were found to take more defensive actions to protect themselves [29]. Therefore, having high perception of internet security threats is especially important for older adults' information security behavior. Compared with young counterparts, older adults should improve their perceived threats. So in aging university, the relevant knowledge should be involved in the course. Through this study, it also compensates the gap of previous research that didn't consider this factors in older adults' information security behavior.

These insights have direct implications for digital literacy education. For instance, recognizing the mediating role of self-efficacy suggests that educational programs should not only impart knowledge but also focus on building confidence through hands-on, mastery-oriented experiences. Similarly, understanding the influence of learning habits highlights the value of promoting continuous, informal learning opportunities that integrate security practices into daily life, rather than relying solely on one-time formal training.

Overall, the above findings support Hypothesis 1 that personal traits, emotion and perceived threats variables can significantly impact older adults' information security behavior. The findings of the study suggest that when watching out the older adults' information security behavior, it is vital to put in perspective the variables that impact their security behavior. Variables like personal traits, well-being and perceived threats can significantly impact how older adults take care themselves in the use of computer and digital applications. Also, prediction 2 is partially supported with learning habit and self-efficacy significantly mediating between some personal trait and well-being variables and information security behavior.

6. Conclusion

In the background of COVID-19 winding up the whole world, in order to minimize the infection risk, more and more people choose to stay at home and use the Internet to stay in touch and receive services, which is particularly adopted to older adults who are considered one of the most vulnerable subgroup populations in this pandemic time. Yet, unlike millennials and Gen Z whose digital technology skill is proficient and carefully watch their information security behavior, older adults often lack enough consciousness in using and applying digital technology to their work and daily lives. The current study is significant in that it explored the factors that impact older adults' information security behavior. It is important to determine what will cause the changes in older adults' information security behavior. By identifying and analyzing the factors, the current study has contributed to the research and concluded the potential influences on older adults' information security behavior. Another important finding of this study is to explore the mediators that mediate between predictors and information security behavior. This line of research has significant implications in practice since trainers and government are able to identify the mediating factors and incorporate them into their practice as they design and develop methods and policies for correcting older adults' information security behavior. Therefore, practical interventions should move beyond formal training and actively leverage the informal learning networks and social capital that older adults already possess. For instance, policymakers and community trainers could: develop concise, engaging cybersecurity tips designed for easy sharing within family and community chat groups; promote "digital mentoring" initiatives that empower younger family members to provide informal guidance; and facilitate peer-led discussion forums in community centers where experiences and strategies for online safety are shared. By empowering these informal learning activities, cybersecurity awareness can be seamlessly integrated into the daily routines of older adults, leading to more sustainable behavioral habits.

Ultimately, fostering robust information security behaviors in older adults requires a holistic educational approach that synergizes formal instruction with the empowerment of informal learning channels. Community centers, libraries, and senior organizations can serve as pivotal hubs for such integrated educational efforts, providing both structured workshops and platforms for peer-based knowledge exchange. This dual focus ensures that education is accessible, relevant, and sustained, thereby effectively translating awareness into consistent safe practices.

As with any empirical research, this study is not without limitations. One of the areas for future improvement is to consider predictors with perceived as the mediator to further affect the information security behavior, which need to review more articles to design items under the same theoretical construct. New statistical methods like item-analysis can be applied to ensure the items are optimally retained to increase its reliability.

Acknowledgments

This research was funded by The Youth Research Project of Humanities and Social Sciences of the Ministry of Education, "The Reality Dilemma and Optimization Path of Informal Learning for Urban Older Adults" (19XJC880010).

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