

Understanding factors influencing older adults' Desire to be more proficient in using ICT

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Abstract

As more Australians live to an older age and endeavour to remain independent, it is imperative that they are empowered to adopt and sustain the use of ICT in ways that benefit their lives and supports social and economic connectedness and inclusion. Importantly, older Australians need to be encouraged to improve their proficiency with ICT. Failure to understand how low digital literacy influences perceptions of the value of ICT, the support for ICT, and concerns about using ICT means policy makers and educators risk designing strategies that lack nuance and impact. This paper draws on a cross-sectional survey of 708 older Australians and uses partial least squares SEM to analyse relationships between the desire to be more proficient with ICT and factors associated with perceived value of ICT, support for ICT, concerns about ICT and digital literacy. The analysis reveals that the desire to be more proficient is related to higher self-satisfaction in using ICT, higher social norms for using ICT, and higher perceptions of concerns including risks using ICT, fear of falling behind in understanding ICT, and higher levels of anxiety in using ICT. Implications exist for encouraging greater digital literacy and the design of policy and initiatives to support it.

Introduction

In recent decades we have experienced the emergence of two societal developments that have the potential to universally change how we live our lives. These include the challenges brought about by an ageing population, and digitalization and the pervasiveness of ICT (Olsson et al., 2019a). As Olsson et al., (2019b) notes, the adoption, use and pervasiveness of ICT has evolved quickly over the last two decades from a basic internet where users mostly connected to from desktop home computers, to one of global connectivity.

Life is now permeated by an increasing array of information and communication technologies (Hepp & Krotz, 2014). As a consequence, the Internet and the devices that connect us have increasingly become a foundation for all kinds of services and activities, including commercial (banking and shopping), public (social support services, tax departments, etc.) and health and well-being related ones (Olsson et al., 2019). Research has examined the psychological, social and health outcomes associated with older adults using ICTs to engage with life including, travel and banking; engaging in entertainment in the form of online movies, music and games; and virtually communicating and connecting with friends and relatives (Tyler et al., 2020). Szabo et al. (2019) for example found older adults engaged with ICTs for three main reasons: social (e.g., connection with friends and family), instrumental (e.g., banking) and informational (e.g., accessing health-related information). Other research has identified that ICTs can enhance aspects of older adults' lives including enhancing their psychological well-being and life satisfaction, reducing depression, maintaining health, and slowing cognitive decline (Gilhooly et al. 2010, Wagner et al. 2010, Cotten et al. 2012, 2014, Xavier et al. 2014, Fang et al. 2017, Hunsaker and Hargittai 2018).

Whilst the benefits of using ICTs is well documented, the intersection of ageing and the need to be proficient with ICT has brought about concerns related to digital inclusion and the capacity of older citizens to be engaged in society in a connected and meaningful way. Remaining proficient with ICT is connected to notions of lifelong learning and related to Goal 4 of the United Nation's 2030 Agenda for Sustainable Development, regarding spreading lifelong learning activities to all ages by creating "opportunities for equitable access to university for older adults, paying particular attention to vulnerable groups" ([2] p. 41). As Muñoz-Rodríguez et al., (2020) note, the governing principle enshrined in UN Agenda 2030 is that no one should be left behind, including older adults.

In 2022, engagement with an increasingly technological society is an issue that has the potential to leave older adults behind, and acknowledging and understanding their digital ability, engagement, and willingness to learn and be proficient is paramount (Muñoz-Rodríguez et al. 2020). As Tyler et al (2020) note, older adults still clearly lag behind younger cohorts when it comes to ICT and Internet use, and there are many who are unconnected. In Australia in 2014–2015, regular use of the Internet was about 51% for those 65 years + with those in the 45–65 years or over age groups spending the lowest mean number of hours on the Internet (7 h per week) (ABS 2016). According to the latest Australian Digital Inclusion Index published in 2019, there have been improvements in digital inclusion but there still remains a large digital divide between different groups of people, including older adults and especially those with additional

vulnerabilities e.g., lower levels of income and education, being an Indigenous Australian, living in a rural area, and having some form of additional physical or intellectual disability (Tyler et al ., 2020).

Moreover, older adults who did not receive ICT related training earlier in life through school, or who did not routinely experience digital technology in the workplace are likely to be at greater risk of digital exclusion (Betts et al., 2019; Barnard, et al., 2013). Consequently, there is growing concern that some older adults experience increasing levels of digital exclusion because they lack or have lost the necessary skills to successfully engage with the digital world (Hanson, 2010; McDonough, 2016). Whilst Frissen (2005) suggests that this digital divide is based upon age-related experiences including education and may disappear over time as the current cohort of digital natives age, there is a need to shift from adoption of ICT to fostering continued learning and increased proficiency, especially once older adults retire and potentially become less connected with technology (Nguyen et al.,2021).

Whilst research also mostly looks at older adults and their adoption of ICT, there remains limited insight regarding learning and improving proficiency. Godfrey and Johnson (2009) suggest that, enhancing older adults' skill sets, providing supportive learning environments, and utilizing social support may together foster improved inclusion. Moreover, with the rapid pace of evolution in the technological world, technology users need to continue to refine their skills so that they can maintain their desired level of engagement with technology. It is clear that there is a recognition that older adults need to be taught appropriate skills to engage with digital technology but guidance concerning best practice for digital inclusion sessions is less forthcoming. That is, a focus solely on adoption of ICT is not enough, and attention needs to be on building the motivation and ability to remain engaged and current with ICT (Betts et al., 2019).

Theoretical background and hypotheses

Researchers have utilised several models to examine the acceptance and sustained engagement with ICT, including the Technology Acceptance Model (TAM) proposed by Davis (1989), the Unified Theory of Acceptance and Use of Technology (UTAUT) developed by Venkatesh et al. (2003), the Theory of Planned Behaviour (TPB; Ajzen, 1991) and the Unified Model of IT Continuance (Bhattacharjee & Lin, 2015). In order to better understand the desire to be more proficient at using ICT, this paper applies an expanded TAM, drawing upon elements of the Theory of Planned Behaviour and the UTAUT. The research considers that the desire to be more proficient with ICT is related to issues of the perceived value of ICT, the support for engaging with ICT, barriers and concerns associated with using ICT, and the digital literacy of users.

Perceived value of ICT

As Vroman et al. (2015) found, ICT uptake by older adults was influenced by their perceived value of ICT activities. They argue that any learning and development activity related to using ICT should relate to the value that an older adult places in the activity or the desired outcome. Our model highlights, attitude to ICT, Perceived ease of use and perceived usefulness, along with social connection, and self-satisfaction as important aspects of perceived value.

Attitude refers to the degree to which a person has a favourable or unfavourable evaluation of the behaviour of interest (Ajzen, 2011; Lee & Kim, 2009). From an ICT perspective, Guner and Acarturk, (2020) note that in recent TAM and TPB studies, attitude significantly predicts the intention to adopt and use ICT (e.g., Kim et al., 2009).

Perceived Ease of Use has been defined as the level of difficulty or effort needed to use technology, while Perceived Usefulness is the level of belief an individual has about whether technology will provide an advantage and lead to better outcomes than not using it (Brown et al., 2010). In the TAM, attitude towards technology, in this case ICT, is influenced by the Perceived Usefulness and Perceived Ease of Use of ICT together with external factors like digital literacy (Guner & Acarturk, 2020; Mac Callum et al., 2014.). perceived usefulness and ease of use are expected to have positive associations with desire to improve ICT proficiency.

The on-going COVID-19 pandemic has created significant focus on the role of ICT in social isolation and connection (Lee et al., 2021; Pandey et al., 2021). Being in home quarantine and isolation was seen as taking its toll on both the mental and physical health on many people including older adults (World Health Organization, 2020a; Pandey et al., 2021). ICT played an important role in helping people communicate with work colleagues, family and friends through mechanisms including emails, websites, conference platforms, or smart phone applications. ICT serves as communication channels and social interaction media between sources of information and receivers (Lee et al., 2021). The importance of being able to use ICT to connect and communicate with others is likely to be associated with the desire to improve ICT proficiency.

It is clear that learning plays an important role in productive ageing (Dench & Regan, 2000). In a study by Boulton-Lewis et al., (2006, p. 279), the most frequent reasons participants gave for wanting to keep learning were “to keep the mind active, use the brain, exercise the mind, stay mentally stimulated, grow, attain goals, constantly learn, never stop.” Ardeli made a case for lifelong learning and continued education for older persons in a society that is characterized by rapid technological changes (Boulton-Lewis, 2010). Older adults are motivated to learn for reasons of self-fulfilment, self-satisfaction, and pleasure. Self-Satisfaction (SS) is the degree to which a product/service gives the user satisfaction with his or her achievements (Park et al. 2013). For example, user perceptions of having an individual and distinct personality, achieving something new and difficult which requires great effort, and belief in oneself and one's abilities reflected by a product/service, all of these can generate great motivation through self-satisfaction. Self-related positive affect may mediate the effects that physical activity has on life satisfaction (Rejeski and Mihalko, 2001). Self-Satisfaction is regarded as having a positive association with the desire to be more proficient with ICT. The following hypotheses are proposed:

H1a: A positive attitude towards ICT use is positively related to the desire improve ICT proficiency.

H1b: Perceived ease of use of ICT use is positively related to a positive attitude towards ICT use.

H1c: Perceived usefulness of ICT positively related to a positive attitude towards ICT use.

H1d: Perceived ease of use of ICT use is positively related to Perceived usefulness of ICT.

H1e: Self-satisfaction from using ICT is positively related to the desire improve ICT proficiency.

H1f: Being socially connected through using ICT is positively related to the desire improve ICT proficiency.

Support for ICT Use

The social context can change an individual's perceptions about certain behaviours (Michie et al., 2014). Indeed, people often choose to perform an action when one or more important referents say they should, even though they may not like or believe in it (Schepers & Wetzels, 2007). This influence is variously called subjective norm (e.g., in TPB) and social influence (e.g., in TAM2 and TAM3). Social norms can also reference the atmosphere of a society or the surroundings that affect an individual's decision-making process in terms of social pressures or collective beliefs (Venkatesh & Bala, 2008). Researchers have found that subjective norm has some influence on the ICT related behaviour of older consumers (Han & Nam, 2021; Pan & Jordan-Marsh, 2010), although the evidence is mixed (Schepers & Wetzels, 2007). From the perspective of improving ICT proficiency, the perceived and actual support from others, especially those they have close relationships with (e.g., family, friends, spouse) is likely to provide encouragement to remain proficient.

The ability to engage with ICT and improve proficiency is likely to relate to the resources available to older adults. These resources and their availability are known as facilitating conditions; defined as the degree to

which an individual believes that organizational and technical infrastructure exists to support the use of ICT (Venkatesh et al., 2012). In other words, it reflects environmental barriers or availability of resources that older adults may perceive in relation to engaging with ICT (Macedo, 2017). In earlier versions of the UTAUT model, facilitating conditions were theorised as a driver of use behaviour, meaning that the more the users perceive the availability of resources, knowledge, and support, the more likely it is that they will actually use ICT. For older adults this may take the form of having the necessary resources such as knowledge, time, and money to adopt and use forms of ICT (Choudri et al., 2018). It may also take the form of perceived or real support, assistance and mentoring that shape engagement with ICT and aid in the reduction of anxiety associated with adoption and use (Arthanat, 2021). In the present study, facilitating conditions are described as the person's beliefs about the costs, including money, knowledge, and assistance older adults need to afford to own and use ICT. In this research we distinguish between resources to afford and skills to use (facilitating conditions resources), and the social support and assistance available to use ICT (facilitating conditions – use) (Guner & Arcaturk, 2021; Michailidou et al., 2015). The following hypotheses are proposed:

H2a: Subjective norm is positively related to the desire improve ICT proficiency.

H2b: Facilitating conditions (Help) is positively related to the desire improve ICT proficiency.

H2c: Facilitating conditions (Resources) is positively related to the desire improve ICT proficiency.

ICT Concerns

Concerns about using ICT, including the desire to use more ICT, or the need to maintain use of particular ICT, are likely to prompt older adults to be focused on being more proficient with ICT. We consider that perceived risks, anxiety about using ICT, and worrying about the complexity of future technology, and falling behind will be related to the desire to remain current.

Risk perceptions are beliefs about potential harm or the possibility of a loss. It is a subjective judgment that people make about the characteristics and severity of a risk (Arfi et al., 2021). Consumer research has demonstrated that perceived risk influences the adoption and use of products and services, including ICT (Laukkanen et al., 2007; Nunan & Domenico, 2019). Perceived risks can manifest in many ways including financial, performance, social, physical, psychological and time risks. In this research we utilise a reconceptualization of these risk factors as presented by Figueiredo et al. (2020), incorporating Operational and Functional Risk (e.g., forgetting instructions or passwords, not keeping up, wasting time), Personal and Social Risk (e.g., being made fun of, feeling incompetent, getting frustrated, being overwhelmed), Privacy and Transaction Risk (e.g., losing privacy, identity theft, automatic payments), Purchase Transaction Risk (e.g., making transaction mistakes, not receiving goods, processing errors), Overspending Risk (e.g., buying too much online, software upgrade or device costs), and Physical Harm Risk (e.g., becoming addicted to ICT, eyesight strain, or repetitive strain injury). Perceiving risks associated with using ICT is likely to prompt a desire to be more proficient to minimise, avoid or overcome risks.

Anxiety generally refers to an emotional state or condition (state anxiety) or personality trait (trait anxiety), characterized by tension, apprehension, and worry (Thatcher & Perrewé, 2002). Individuals experience anxiety when they perceive conditions in their environment, or things and systems they interact with to be threatening (Thatcher et al., 2007). From a computer or ICT perspective, researchers have argued that as opposed to trait anxiety, which is an enduring personality trait, computer or ICT anxiety is a form of 'state anxiety' which is amenable to change (Chua et al., 1999; Heinssen et al., 1987). Being apprehensive about using ICT is also likely to prompt a desire to be more proficient at using ICT.

The pace of change in ICT is relentless, new devices, new platforms, new interfaces all serve to make skills and capabilities redundant if they are not renewed or updated. We consider that the fear of falling behind, not being current, or finding new ICT too complex is related to the desire to improve proficiency. Research has found that concerns about being current are central to the thoughts of older adults. Mansvelt et al., (2020) found for example that participants in their research felt that digital technologies were “the way of the future” and were deeply embedded in social and economic life. Consuming ICTs, purchasing them, appropriating, and accommodating them was seen necessary as one aged and in the context of a world in which digital technologies were constantly evolving. They found that metaphors about “moving with”, “keeping on board”, and “keeping pace with” were used to describe the inevitability of digital evolutions and their participants saw the imperative of engaging with ICT in order to be an independent and socially connected older citizen (Mansvelt et al., 2020). Thus, we consider that perceptions of the need to remain current is likely to be associated with the desire to be more proficient. The following hypotheses are proposed:

H3e: Anxiety about using ICT is positively related to the desire improve ICT proficiency.

H3f: Fear of not remaining current with ICT is positively related to the desire improve ICT proficiency.

H3g: Higher perceived risks associated with using ICT is positively related to the desire improve ICT proficiency.

Digital ability

Digital skills, knowledge and ability is fundamental in today's digitally based economy and information-oriented society (Van Deursen et al., 2017; Van Laar et al., 2017). Digital literacy is related to the ability of individuals to appropriately use digital tools and the internet to identify, access, manage, integrate, evaluate, analyse, and synthesize digital resources. Improving the inclusion and engagement of older adults in digital technology is becoming increasingly important (Oh et al., 2021; Scheerder et al., 2017) and while numerous studies have measured the digital literacy of younger generations, few have examined the digital literacy of older adults and their engagement in aspects of the digital economy (Van Deursen, et al., 2016; Oh et al., 2021). Developing digital literacy in older adults and other more vulnerable populations facilitates a reduction in the digital divide through constructing new knowledge, creating media expressions, and communicating with others (Chen, & Li, 2021). Research suggests that people with lower digital literacy are likely to perceive less value in using ICT, including having a less positive attitude, perceiving

ICT to be less useful and less easy to use, have less self-satisfaction from using ICT and perceiving less value in using ICT to connect socially (De Boer et al., 2019). Older adults with lower digital literacy are also likely to have varying levels of support for ICT including having pressure from others to be more engaged with ICT, possibly having more mentorship around ICT, but may have fewer resources for engaging with ICT. Older adults with lower digital literacy may also perceive greater risks, anxiety, and concerns about using ICT and remaining current with ICT (Di Giacomo et al., 2019). The following hypotheses are proposed:

H4a: Lower digital literacy is negatively related to having a positive attitude towards ICT.

H4b: Lower digital literacy is negatively related to perceived ease of use of ICT.

H4c: Lower digital literacy is negatively related to perceived ease of use of ICT.

H4d: Lower digital literacy is negatively related to self-satisfaction from using ICT.

H4e: Lower digital literacy is negatively related to Being socially connected through using ICT.

H4f: Lower digital literacy is positively related to subjective norm.

H4g: Lower digital literacy is positively related to Facilitating conditions (Help).

H4h: Lower digital literacy is negatively related to Facilitating conditions (Resources).

H4i: Lower digital literacy is negatively related to Anxiety about using ICT.

H4j: Lower digital literacy is positively related to fear of not being able to remain current with ICT.

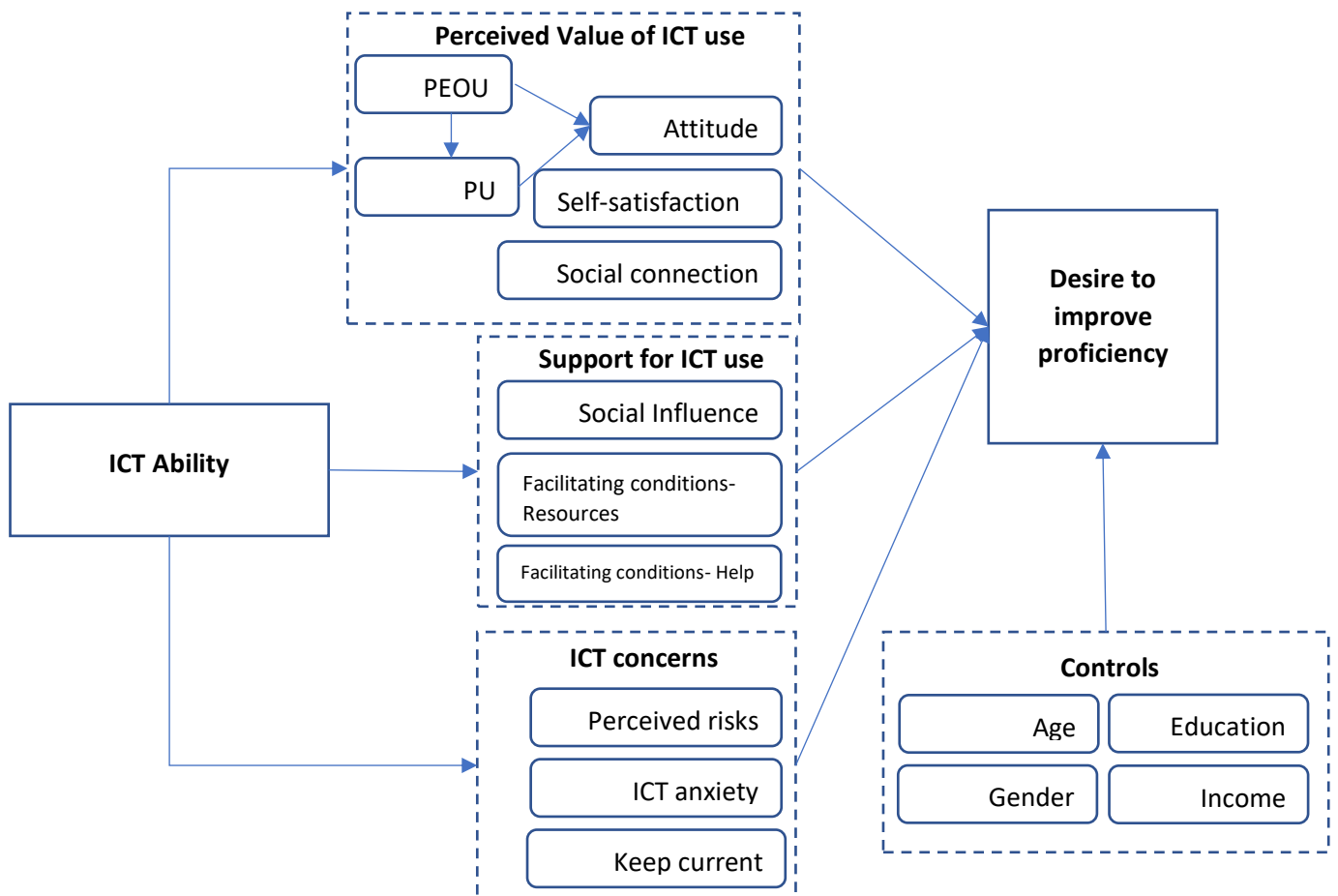
H4k: Lower digital literacy is related to perceived risk in using ICT.

Research methodology

Research model

To investigate the relationships that influence older adults' desire to be more proficient with ICT, we propose a research model based on the literature review and our prior research. We posit that the older adults' desire to improve their ICT proficiency is related to the perceived value in using ICT, the support they have for engaging with ICT, and the concerns they have about ICT. In turn, perceived value, types of support, and ICT concerns are influenced by the level of digital literacy of older adults. Several controls, including age, gender, education, and income are considered. The relationships among these variables are shown in figure 1.

Figure 1: Conceptual Framework



Measurement development

Theoretical constructs were operationalised using previously validated multi-item scales. Scales were adapted with slight modifications and rephrasing through a process of consultation and prior qualitative research with older adults (Figueiredo et al., 2020). The measure of digital literacy was based on the Internet Skills Scale (ISS; Van Deursen et al., 2016; Van Deursen & Mossberger, 2018). The scale encompasses not only technical ability but also other technical and cognitive skill types that support engagement with the internet, digital media, and other ICT, including information skills, mobile device, social skills, and creative (Van Deursen et al., 2016). It is reverse coded in this analysis to highlight low digital literacy and its influence on perceptions and desire to be more proficient. For factors associated with Perceived value of ICT, including Attitude to ICT, Perceived Ease of Use, Perceived Usefulness, Social connection, and Self-satisfaction, we adapted scales from Guner & Acarturk (2020) and Venkatesh et al. (2003). For factors associated with Support for ICT use, including subjective norm/social influence and Facilitating conditions, we again adapted scales from Guner & Acarturk (2020), however we extend the scale for facilitating conditions based on our qualitative research and subsequently analysed two factors representing 'access to resources for ICT' and 'help available to support ICT use'. For factors associated with ICT Concerns we used measures adapted from Chan and Chen (2014) to measure ICT anxiety. Perceived Risk was measured using a combination of items drawn from consumer behaviour and information systems research (Cocosila & Archer, 2010; Featherman & Pavlou, 2003; Stone & Mason 1995; Stone & Grønhaug, 1993). The measures for perceived ICT risk were further developed through qualitative research with older adults and subsequent quantitative analysis using exploratory and confirmatory factor analysis (Figueiredo et al., 2020). The final Perceived ICT Risk Scale comprised, Operational and Functional Risk (12 items), Personal and Social Risk (10 items), Privacy and Transaction Risk (7 items), Purchase Transaction Risk (5 items), Overspending Risk (4 items), Physical Harm Risk (3 items). Each item was measured on 7-point Likert scales ranging from strongly disagree (1) to strongly agree (7). The scale is treated as a second order factor in the analysis (Rehman et al., 2020).

Data collection and sample

This research is part of a larger project which seeks to investigate how technology use and perceived risk influences older adults' connectedness, social inclusion, and participation. The survey was carefully designed to be applied to older adults after a review of literature and an initial phase of 22 exploratory interviews conducted from November 2020 to January 2021. Interviews were used to determine appropriate scales and factors, and to extend existing measures with new insights around perceived risk and willingness to engage with ICT.

The study used a non-probability sampling method. Participants were recruited from the U3A Network (www.u3avictoria.org.au) which is an international movement that provides lifelong learning opportunities through courses and activities to people who are retired or semi-retired over the age of 50 years of age. There are 104 U3As throughout Victoria, Australia, who make up the U3A Network Victoria and offer

courses to members. U3A members were contacted via email, newsletter, and nominated course enrolments to complete the online survey.

The survey was hosted on a Qualtrics platform. Three recruitment bulletin emails were sent to the 104 member U3As of U3A Network Victoria, as well as a bulk email to a wider U3A network. In addition, notifications were placed in U3A Network Victoria publications (Network News, Facebook, Network Council papers). The survey was promoted through the Social Older adults' programs, and ten U3As that had members complete the survey in Digital Literacy classes. Incomplete responses lacking completion of the demographics section were not included in the final analysis. After removing duplicates and invalid responses (where no demographic information was provided) the final sample comprised 708 usable responses.

Table 1 shows a profile of the final sample. The largest age category of participants was 70-74 years of age (37.8%). There were significantly more female participants (69.2%) compared to male participants (30.7%). Education varied amongst the participants with 13.4% having achieved lower than year 11 or below and 7.6% completing secondary school (year 12). A significant proportion had a graduate diploma (17.7%) with a significant number of respondents being highly educated with a bachelor's degree (21.5%) and postgraduate qualifications (17.9%). As expected for this age group, most of the participants were retired or no longer working (87.3%). The income of most participants (53.2%) was less than \$51,999 however, 10.5% had an income of over \$91,000 per year. Most participants were currently in couple relationships (57.1%) compared to single (35.4%). A greater percentage of participants lived in urban areas (67.5%) compared to rural or regional locations (31.6%).

With respect to ICT ownership and usage, almost all survey respondents had personal access to the internet (92.5%) or owned a smartphone (91.4%). This was followed by a laptop (71.5%) , and an iPad or tablet (69.3%) as the most owned pieces of technology. Just over half owned an internet-enabled TV or a desktop computer. Wearable devices and the iPod Touch (digital music player) were not commonly owned items (24.7% and 10.7% respectively).

Table 1 Sample Characteristics.

Characteristics		Frequency	Percentage
Sex	Gender		
	Female	489	69.2
	Male	217	30.7
Age	Other (Please specify)	1	0.1
	Less than 50 years	6	0.8
	50 – 54	1	0.1
	55 – 59	6	0.8
	60 – 64	60	8.5
	65 - 69	158	22.4
	70 – 74	267	37.8
	75 - 79	123	17.4
	80 – 85	71	10.1
	85+	13	1.8
	Prefer not to say	1	0.1
Education	Year 11 or below	95	13.4
	Year 12	54	7.6
	Certificate I/II	8	1.1
	Certificate III/IV	30	4.2
	Advanced Diploma and Diploma	100	14.1
	Bachelor Degree	152	21.5
	Graduate Diploma and Graduate Certificate	125	17.7
	Postgraduate Degree	127	17.9
	Prefer not to say	15	2.1
	Work status	Working full-time (on-going)	10
Working part-time (on-going)		32	4.5
Working casually (intermittent)		33	4.7
Unemployed / seeking work		4	0.6
Fully retired / no longer working		618	87.3
Prefer not to say		6	0.8
Relationship status	Never partnered and living alone	24	3.4
	Widowed and living alone	119	16.8
	Divorced and living alone	91	12.9
	Married	336	47.5
	Separated and living alone	16	2.3
	De facto / partnered	68	9.6
	Other	21	3.0
	Prefer not to say	28	4.0
Personal income	\$7,800 - \$15,599 per year	52	7.3
	\$15,600 - \$20,799 per year	64	9.0
	\$20,800 - \$25,999 per year	74	10.5
	\$26,000 - \$33,799 per year	64	9.0
	\$33,800 - \$41,599 per year	68	9.6
	\$41,600 - \$51,999 per year	55	7.8
	\$52,000 - \$64,999 per year	46	6.5
	\$65,000 - \$77,999 per year	19	2.7
	\$78,000 - \$90,999 per year	14	2.0
	\$91,000 - \$103,999 per year	12	1.7
	\$104,000 - \$155,999 per year	4	0.6
	\$156,000 or more per year	74	10.5
	Prefer not to say	151	21.3
Location	Rural	224	31.6
	Urban	478	67.5

Data analysis and results

Descriptive statistics were calculated using IBM SPSS Statistics (Version 28), and partial least squares structural equation modelling (PLS-SEM) was analysed using SmartPLS (Version 3.3.3) (Ringle et al., 2015). PLS-SEM is a distribution-free method of determining the predictive power of complex models (Hair et al., 2019; Hair et al., 2014). PLS-SEM was appropriate for the analysis of a predictive model that utilised multiple constructs and indicators. PLS-SEM was also deemed suitable given the sample size ($N = 708$). The first stage of the analysis required establishing the validity and reliability of the model (Appendix 1) including assessing indicator loadings, internal consistency, and construct reliability (Hair et al., 2019; Hair et al., 2014). The second stage of the analysis tested the hypothesized relationships in the model.

Measurement validation

Reliability measures determine whether items are consistently measuring the construct. The internal consistency of each construct and measure (Table 2) was assessed using Cronbach's Alpha (CA). Each was above the acceptable threshold of 0.7. The convergent validity of each construct was assessed using evaluation of the average variance extracted (AVE); which were above 0.5 (whereby 50% or more of the variance is explained). In addition, all the composite reliability scores were above 0.7 (Hair et al., 2019; Hair et al., 2021).

Table 2. Construct reliability and validity

Construct	Identifier	Mean	SD	Ca	CR	AVE	Adj R2
Desire to be more proficient	PROF	4.65	1.31	0.91	0.94	0.75	0.30
Perceived value of ICT							
Attitude Toward Using ICT	ATT	5.56	0.95	0.85	0.90	0.64	0.60
Perceived Ease of Use of ICT	PEOU	4.92	1.41	0.96	0.97	0.89	0.59
Perceived Usefulness of ICT	PU	5.85	1.14	0.95	0.96	0.87	0.31
Social connection	SOC	5.32	0.95	0.88	0.90	0.58	0.08
Self-satisfaction	SAT	5.42	1.07	0.83	0.90	0.74	0.18
Support for ICT use							
Subjective Norm to use ICT	SUBN	4.47	1.55	0.85	0.90	0.70	0.02
FC resources	FCR	5.42	1.09	0.86	0.90	0.71	0.56
FC help	FCH	3.88	1.32	0.71	0.84	0.63	0.02
ICT Concerns							
Being current	CUR	3.36	1.49	0.96	0.97	0.92	0.39
Risks	RSK	3.16	1.12	0.90	0.93	0.68	0.45
Anxiety	ANX	2.76	1.56	0.94	0.96	0.86	0.49
ICT Ability							
DL (low)	DLIT	4.89	1.13	0.87	0.90	0.65	-----

The next phase in determining the validity and reliability of the constructs, is to determine discriminant validity. Discriminant validity measures indicate the extent to which each construct differs from the others. Two approaches were used to assess discriminant validity – Fornell-Larcker criterion and the Heterotrait-Monotrait ratio (HTMT; Hair et al., 2019). In Table 3 the values on the diagonal (in bold) are the square root of the average variance extracted. The table also shows bivariate correlations for all factors. All criteria for discriminant validity were met using both Fornell-Larcker criteria as well as those for the Heterotrait-Monotrait ratio (HTMT; Hair et al., 2019). We also tested the extent of common method bias using Harman’s one-factor test (Podsakoff et al., 2003), which assesses whether a single factor accounts for greater than 50% of the variance. The results showed that no factor significantly dominated. Other evidence of common method bias includes exceptionally high correlations ($r > 0.90$) among the variables (Pavlou & El Sawy, 2006). The inter-construct correlation matrix showed that there were no unusually high correlations (Table 3). Thus, there is likely no common method bias problem in this study. Ultimately, the results of the instrument validity tests indicated that the measurement model was appropriate.

Table 3. Discriminant validity – Fornell-Larcker criterion

	PROF	ATT	PEOU	PU	SATIS	SOC	SN	FCR	FCH	RSK	ANX	CUR	DLL
PROF	0.87												
ATT	-.14**	0.80											
PEOU	-.32**	.68**	0.94										
PU	-.06	.68**	.54**	0.93									
SATIS	.13**	.61**	.41**	.59**	0.86								
SOC	.15**	.52**	.31**	.49**	.76**	0.8							
SN	.28**	.01	-.11**	.05	.18**	.23**	0.84						
FCR	-.29**	.69**	.78**	.56**	.41**	.32**	-.05	0.84					
FCH	.10*	.07	.02	.03	.11**	.20**	.29**	.09*	0.80				
RSK	.41**	-.57**	-.61**	-.38**	-.20**	-.13**	.18**	-.65**	.06	0.82			
ANX	.38**	-.65**	-.70**	-.45**	-.29**	-.21**	.21**	-.69**	.04	.79**	0.93		
CUR	.45**	-.46**	-.61**	-.29**	-.17**	-.09*	.17**	-.57**	.04	.71**	.69**	0.96	
DLL(low)	.34**	-.58**	-.77**	-.48**	-.32**	-.25**	.14**	-.72**	.03	.65**	.70**	.63**	0.80

Square root of average variance extracted (on Diagonal and bold)

Bivariate Correlations presented under square root of average variance extracted

Hypothesis testing

To test the hypotheses, we examined the path coefficients and their statistical significance (t-values and p-values) using PLS. The results are presented in Table 4. For perceived value, the relationship between positive attitude and proficiency desire (H1a: $t=0.1818$, $p=0.069$) and social connection and proficiency desire (H1f: $t=0.442$, $p=0.659$) were not significant and H1a and H1f are not supported. The relationship between self-satisfaction and proficiency desire (H1e: $t=3.077$, $p=0.002$) was positive and significant and supports H1e. The relationship between TAM variables PEOU and attitude (H1b: $t=8.906$, $p=0.000$), PU and attitude (H1c: $t=12.784$, $p=0.000$), and PEOU and PU (H1d: $t=8.058$, $p=0.000$) were all significant, supporting H1b, H1c, and H1d.

For support for ICT, the relationship between subjective norm and desire for proficiency (H2a: $t=3.948$, $p=0.000$) was significant. The relationship between FC help and desire for proficiency was not significant (H2b: $t=0.268$, $p=0.789$), whilst the relationship between FC resources and desire for proficiency was

negative but significant (H2c: $t=3.203$, $p=0.001$) and counter to the hypothesized relationship. Thus, H2a is supported, H2b is not supported and H2c is rejected.

For ICT concerns, the relationship between Anxiety towards ICT and the desire to be more proficient was positive and significant (H3a: $t=2.175$, $p=0.030$). The relationships between fear of not being current and desire to be more proficient (H3b: $t=5.487$, $p=0.000$) and between perceived risks and the desire to be more proficient (H3c: $t=2.290$, $p=0.022$) were both positive and significant. The hypotheses H3a, H3b and H3c are all accepted.

Table 4: Summary of Results (Main effects)

Hypothesis	Relationships	Beta	t-value	p-value
Perceived value of ICT				
H1a (+)	Attitude -> Desire increased proficiency	0.105	1.818	0.069
H1b (+)	Perceived ease of use -> Attitude	0.367	8.906	0.000
H1c (+)	Perceived usefulness -> Attitude	0.456	12.784	0.000
H1d (+)	Perceived ease of use -> Perceived usefulness	0.443	8.058	0.000
H1e (+)	Self-satisfaction -> Desire increased proficiency	0.175	3.077	0.002
H1f (+)	Social connect -> Desire increased proficiency	0.025	0.442	0.659
Support for ICT use				
H2a (+)	Subjective norm -> Desire increased proficiency	0.150	3.948	0.000
H2b (+)	FC help -> Desire increased proficiency	0.009	0.268	0.789
H2c (+)	FC resources -> Desire increased proficiency	-0.145	3.203	0.001
ICT Concerns				
H3a (+)	Anxiety -> Desire increased proficiency	0.121	2.175	0.030
H3b (+)	Being current -> Desire increased proficiency	0.248	5.487	0.000
H3c (+)	Risks -> Desire increased proficiency	0.127	2.290	0.022
ICT Ability				
H4a (-)	Low DL -> Attitude	-0.069	1.586	0.113
H4b (-)	Low DL -> Perceived ease of use	-0.767	39.737	0.000
H4c (-)	Low DL -> Perceived usefulness	-0.136	2.406	0.016
H4d (-)	Low DL -> Self satisfaction	-0.330	8.532	0.000
H4e (-)	Low DL -> Social connect	-0.286	7.112	0.000
H4f (+)	Low DL -> Subjective Norm	0.132	3.463	0.001
H4g (+)	Low DL -> FC help	0.056	1.275	0.203
H4h (-)	Low DL -> FC resources	-0.748	42.947	0.000
H4i (+)	Low DL -> Anxiety	0.698	34.087	0.000
H4j (+)	Low DL -> Being current	0.624	23.690	0.000
H4k (+)	Low DL -> Risks	0.669	32.595	0.000

For low Digital literacy there was a significant relationship with all variables except Attitude (H4a: $t=1.586$, $p=0.113$), and FC Help (H4g: $t=1.275$, $p=0.203$). Specifically for value of ICT variables, low digital literacy was associated with lower perceived ease of use (H4b: $t=39.73$, $p=0.000$), and lower perceived usefulness of ICT (H4c: $t=2.406$, $p=0.016$). Low digital literacy was also associated with less self-satisfaction (H4d: $t=8.532$, $p=0.000$), and lower social connection (H4e: $t=7.112$, $p=0.000$).

From a support for ICT perspective, lower digital literacy was associated with fewer available resources for engaging with and using ICT (H4h: $t=42.94$, $p=0.000$), but a higher social norm, or a sense from others that they should be more engaged with ICT (H4f: $t=3.463$, $p=0.001$). The relationship between lower digital literacy and FC help was not significant ((Hg: $t=1.275$, $p=0.203$).

With regard to ICT concerns, lower digital literacy was associated with higher levels of anxiety regarding ICT use (H4i: $t=34.08$, $p=0.000$), higher perceived risks associate with using ICT (H4k: $t=32.59$, $p=0.000$), but also a desire to be current with ICT (H4j: $t=23.69$, $p=0.000$). For the control variables, age, gender, incomes, and education, none had a significant influence on the desire to remain proficient.

Discussion

Over recent years, society's reliance on digital technology has increased significantly. As Betts et al., (2019) notes, tasks that have historically and routinely been performed through face-to-face means are migrating to the digital world with many companies and service providers only interacting with their customers through digital means. For older adults, being able to engage in daily activities such as shopping, paying bills, interacting with friends and family, attending medical appointments, and accessing forms of entertainment are becoming more complicated for the less digitally literate. ICT that enables positive and active ageing by facilitating access to information, entertainment, health and healthcare, socio-economic participation, and other life activities, are important to adopt and use.

Although many older adults are frequent users of information and communication technologies, many still lack the access they would like, and lack the skills needed, and are at risk of being excluded from many parts of society and the economy, particularly as the pace of digital innovation and change increases (Lissitsa et al., 2022; Neves, et al., 2018). For some, this exclusion is voluntary in that they don't want to engage. For others it is a function of a lack of skills, access, or affordability (Borg & Smith, 2018). For many, regardless of their digital literacy there is a need and desire to be more proficient, to understand what the ICT can do to help them and improve their lives, to engage in the digital economy, and to remain socially engaged through technology. It is important to both understand and foster a desire for improved engagement and proficiency in the sustained use of ICT and digital media. Our analysis has highlighted a number of critical factors that influence the desire to be more proficient and offers insight into pathways to support older adults in being more proficient.

Our research argues that the perceived value of ICT should influence the desire to be more proficient. We found mixed results for this notion in that attitude and social connection were not significant, but that self-satisfaction, the sense that today's ICT improves one's quality of life and provides a sense of accomplishment, was significant. As Vroman et al. (2015) argues, the desire by older adults to learn about ICT should relate to the positive value it can have, and more specifically, on being able to engage in activities of interest or usefulness e.g., paying bills, accessing medical services, browsing for information, shopping, enjoying entertainment or chatting with friends and family.

Our research also considered the question of the social context and support for engaging with ICT and the influence that had on the desire to increase ICT proficiency. We found that subjective norm, that is the social pressure or encouragement by friends, family, organisations, and others important to the individual, had a positive influence on the desire to increase proficiency. From an education perspective or social marketing or public policy initiative, encouraging support from others can be an important part of fostering engagement with ICT and encouraging increased proficiency. Nonetheless, there is a cautionary note in this approach in that encouragement should not be perceived as pressure or coercion. For example, the children of older adults often want their parents to be able to use the internet, use a smartphone, or to be able to execute online transactions and processes, but they may not be skilled as teachers and may lack patience and sufficient technical skills to help their parents or an older adult. Their attempts and own lack of skill in helping may be perceived as pressure or coercive behaviour by their parents. Our results also

showed that having resources (FC Resources) was negatively related to the desire to increase proficiency. This is explained by respondents who have what they perceive to be monetary resources and a perceived good level of knowledge. It is important that even if older adults perceive they have abilities and knowledge, that they are encouraged to maintain and update them. As Olssen et al., (2019b) note, ICT-literacy is not like conventional literacy, in that there needs to be continual personal investment in learning about and engaging with new devices, platforms, and software, and that people who fail to remain proficient are at risk of gradual exclusion.

Our model also considered concerns about using ICT. In particular, we focused on anxiety about using ICT, the fear and worry of not remaining current and falling behind in understanding and using ICT, and perceptions of risk associated with using ICT. We found that anxiety, including notions about making mistakes, being apprehensive, or being intimidated about using ICT was positively associated with the desire to be more proficient. Anxiety related to ICT is complex as it can be an emotion state or response to situations, it can be part of the personality of an individual, or it can be specifically related to fear of devices and computers. The fear of falling behind was also associated with the desire to be more proficient. Remaining current and up-to-date with technology is challenging for most adults (Francis et al., 2018) and it can be exacerbated if a person is retired and less formally engaged with multiple forms of ICT on a daily basis. The challenge facing many agencies and educators engaged in educating older adults about ICT is maintaining the motivation to continually learn in the face of complexity and rapid change, especially when cognitive and other personal resources may be challenged. We also found that perceived risks associated with using ICT was positively related to the desire to be more proficient. The media are replete with stories of older adults being caught out by a range of risks when using ICT (Lee, 2018) including operational and functional risks, personal and social risks, privacy risks, purchase transaction risks, and overspending risks. Encouraging older adults to be aware of the range of risks, without creating fear or panic, may motivate the desire to learn and be more proficient (Figueiredo et al., 2021)

Our analysis also sought to determine the role and influence of digital literacy, specifically the lack of it, has on perceived value of ICT, the perceptions of support and need for support in using ICT, and in creating concerns in using ICT. From the perspective of perceived value of ICT, we found that a low level of digital literacy was associated with lower ease of use and usefulness of ICT, a lower level of self-satisfaction from using or trying to use ICT, and lower perceptions of the value of social connection e.g., using ICT to help feel less isolated, be connected to family and friends, being able to communicate with others. From the perspective of social support and need for support in using ICT we found that lower levels of digital literacy were associated with the perception that family, friends, and others think they should use today's ICT. Lower levels of digital literacy were also associated with lower facilitating conditions (e.g., resources) or their beliefs about the costs, money and skills needed to access and use ICT. Lower digital literacy can result in a lack of understanding about the resources needed or about how to do what is desired or needed with fewer resources and can be an inhibitor to motivations to adoption and sustain the use of ICT. We also found that low levels of digital literacy were strongly associated with anxiety towards using ICT, a fear of not being able to keep current or up to date with ICT, and higher perceptions of risk associated with using ICT.

Conclusions and limitations

The debates surrounding the digital inclusion of older adults have been going on for some time, with the goal of creating adoption and continued engagement by older adults with ICT. It also appears that the rate of change in ICT and the increasing imperative to be digitally literate is challenging for many older adults who may have left the workforce and lack access to newer technology, have reduced incomes, and may be experiencing physical, cognitive and motivation challenges. Despite the promises that new ICT will save time, make life easier, open the world up for all, and enable greater inclusion, the array of choices, technologies and demands to engage, may create a paradox of greater complexity and less willingness to engage (Mick & Fournier, 1998). Those engaged in digital literacy education for older adults need to consider the motivation, opportunity, and ability of individuals to appropriately use digital tools and facilities and to enable them to construct a set of ICT's that best enable them to do what they need and want to. Policy makers, social marketers, seniors' educators need to look beyond the notion that seniors or older adults are a homogenous group and craft programs and initiatives that have real value for those who have different needs and desires.

Our research highlights the importance of developing a level of digital literacy that enables older Australians to employ or engage with ICT to do what they need it to do, and perhaps even, what they want it to do. The challenge is to ensure that initiatives and programs designed to educate, instruct, and support older adults to be more digitally literate, are sufficiently nuanced and not forced by budget constraints or lack of sufficient analysis and strategy, into a 'one size fits all model'. Policy makers and educators need to recognise that not all older Australians are going to be ICT experts and that strategies and initiatives need to be designed at an appropriate level and for an appropriate set of 'must be able to do' or 'want to do' tasks. Adopting a balance between educating and instructing around a day-to-day Jobs-to-Do ICT focus, and a building a future focused motivating and positive sense of the value of ICT and the need to continually learn, is imperative.

Study limitations and recommendations for further research

The main limitation of the current study is its cross-sectional design, which does not enable proof of a causal effect of psychological variables on actual anxiety reduction. Therefore, we suggest conducting longitudinal research examining how older adults engage with ICT, and how different communication strategies and participatory programs can encourage the desire to be digitally literate and to engage in continued learning around ICT and its value for improving quality of life. An additional limitation of the study is the quantitative nature of analysis. It would be useful to undertake qualitative and ethnographic work to reveal in-depth mechanisms associated with digital literacy and how the influence of others, including family and friends, shape or inhibit the motivation to learn and use ICT. Qualitative research would also aid in understanding the ICT ecosystem of older adults and what and how ICT adds value to their lives and how the ecosystem influences anxiety associated with adoption and engagement with ICT.

In this study we used convenience sampling, which as opposed to random sampling, does not allow generalization to the entire population. Moreover, we utilised U3A as our primary source of participants. In general participants in this type of organisation and associated courses tend to be more highly educated than the general population. It would be important to extend the research into lower SES populations and those with a more diverse cultural and linguistic background. As with Lissitsa et al. (2022) we argue that the findings of this study are supported by the findings of previous studies but that some caution should be exercised about generalizing results. Our survey sample may not be representative due to the noted limitations.

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