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Facilitators and barriers of technology adoption and social connectedness among rural older adults: a qualitative study

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ABSTRACT

Background: Social disconnection is a public health concern among rural Australian older adults. While research suggests technology can enhance social wellbeing and protect against social disconnection, many older adults are not digitally literate, and little is known as to why and how technology adoption could be promoted in rural contexts. This study aimed to (1) explore the barriers and facilitators of technology adoption among rural older adults and (2) determine the potential utility of technology to promote social connectedness in the aged population. The Theoretical Domains Framework and the Behaviour Change Wheel (BCW) were employed to gain a comprehensive understanding of the digital and social behaviours of rural Australian older adults.

Methods: Semi-structured interviews were conducted with a convenience sample of 33 rural older adults aged between 65 and 87 years. Interviews were conducted over the phone, audio-recorded, and transcribed. Interview transcripts were coded and analysed using thematic analysis and the BCW.

Results: Numerous barriers and facilitators of technology adoption were identified, with the most prominent being knowledge, perceived value, perceived self-efficacy, and social support. Findings suggest that older adults' technology adoption is not simply a technical matter, but influenced by various individual, social, and environmental contexts. Consideration of these factors during development, marketing, training and implementation may facilitate technology adoption among older adults. With regard to social connectedness, several rural barriers emerged, including low population density, geographic isolation, limited community opportunities and poor public transport infrastructure.

Conclusion: Technology was consistently identified as a facilitator of the social experience, indicating that technology is a promising tool to enhance social connectedness among older adults, particularly those living in rural areas. Future research should focus on enhancing the capability, opportunity and motivation of older adults in technology adoption, with reference to the rural contexts.

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Introduction

Australia is undergoing a significant demographic shift, marked by an aging population that constituted 16% of the total in 2020, a proportion that is expected to rise to 22% by 2050 (Australian Bureau of Statistics, 2020a; Australian Institute of Health and Welfare [AIHW], 2020). This shift accentuates the prevalent issue of social disconnection particularly prevalent among older individuals, marked by the absence of meaningful social relationships (Holt-Lunstad et al., 2017). Extensive research underscores the benefits of positive social relationships for physical and mental health, including a reduced risk of illness, physical and cognitive decline, and premature mortality (Holt-Lunstad et al., 2017; Petersen et al., 2019). Socially active older adults report greater life satisfaction and overall quality of life, with positive social ties fostering healthier lifestyle practices (Kelly et al., 2017; Watt et al., 2014).

Social disconnection is indicated by the absence of social ties, infrequent social contact, and/or limited participation in social activities (Cornwell et al., 2008). This is common among older adults due to children leaving home, retirement and/or loss of spouse. Access to support can be compounded by geographical isolation. Social disconnection in old age precipitates severe consequences for health, encompassing cardiovascular, autoimmune, neurocognitive, and mental health issues (Evans et al., 2019; Hawkley et al., 2010). This social disconnection strains rural healthcare systems, with approximately 19% of older adults in non-metropolitan regions lacking meaningful relationships (ABS, 2020a). Rural older adults face unique challenges, including geographic isolation, population sparsity, limited public transport and distance between neighbours, contributing to their vulnerability to social disconnection (Stantley et al., 2019). The impact of geographic location on social connectedness varies, with each locale possessing distinct attributes influencing the social and emotional wellbeing of its residents (Henning-Smith et al., 2019). To our knowledge, little research has been conducted on improving wellbeing of rural residents targeting older adults (see Luke et al., 2024 for a review). Recent research on rural Australian older adults has tended to focus on predictors of wellbeing (Hodgkin et al., 2018), technology training to facilitate connections (Burmeister et al., 2016), and exploring the social benefits of using information and communication technology (Berg et al., 2017). However, little has addressed the low technology adoption and/or engagement to enhance social connectedness via technology.

While technology demonstrates the potential to enhance social connectedness across various demographics (Baker et al., 2018; Mitzner et al., 2019), the adoption of modern technologies among older adults, especially in rural areas, remains complex. Research suggests that technology-driven interventions, including mobile devices, video call platforms and social media, hold promise in mitigating loneliness and social isolation (Siette et al., 2021). However, significant barriers remain to widespread adoption of technology among older adults, such as inaccessibility and technology literacy (Wister et al., 2021). Further research is imperative to comprehend the experiences of rural older adults, to facilitate technology adoption for enhanced connectedness.

Older adults exhibit low rates of technology adoption, with approximately 26% of Australian older adults abstaining from technology use (ABS, 2020b; Chopik, 2016). The complexity of technology use among older adults stems from individual factors

(e.g. demographics, knowledge, emotional needs) and contextual factors (e.g. socioeconomic status, technology functional features; Schroeder et al., 2023). Furthermore, rural Australian communities face a pronounced digital disadvantage compared to urban areas, lacking adequate infrastructure and support services, thus heightening the risk of disconnection and digital exclusion for older adults (Correa & Pavez, 2016; Park, 2017). Despite challenges, studies examining technology use and social connectedness in this population are scarce, potentially influenced by persistent stereotypes about high social capital in rural communities (Beer et al., 2016).

The Behaviour Change Wheel (BCW; Michie et al., 2011) is a framework for guiding the design and implementation of behaviour change interventions. It features a behaviour system involving three conditions (**C**apability, **O**pportunity and **M**otivation) deemed essential for behaviour change (**B**) at the centre (Figure 1). Encircled by nine intervention functions which address deficits of one or more of these conditions, and seven policy categories that could enable interventions to occur. The Theoretical Domains Framework (TDF) integrates different behaviour change theories and identifies 14 domains of theoretical constructs, representing a range of possible theory-based facilitators and barriers of behaviour change (Cane et al., 2012). The TDF provides an empirical base and a method for assessing implementation problems with theories. The domains in the TDF have been mapped onto the BCW (Atkins et al., 2017).

We aimed to explore the barriers and facilitators of technology adoption and social connectedness among rural Australian older adults using a phenomenological approach and assess how the themes may align with the TDF. The insight gained will contribute to future interventions strategies that can address rural older adults' specific needs and contexts.
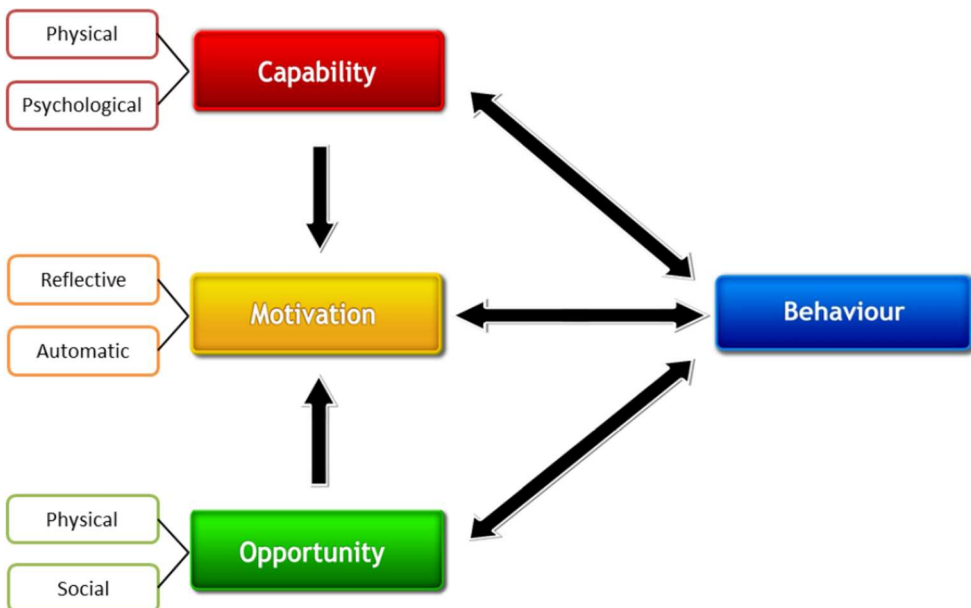

Figure 1. The COM-B model, adapted from Michie et al. (2011).

Method

Participants

Participants were adults ($N = 33$) aged 65 years and older, with 25 females ($M_{age} = 72.80$, $SD_{age} = 6.53$) and 8 males ($M_{age} = 72.87$, $SD_{age} = 6.15$) who resided in regional Victoria, Australia, owned a phone and spoke English. The majority of participants (48%) resided in Greater Bendigo and were retired (78%). Sample characteristics are detailed in Table 1.

Procedure

Ethics approval was obtained from La Trobe University's Human Research Ethics Committee (HEC19423). Recruitment flyers were posted in public spaces within central Victoria, Australia (e.g. community centres, libraries, notice boards, supermarkets) and on social media. Participants were selected via convenience sampling. Interested participants contacted the research team to schedule an interview. Recruitment continued until ($N = 33$) no new concepts emerged from additional data (Liamputtong, 2020), and the research team felt the depth of information provided by participants was sufficient to provide insight about the research question and included shared experiences across participants. This sample size is consistent with evidence found in other qualitative research to reach saturation (Hennink & Kaiser, 2022).

Table 1. Sample characteristics.

	n	%
Gender		
Male	8	24
Female	25	76
Age (years)		
65–69	13	39
70–74	7	21
75–79	7	21
80–84	4	12
85+	2	6
Suburb		
Greater Bendigo[a]	16	48
Echuca/Moama	9	27
Swan Hill	3	9
Shepparton Region	3	9
Other	2	6
Marital Status		
Married/Partnered	22	67
Widowed	5	15
Divorced	6	18
Employment Status		
Working	4	12
Retired ≤ 5 years	10	30
Retired > 5 years	16	48
Undisclosed	3	9
Diagnosed Health Condition		
None	19	57
Chronic conditions	17	43

Note: $N = 33$.
[a]Greater Bendigo includes suburbs within a 60 km radius of central Bendigo.

Interviews

Semi-structured interviews took place between April and June 2020, conducted by the first and second authors (both were female). The first author has doctoral qualification in Psychology, with experience in conducting interviews for research. The student researcher (second author) completed four years of Psychology education, was trained and supervised by the first author before conducting interviews independently. They did not have relationships with participants prior to study commencement. Participants were informed about the study via the Participant Information Consent Form. Consent was obtained and demographic information collected prior to commencement. All interested participants took part in the interviews. Interviews were conducted via an online platform, Zoom. Participants called a national phone number to join the interview and they did not need to have a computer or smart device. Only the research team and participants were present at the interviews. Fifteen questions related to technology use (e.g. 'What are some barriers you've struggled with when using technology?') and nine to social activity (e.g. 'What factors enable you to be socially connected?'). These questions explored rural older adults' experiences with technology, and what support they need to be more digitally and socially active. See Supplementary Material for interview questions. Interviews lasted approximately 60 minutes ($M = 53.97$, $SD = 21.85$), and were audio-recorded and transcribed manually verbatim by the student researcher. Participants were reimbursed with an AUD$20 voucher.

Data analysis

Thematic Analysis was used to identify, analyse and report themes within data obtained from the interviews (Braun & Clarke, 2006). Data were coded by two researchers into themes using NVivo Plus qualitative analysis software. Codes and themes were then reviewed and refined by the team, to ensure they were representative of the data set. The approach was inductive-deductive, whereby the responses were coded openly, then deductively categorised in line with the COM-B model and TDF, per Ojo et al. (2019). A checklist of criteria for reporting qualitative research was followed to ensure scientific rigour of the study (Tong et al., 2007).

Results

Responses from the interviews revealed various facilitators and barriers of technology adoption across all three components of the COM-B model and TDF domains. Results are presented in Tables 2 and 3, respectively, with example quotations from participants. The most prominent of these include knowledge, perceptions, self-efficacy, and social support. Findings suggest that technology adoption is influenced by various individual, social, and environmental contexts.

Psychological capability

Knowledge

Most participants reported a sound understanding of technology and expressed some level of confidence in their ability to successfully operate technology. A few, however,

Table 2. Facilitators of technology adoption, with reference to the COM-B Model and TDF.

COM-B component	Relevant TDF	Facilitators of technology adoption	Quotes from participants
Psychological capability	Knowledge	Perceptions of benefit	'[Technology] has enhanced our lives in a million ways – socially, economically, industrially, and scientifically.' (Participant 24, Female, 65)
		Previous experience	'When I first started using technology I was like most other people in my generation - worried that I was going to bugger it up. I quickly learned that most mistakes can be undone' (Participant 16, male, 67)
		Knowing how to protect oneself online	'I think we need to be aware but not alarmed, and just be careful about the kind of information we give out.' (Participant 25, Female, 70)
		Knowing where to access information	'If I don't know what to do, I just put it into google and 9 times out of 10 it comes up with something I can work with.' (Participant 19, Female, 78)
Physical capability	Physical skills	Modifying devices	'I've started … to use voice recognition because my fingers are … getting worse.' (Participant 21, Female, 70)
Social opportunity	Social Influences	Support from family	'I rely on my son who is very technically competent to sort out some of the trickier things I might be trying to do on the computer.' (Participant 16, Male, 67)
			'I'm lucky to have family members who are young and very knowledgeable in that area. So, if there is something I am not up to date with, they help me.' (Participant 18, Female, 69)
		Peer mentors	'This group that I went to once, was more like a help session … It was people talking amongst themselves and sorting things out. I found that helpful because you picked things up from other people in the group.' (Participant 20, Male, 79)
		Senior support groups	'I joined The University of the Third Age and their android phone group. That's very helpful because you can raise a question in that group, and someone might have the answer.' (Participant 13, Male, 76)
		Professional support	'Whenever I have a glitch in any of my products, I just take it to [Telstra]. They have always solved my problems with professional courtesy. They don't make me feel silly,' (Participant 22, Female, 80)
Physical opportunity	Environmental context and resources	Educational opportunities	'I'm self-taught. I believe that … if I went and did a course, I would be able to do a lot more with technology.' (Participant 4, Female, 69)
		Free classes	'I think some more free, especially for pensioners, some more free courses would be really good.' (Participant 16, Male, 67)
		Similarity between devices	'I got the tablet first, and then when I went to get a smartphone, my son said to me 'If you get the Samsung phone, then you'll have the same face on the tablet as your phone, and you know how to work the tablet so you should know how to work the phone.' (Participant 6, Female, 77)
		Written instructions	'I write a little notebook in my own words and jot down exactly what keys to press etc. Then, when I don't have immediate help there, I can look back over my notes and work through it step by step.' (Participant 32, Female, 74)

(Continued)

Table 2. Continued.

COM-B component	Relevant TDF	Facilitators of technology adoption	Quotes from participants
Reflective motivation	Social/professional role and identity	Occupational experience	'I'm quite lucky because of my previous position working in local government, I had a lot of training in IT. That was good grounding and I've come a long way with technology.' (Participant 11, Female, 65)
	Beliefs in capabilities	Willingness to persist	'I find the more I play around with it, the more I learn … If you just persist you will learn it really isn't that hard.' (Participant 26, Female, 82)
		Confidence in one's technical capabilities	'I feel quite confident using all of the [devices] for what I want to do.' (Participant 19, Female, 78) 'I've been using [technology] for a fair while now, so I feel reasonably comfortable.' (Participant 12, Female, 87)
	Beliefs about consequences	Fear of being left behind	'I realised in the early 90s if you weren't computer literate you wouldn't have a job in the next couple of years, and I was right. I had never typed in my life, but I taught myself how to type. Now I've been using technology for 25 years.' (Participant 15, Female, 70)

reported little confidence in their digital literacy skills. This perceived lack of knowledge was generally associated with the use of fewer devices, lower levels of self-efficacy, and unfamiliarity with technical terminology. Poor knowledge of jargon often resulted in frustration, misunderstandings, and user errors, 'When I was first learning how to use technology, it kept asking me to sign up for an account. To me, an account is something that you pay, but in this technological age, account doesn't always mean that.' (Participant 14, Female, 69). All participants were aware of general technologies, such as smartphones and computers, but were less aware of emerging technologies such as smartwatches and smart speakers. This lack of awareness hindered adoption of such devices: 'I'm not using [any other devices] because I'm not aware of anything else …' (Participant 12, Female, 87).

Perceived usefulness of technology played a significant role in adoption. Participants were more likely to use a device if it served a clear, meaningful purpose and complimented their lifestyle. For instance, Participant 22 (Female, 80) said: '… Once you learn the independence [technology] gives you, and how you can do anything anywhere, you just keep using it …' Participants were generally more reluctant to adopt devices if they were unaware of the advantages it may bring: 'I think that's why a lot of older people aren't very tech savvy, because they can't really see the purpose of using these devices … You've actually got to demonstrate how it can help them and the positive outcomes …' (Participant 9, Female, 73).

Memory, attention and decision processes

Age-related cognitive deficits were significant barriers to successful technology use. Several participants struggled due to poor memory and short attention span. Infrequent use of devices and functions appeared to exacerbate memory problems, with many participants saying they were taught how to use devices but forgot: 'I was given a Bluetooth speaker a few months ago and I was shown how to use it. I needed to use it the other day, but do you think I could remember?' (Participant 4, Female, 69).

Table 3. Barriers to technology adoption, with reference to the COM-B Model and TDF.

COM-B Component	Relevant TDF Domain	Barrier to technology adoption	Evidence from the interviews
Psychological Capability	Knowledge	Unaware of benefits	'I think a lot of older people aren't very tech savvy because they can't really see the purpose of using these devices … You've actually got to demonstrate how it can help them and the positive outcomes … ' (Participant 9, Female, 73)
		Unaware of devices	'I'm not using [any other devices] because I'm not aware of anything else … ' (Participant 12, Female, 87)
		Technological knowledge	'I remember when I bought my first smart phone, I walked out of the shop and thought 'I have no idea how to turn you on.' (Participant 18, Female 69)
		Technical terminology	'I'm very illiterate on any of those modern or advanced technologies … The word "app" I've only ever heard on the television. I don't know what it means … ' (Participant 3, Female, 86)
	Memory, Attention and Decision Processes	Cognitive deficits	'My attention span and the way I think are major barriers. My thinking patterns don't seem to align with the way computers work.' (Participant 32, Female, 74)
Physical Capability	Physical Skills	Sensory/functional limitations	'On the smartphone, the [size of the print] is a problem. I have got it as big as I can but if I don't have my glasses on, I struggle.' (Participant 16, Male, 67)
Social Opportunity	Social influence	Inadequate teaching	'I went to a class on using Microsoft Word. It was the worst experience of my life because the person running it had no idea how to teach.' (Participant 2, Male, 79)
		Lack of professionalism	'I don't want someone making me feel stupid or rolling their eyes, or raising their eyebrows, or having a tone with me … if they can't disguise [their] annoyance, then don't be in the job … I think it puts a lot of older people off … ' (Participant 23, Male, 75)
Physical Opportunity	Environmental Context and Resources	One-size-fits-all classes	'They were not bad teachers but they're trying to teach to an audience that starts from base grade through to a more developed grade. And it's difficult to organise these classes because of the discrepancy between the capabilities of the members.' (Participant 24, Female, 65)
		Poor marketing	'I just think basic classes that are easily accessible – not ones that you have to search around to find out that they're even available.' (Participant 9, Female, 73)
		Technology-related expenses	'I looked at some of the courses and they're all $300 or $400 for a course. I know I could afford it, but a lot of other people couldn't.' (Participant 2, Male 79)
		Lack of instruction manuals	'One of the frustrating things in later years has been the fact that so many manuals are not hardcopy … . you actually have to download copies of the manuals if you want them, and you have to find them online.' (Participant 33, Male 77)

(Continued)

Table 3. Continued.

COM-B Component	Relevant TDF Domain	Barrier to technology adoption	Evidence from the interviews
		Poor technological infrastructure in rural areas	'No mobile phones work there because of the black spot, and we have to pay extra if we want towers and that sort of stuff on the house.' (Participant 17, Female, 65)
		Devices not age-appropriate	'The print has to contrast with the background so I can read it, and it has to be big enough …' (Participant 13, Male, 76)
Reflective Motivation	Beliefs in capabilities	Poor self-efficacy	'It can be very nerve wracking for me because I'm not sure if I'm pushing the right buttons …' (Participant 7, Female, 72)
	Intention	Lack of motivation	'My lack of commitment and motivation to use technology is major. I could easily go and do a course down at the library, but have I? It's a motivation thing.' (Participant 32, Female, 74)
	Emotion	Security concerns	I'm always very concerned about my cyber security and my information … I don't like the fact that people can hack into your own personal details and your bank details. Fraud, identity fraud and just other governments being able to use things for bad purposes concerns me a lot.' (Participant 22, Female, 80)
		Fear of making user-errors	'I'm fairly confident until things start to go wrong. Then I get a little hesitant. If I want to do something, am I going to turn the world upside down?' (Participant 20, Male 79)

Physical capability

Physical skills

Some participants had physical limitations that hindered the use of digital devices: 'I've got arthritis in my fingers and I'm not as nimble across the keyboard as used to be …' (Participant 24, Female, 65). Decreased visual acuity presented additional barriers to successful technology use. Several participants mentioned difficulties using devices with small screens (e.g. smartphones) and reading small text: 'On the smartphone, the [size of the print] is a problem. I have got it as big as I can but some days if I don't have my glasses on, I struggle.' (Participant 16, Male, 67).

Social opportunity

Social influences

External support and social networks had strong influence on the adoption and learning process. Participants often sought technical support from digitally literate children and grandchildren: 'I'm lucky to have family members who are young and very knowledgeable in that area. So, if there is something I am not up to date with, they help me.' (Participant 18, Female, 69). However, when providing assistance, younger people tended to rush through the process or complete the job for them, rather than providing instruction and guidance. Participant 26 (Female, 82) summarised the frustrations of many: 'When I got help from the kids, because they already know everything about technology, they were rushing me through it and saying "do this, do this" and it was very hard.'

Senior support groups were commonly identified as facilitating technology adoption. The congenial atmosphere of group settings allows older adults share knowledge, discuss problems, and provide mutual assistance. Several participants favoured this type of learning environment over formal classes: 'This group that I went to once, was more like a help session … It was people talking amongst themselves and sorting things out. I found that helpful because you picked things up from other people in the group.' (Participant 20, Male, 79). Many participants were more comfortable seeking support from digitally literate peers than younger 'experts'.

All participants said the availability of professional support was imperative for successful technology use. Support technicians help older adults develop relevant technological skills and confidence. The mere availability of professional support gave them the confidence to explore new devices: 'The support people out there are very important … they give you a bit of confidence, because you know that you can do stuff.' (Participant 11, Female, 65). However, not all experiences were positive. Several participants were apprehensive to seek professional help, as they had been made to feel stupid and incompetent in the past ' … I think it puts a lot of people off [seeking help] because you're not stupid … it makes you want to stay away because you walk away feeling ashamed of yourself … ' (Participant 23, Male, 75). Other participants were frustrated by the generic advice they had received from support staff: 'I've been to the computer shop and they tell me "just read the manual" or "just press the button". I hate that sort of stuff.' (Participant 32, Female, 74).

Physical opportunity

Environmental contexts and resources

Most participants believed attending a class or lesson would improve their digital literacy: 'I'm self-taught. I believe that … if I went and did a course, I would be able to do a lot more with technology.' (Participant 4, Female, 69). Difficulty level, teaching pace, class size and student-to-teacher ratio were identified as important determinants of learning success. Participants believed the current learning opportunities available within the community could be improved. The 'one-size-fits-all' teaching approach used in most classes was deemed unsuitable for older adults, due to the discrepancies in technological knowledge and skill among older tech-users. Participant 24 (Female, 65) said: 'You'll go to a class and you'll find [everyone] is scattered across the spectrum in terms of their ability … Some people drop out after one week because it is beyond them, maybe only 25% of the students last the distance … ' Some participants also said that the teachers were unable to successfully deliver the curriculum: 'I went to a class on using Microsoft Word. It was the worst experience of my life because the person running it had no idea how to teach.' (Participant 2, Male, 79). These inadequate learning environments often exacerbated anxieties, further deterring adoption.

Lack of instruction manuals was identified as a barrier to successful use. Most participants said instruction manuals would be helpful when engaging with unfamiliar technologies but complained that there were few available to them. If available, they were often difficult to access and/or too technical for an aged audience: 'There are no manuals and if you don't know where to find the right information, you could be in for a long paper chase.' (Participant 13, Male, 76); 'There are handbooks that the government has put

out, but there is just so much complex information, so you don't read it … ' (Participant 12, Female, 87).

Some participants believed they would have more success with technology if devices were tailored to meet the physical and sensory needs of older users. Responses suggest that features such as larger text, larger interfaces, and assistive touch would increase device usability: 'The print has to contrast with the background so I can read it, and it has to be big enough … ' (Participant 13, Male, 76). Some participants mentioned they preferred to use tablets over smartphones, as the physical and graphical design features (e.g. larger screen, bigger text) are more age friendly.

There was consensus that the cost of technology may limit adoption, especially for pensioners with fixed incomes. For instance, Participant 25 (Female, 70) said: 'I think older people are a bit wary to outlay money to buy a computer of their own, knowing it is not going to be a cheap purchase.' Similar themes arose regarding the cost of learning opportunities. The high price of classes appeared to discourage attendance, while subsidisation of technology-related expenses appeared to encourage participation: 'The first computer lesson I did was government-funded. We did not have to pay … You could pay, but I couldn't afford to pay.' (Participant 5, Female, 81).

Rural characteristics of poor broadband connectivity, insufficient technological infrastructure and mobile black spots hindered technology use: ' … I came off a farm and my home couldn't get mobile coverage … ' (Participant 16, Male, 67); ' … No mobile phones work there because of the black spot and we have to pay extra if we want towers … on the house.' (Participant 17, Female, 65). The lack of public access technologies in community libraries was identified as a potential barrier to technology use for rural older adults: 'I know there are about 6 or 8 computers in the library, but they are rarely available, and it always seems difficult to get onto a computer.' (Participant 32, Female, 74).

Reflective motivation

Beliefs about capabilities

Perceived self-efficacy significantly impacted willingness to adopt new technologies: 'I've been using [technology] for a fair while now, so I feel reasonably comfortable.' (Participant 12, Female, 87). A small minority of participants reported little to no confidence in their ability to successfully operate modern technologies. A low sense of self-efficacy was generally accompanied with high levels of technology-related anxiety: 'It can be very nerve wracking for me because I'm not sure if I'm pushing the right buttons … ' (Participant 7, Female, 72). Lack of confidence in one's technical capabilities appeared to significantly deter the use of, and even the attempted use of, technology.

Intentions

Persistence was identified as an important predictor of technology adoption. Strong-willed participants tended to have higher rates of technology adoption and success, despite initial challenges: 'I find the more I play around with it, the more I learn … If you just persist you will learn it, really isn't that hard.' (Participant 26, Female, 82). However, perceptions of complexity and difficulty appeared to negatively impact willingness to persist: 'I get very annoyed if it is too complicated and it shouldn't be … So, if it

doesn't solve itself pretty soon I will put it down and walk away…' (Participant 24, Female, 65).

Optimism

Participants' attitudes towards technology were divided. Most participants held positive views, such as: '[Technology] has enhanced our lives in a million ways – socially, economically, industrially and scientifically. It's a great thing and there's bigger and better things to come.' (Participant 24, Female, 65). Positive attitudes appeared to predict greater perceptions of utility and higher rates of adoption. A few participants held less favourable views, fearing the use of technology is negatively impacting our social skills and face-to-face interactions. Nevertheless, most participants believed the positives of technology outweigh the negatives: 'Overall, I think technology enhances everybody's life, but there is certainly a dark side to it…' (Participant 22, Female, 80).

Automatic motivation

Emotions

Fear of digital exclusion motivated technology adoption for many participants: 'In the 1990s when computers were coming in, I thought 'Gee, If I don't join this I'm going to be behind the eight ball'. So, I rode that wave of computers and programs and Microsoft and all that…' (Participant 18, Female, 69)

Many participants feared making user errors and breaking the device. Participant 20 (Male, 79) encapsulated the concerns of many when she said: 'If I want to change something, am I going to turn the world upside down?…' Security concerns were also omnipresent within the sample. Many participants were reluctant to share personal details online due to fear of falling victim to cybercrime. These concerns have discouraged less confident participants from adopting unfamiliar technologies: 'I was too afraid to press the wrong button or do something wrong and get scammed. The scams terrify me. So, until I had enough knowledge … I was too scared to use it.' (Participant 26, Female, 82).

Social connectedness

The interviews revealed several factors influencing social connectedness, presented in Table 4. Findings challenge the notion that social disconnection is prevalent in rural areas, with most participants feeling socially connected. Furthermore, results detailed in subsections below also support the social benefits of technology but highlight the need for adequate training and support for older adults.

Technology and social connectedness

Technology consistently facilitated social activity for participants, predominately through smartphone use for communication, coordination of in-person interactions and reconnecting with old friends: 'I'm always in touch with friends and family … through emails, messages [and] phone calls…' (Participant 6, Female, 77). Overall, technology was deemed a valuable tool for overcoming traditional barriers like

Table 4. What future interventions should target to promote social connectedness among rural older adults, with reference to the COM-B model and TDF domains.

COM-B component	TDF	What is required to promote social connectedness	Quotes from participants
Psychological capability	Knowledge	Awareness of the benefits of being social	'I am involved in a number of groups in town, at least four different organisations. I am invested in all of them, and I love the company.' (Participant 24, Female, 65)
		Awareness of local social opportunities	'I think these groups need to be more accessible and more visible. Perhaps the council could market them better so people know about them.' (Participant 32, Female, 74)
Physical capability	Skills	Physical capability	'If I allowed my health to get worse, it would most likely mean that I would be permanently isolated.' (Participant 18, Female 69)
			'Something that really affects my social activity is the fact that I've been partially deaf all my life.' (Participant 32, Female 74).
Social opportunity	Social influences	Support in new groups	'You'd almost want someone that you knew who was participating in one of those activities and invited you along. I think a lot of the older people don't do a lot of these activities because they're on their own, and they don't know how to approach anyone, so they don't bother. (Participant 1, Male, 65)
		Peer support programme	'For some people, going to a group alone would be too much. Maybe they could start off with a buddy system and that might help with work up to leaving the house and getting involved. It will help boost their confidence and hopefully then, their motivation will be triggered.' (Participant 22, Female 80)
Physical opportunity	Environmental Contexts and Resources	Public transport in rural areas	'There should be more transport services strictly for the elderly' (Participants 14, Female, 69)
		Non-stereotypical social	'There is a stereotype that all old people will go to the elderly sits or to the RSL club[a], and they are all things that I would loathe to be honest. So, I think you've got to have a wide range of things available to people … it's not one-size-fits-all.' (Participant 15, Female, 70)
		Accommodate for varying needs	'I've been an aged care worker so I can appreciate how visual and hearing issues can affect people's ability to be social … I think quite a lot of people think that they're the only one in that situation, and perhaps are a bit hesitant to enquire further … . The people who create the social programs need to remember that visually and hearing-impaired need special consideration.' (Participant 12, Female, 87)
		Community visitors' scheme	'Shires have community mangers … hospitals have primary care staff and leaders in those areas … I think between them, they should be able to work out how to consult or how to visit lonely older adults. Also, there are some amazing volunteers in town, and there would be in every town. It's just a matter of coordinating all the resources.' (Participant 32, Female, 74)

(Continued)

Table 4. Continued.

COM-B component	TDF	What is required to promote social connectedness	Quotes from participants
		Technology training for older adults	'If [seniors] are up to speed with technology, then it can certainly help them stay [socially] connected. There are a lot of lonely people out there at my age or older, whose husband or wife have died. They become almost reclusive … and very disconnected.' (Participant 10, Male, 65)
Reflective motivation	Beliefs about Capabilities	Self-discipline	'There's nothing that actually prevents me from doing things, other than being lazy – can I really be bothered making the effort?' (Participant 4, Female, 69)
		Prioritise social interaction	'I just haven't got time for it. I enjoy it when it happens, occasionally, but I would not want to do it every day.' (Participant 1, Male 65)
Automatic Motivation	Emotion	Social anxiety	'I struggle going into a large group of people I don't know. Unless the environment is very warm and welcoming, that would help calm my anxiety to some extent.' (Participant 22, Female, 80)

RSL stands for the returned and services league of Australia which is an independent support organisation for people who have served or are serving in the Australian Defence Force.

geographic distance: 'Lots of my friends live significant distances from us and I think I would be living a very lonely life if it wasn't for phone and email.' (Participant 18, Female, 69). Conversely, limited technology use intensified feelings of social isolation, especially for those in remote locations: 'I experienced a few years when we didn't have a phone or internet because we lived on a soldier settlement block. There was no phone line for 4 years and that was a period that I was socially disconnected.' (Participant 12, Female, 87).

Social media emerged as a facilitator of connectedness: 'Facebook has helped me stay connected with all my cousins. We don't see each other often but I can catch up with them over Facebook.' (Participant 7, Female, 72). Facebook was viewed more as a communication tool than a social networking platform: 'The good thing about Facebook is, you don't have to post on it to enjoy it. If I see one of my kids online, then I can reach out via Messenger.' (Participant 25, Female, 70). While participants were aware of other social networking sites, such as Instagram and Twitter, many lacked interest in them. A few expressed opposition to social media: 'I am not interested in increasing my sociality through social networking. I'd rather have my teeth pulled out.' (Participant 1, Male, 65). Despite these reservations, all participants acknowledged that social media creates opportunities for connection.

The COVID-19 pandemic highlighted the social benefits of using technology for many participants, with increased usage of communication functions like phone calls, instant messages, and video chats. Participant 18 stated: 'I find I'm using technology even more than usual, as a way of communicating and keeping friendships alive.' Interestingly, digital interactions during COVID-19 enhanced perceptions of social connectedness for some: 'We are getting so many phone calls and SMS's etc … I am more socially connected now, during COVID, than I have been in other points in my life.' (Participant 32, Female, 74).

On the other hand, concerns were raised about access, ability and motivation for technology use among older adults: 'Some people wouldn't have the technological ability, or even the interest, to become good at Facebook … ' (Participant 10, Male 65). Poor digital literacy or a general reluctance to using technology were perceived as potential barriers, alienating these individuals further.

Discussion

Technology emerges as a promising remedy for social disconnection in later life, particularly evident during the COVID-19 pandemic where it bridged distance for rural older adults. This study assessed technology adoption in rural Australian older adults through the lens of individual capability, opportunities, and motivation, employing the Behaviour Change Wheel (BCW) and Theoretical Domains Framework (TDF). Consistent with existing literature (e.g. Siette et al., 2021), technology facilitated social connectedness, allowing rural participants to overcome geographical barriers to engage with others. Conversely, reduced technology appeared to increase feelings of isolation and loneliness (as per Talmage et al., 2021), emphasising the role of technology in combating social disconnection. Key barriers and facilitators of technology adoption include knowledge, perceptions, self-efficacy, and social support.

Technology adoption

Contrary to the stereotype of older adults resisting modern technologies (Czaja & Lee, 2007), participants in this study were digitally active, demonstrating awareness of general technology, including smartphones and computers although not all participants felt confident using technology. Chen and Schulz (2016) emphasise the significance of age-friendly technical information in technology adoption and digital competency among older adults. The perceived lack of knowledge correlated with using fewer devices, lower self-efficacy, and unfamiliarity with technical terms. Scarce and complex instruction manuals further compounded these challenges, especially for digital newcomers (Lee & Coughlin, 2014). Older adults, particularly in rural areas with fewer educational resources than metropolitan areas face disadvantages when adopting unfamiliar technologies (Park, 2017). The findings advocate for technology training for older adults, with a preference for person-centred peer-to-peer training, enhancing engagement with technology (Burmeister et al., 2016).

The perceived value of technology significantly influences its uptake. Older adults are more inclined to adopt technologies deemed useful, beneficial, and user-friendly. This suggests that for adoption to occur, older adults must believe that the personal benefits outweigh the relative effort required to learn and operate a new device. Addressing perceived need is crucial, for example, despite acknowledging the utility of Facebook, some older adults showed disinterest, echoing findings by Peek et al. (2014). Personalised messaging emphasising the utility of technology for establishing and maintaining social connections could enhance adoption and perceived social connectedness among older adults.

Older adults often have poor self-efficacy in adopting technology, perceiving themselves as unprepared and lacking confidence (Anderson & Perrin, 2017). In this study,

those with low technological self-efficacy were reluctant to adopt new technologies, suggesting that improving perceptions of self-efficacy may facilitate adoption. Age differentials also played a role, with the youngest-old group (65-74 years) expressing greater confidence in their digital literacy skills due to previous occupational exposure, while older participants (75-85 years) displayed lower technical capabilities having not been in the workforce during the digital boom (Lee et al., 2018). Consideration of age differences is crucial in intervention, the oldest-old may require greater assistance.

Anxieties regarding technology adoption observed in this sample echo Vaportzis et al.'s (2017) findings. Safety and privacy concerns about the internet negatively impacted perceptions of technology and device use, especially for tasks involving personal information like online banking. These findings are consistent with Niehaves and Plattfaut (2017), who reported that technology-related anxieties increase non-adoption and resistance to change among older adults. These concerns highlight the importance of comprehensive training and skills acquisition to alleviate anxieties. The ability to use technology confidently would grant rural older adults with the tools and opportunities to overcome the various social and spatial barriers that accompany rural living.

Social support emerged as a pivotal factor in technology adoption, given older adults' lower technical familiarity. Assistance during installation, learning and operation was crucial. The sample acknowledged the influential role of social support in fostering technology awareness and validating the utility of unfamiliar devices. Consistent with Wang et al. (2019), participants with digitally literate family members or peers were more likely to explore new devices than participants with limited social support. The study underscores not just the importance of social support but also its delivery. Reluctance to seek help stemmed from fears of rudeness or impatience, emphasising the need for opportunities enabling older adults to learn and gain the necessary skills to become technologically self-reliant.

Effective technology adoption in later life critically relies on professional assistance. Our study indicates that inadequate professional support may not only exacerbate fears but also result in the rejection of technology. Negative experiences, such as breaches in expected etiquette and respect, often intensify feelings of incompetency, fostering reluctance among many older adults to seek professional help in the future. These findings emphasise that technology adoption is, to a significant extent, a social process shaped by social ties and support. Patient and respectful social support during the adoption process is paramount, particularly for older adults with poor self-efficacy and anxiety.

Age-related health issues such as cognitive decline, sensory impairments, and functional limitations contribute to technology challenges. Both our study and Vaportzis et al. (2017) found that older adults with compromised health encountered less success with digital technologies compared to their physically and mentally fit counterparts. Poor device design often exacerbated these health challenges, showing limited regard for the preferences and real-world constraints of older consumers (Steele et al., 2009). Suggestions from participants highlight the need for larger interfaces, enhanced volume control and larger text to enhance usability. Similarly, Mitzner et al. (2010) recommended that digital interfaces adopt simplicity to avoid overwhelming elderly users with unnecessary features. Thus, to minimise stigmatisation and enhance usability, careful consideration of physical and graphical design features is imperative during development.

Social connectedness

Contrary to the notion that old age diminishes social connectedness (Courtin & Knapp, 2017), most participants in this study felt socially connected. However, variation existed in social network size, frequency of social interaction and community participation. Aligning with Fiorillo and Sabatini (2011), social connectedness among older adults seems to be a subjective experience, influenced by individual perceptions of support and belonging.

Geographic isolation, low population density and limited public transport were barriers to social interaction. However, most participants were not directly affected by these barriers. While poor health (Fakoya et al., 2020) and functional limitations (Seyfzadeh et al., 2019) may impede social interaction in rural environments (e.g. due to limited public transport and distance between neighbours and services), the majority of participants were mobile and driving, enabling them to maintain social connection. Secondly, research indicates that many rural Australian communities lack essential social opportunities and community resources (Henning-Smith et al., 2018). Those in this study spoke of abundant social opportunities for older adults in regional Victoria. Thus, social wellbeing appears to be influenced by the unique interplay between the individual and the rural context.

Many older adults in our study believed digital interaction increased their social connectedness. Participants reported frequent use of mobile phones and social networking. Our study complements previous literature (e.g. Neves et al., 2017) by illustrating the utility of technology in overcoming rural barriers to social interaction such as remoteness. The current evidence suggests that technology may not only support but enhance the social wellbeing of older adults living in rural locations. However, the identified barriers to technology adoption emphasise the urgent need for intervention, adequate support, and age-friendly resources.

Implications for intervention

Interventions geared towards technology must prioritise optimising the learning experience and support for older users in rural areas. For effective training, the focus should be on fostering digital literacy skills, ensuring sustainability irrespective of the availability of instruction manuals. Training programmes need to consider difficulty levels and pacing. Classes should be tailored to the right level to prevent heightening anxieties and discouraging adoption. Educators should acknowledge expressions of confusion and frustration during the learning process while emphasising the positive impact of practice on skill advancement. Fostering a sense of accomplishment and building confidence among older adults are critical outcomes of technology training. Prioritising the development of relevant technology skills, particularly as communication tools, becomes essential in this context. Proficiency in using technology serves as a protective measure for at risk older adults, preventing social disconnection by facilitating interactions with others, irrespective of personal barriers such as poor health or sensory impairments.

Strengths and limitations

To our knowledge, this study is the first to explore technology use and social connection among rural older Australians. Strengths include application of the COM-B to explore

factors influencing technology adoption, coupled with insights gained from using the Theoretical Domains Framework (TDF). However, given most participants were female, transferability to men living in rural Australia is limited. Further, recruitment through social media, necessitated by COVID-19 constraints, could have excluded digitally inactive people. Australia is multicultural and cultural background is likely to influence individual's perception of and expectations around social connection but this was not explored in this study.

Conclusion

The findings of this study suggest that older Australian adults living rurally will adopt modern technologies if they believe they are physically and mentally capable, adequately supported, and perceive benefits to outweigh costs. This study provided important perspectives from rural consumers. Understanding the primary enablers and barriers of technology adoption and social connection of older adults in the context of rural/regional areas will inform strategies for supporting future technology adoption in rural Australia to promote social connectedness in older adults.

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No potential conflict of interest was reported by the author(s).

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Institutional Review Board statement

☑ The study was conducted in accordance with the Declaration of Helsinki and was approved by an Institutional Review Board/Ethics Committee.
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