Old and afraid of new communication technologies? Reconceptualising and contesting the 'age-based digital divide'

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Abstract
Despite sociological attempts to critically address an age-based digital divide, older adults (65+) continue to be portrayed in the academic literature and public discourse as a homogeneous group characterised by technophobia, digital illiteracy, and technology non-use. Additionally, the role of socioeconomic factors and personal contexts in later life are often overlooked in studies on technology adoption and use. For example, older adults who are identified as least likely to use technology (frail, care-dependent, low socioeconomic/educational backgrounds) are typically described as a uniform cluster. Yet, research on digital technology use with this group remains scant – so what can we learn from studying technology adoption among them? This article discusses long-term deployment of new communication technologies with such a group of older adults, shedding light on the dynamics of technology adoption and contexts of use/non-use. It is based on a case study approach and a cross-cultural perspective, using Canadian and Australian mixed-methods research from two projects that included interviews, psychometric scales, and field observations. We present cases from these projects and contest the simplistic notion of an age-based digital divide, by drawing on Strong Structuration Theory to explore the interconnection of agency, structure, and context in the sociotechnical process of technology adoption and use/non-use among older adults.

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Digital technologies and older adults: a recursive approach

While technology use among older adults (aged 65+) in industrialised countries has significantly increased over the last decade (Eurostat, 2016; Malta, 2012; Smith, 2014), they are less likely than other age groups to adopt digital communication technologies and more likely to discontinue use with age (Berkowsky et al., 2015). Further, the general literature tends to portray older adults as non-users, technology-resistant, and a homogenous group (Neves et al., 2017; Vines et al., 2015). This characterisation, along with ageing stereotypes, masks multifaceted social and agentic processes that involve literacy, status, identity, and practices. So rather than examining age as an isolated variable, we need to uncover the complex web of agentic and structural factors that influence technology adoption and use in later life. As digital exclusion is now closely aligned with social exclusion (Robinson et al., 2015), understanding adoption and use has become a pressing issue – particularly considering the internet can help enhance opportunities for social connectedness and public participation, offers services that support daily living and independence in later life, and has become a central access point for public services including aged care (Peek et al., 2016; Tsai et al., 2015).

The main determinants of adoption of new communication technologies among older adults relate to attitudinal, functional, and physical factors (Barnard et al., 2013; Neves et al., 2013; Tsai et al., 2015). The attitudinal factors include interest, perceived usefulness, and confidence with technology (including 'computer anxiety') as well as age-based perceptions, such as 'being too old for technology' (Neves and Amaro, 2012; Vroman et al., 2015). Functional factors encompass equipment, access, education, digital skills, but also usability issues with technology design and size (Neves et al., 2015; Tsai et al., 2015). Finally, physical factors include health limitations, sometimes associated with age-related impairments such as reduced dexterity, visual acuity, etc. (Czaja and Lee, 2007). However, we miss a comprehensive understanding of contexts and experiences of adoption and use among those older adults who seem to be, according to the aforementioned literature, least likely to adopt digital communication technologies, namely: those who are frail, institutionalised or community-dwelling but dependent on home care assistance, with low-literacy, and/or low-income. The research presented in this article helps bridge this gap by exploring sociotechnical dimensions of technology adoption and use in later life among such a group of older adults, bringing together research conducted in Canada and Australia.

This article draws on research that investigated the adoption and long-term use of new digital communication tools among a group of institutionalised older adults in Canada (Study One) and a group of community-dwelling older Australian adults dependent on home care assistance (Study Two). Studies on digital technology among these groups – particularly long-term deployments of technology – are scarce due to access, recruitment, and ethical issues with frail older adults (Neves et al., 2017; Waycott et al., 2015). Each study used tablet-based communication applications (apps) designed to address
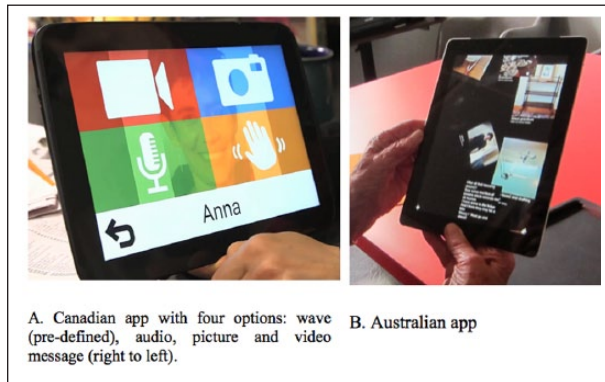
A. Canadian app with four options: wave (pre-defined), audio, picture and video message (right to left).

B. Australian app

Figure 1. The Canadian and the Australian tablet-based applications.

social isolation and loneliness in later life, although each tool had different functions. The tool used in the Canadian study was an accessible asynchronous app co-designed with older adults to facilitate digital communication with family and friends. It allowed users to send/receive photos, audio, video, and text messages. The interface had large touch icons (no typing, only swiping/tapping) to accommodate users with visual and motor impairments, as informed by field studies (see Figure 1; see also Baecker et al., 2014; Neves et al., 2015, 2017). The Australian tool was an iPad photo-sharing app designed in response to older adults' communication needs. It enabled older adults to create and share captioned photographs and messages, using the iPad's built-in camera and onscreen keyboard. Participants shared the images they created within a closed social network; the images floated down the screen on an interactive display that all participants could see on their iPads. The app had a simple interface (see Figure 1; see also Waycott et al., 2013). Both the Canadian and Australian studies aimed to analyse acceptability (adoption and use) of the technology and its feasibility to foster social connectedness and help alleviate loneliness and social isolation. To accomplish these aims, studies were based on a mixed-methods design, including semi-structured interviews, focus groups, psychometric scales, and field observations over periods of 2 to 12 months.

To frame this research, we followed a *recursive approach* to technology adoption based on the interrelation between the user's context and technology (Greenhalgh and Stones, 2010). This theoretical and analytical approach looks at technology, social context, and human agency as *recursively* related. That is, they affect each other: 'In recursive traditions, researchers do not study "technologies" and "contexts" separately but technologies-in-use' (Greenhalgh and Stones, 2010, p. 1286). Technology adoption and use occur in specific circumstances; understanding use/non-use therefore requires a holistic approach that considers the relationship between personal, social, and technological issues. This approach involves exploring different contexts (personal, social, technological) and how they interplay.

Existing models of technology adoption, such as the Technology Acceptance Model (TAM) and variants, often overlook the interconnection of agentic (actions, choices) and structural (social class, age-related social norms, gender, etc.) elements (Neves et al., 2015;

Peek et al., 2016). They also neglect the lived experience of technology 'appropriation' – the embodied interaction between technology and personal practices (Dourish, 2004). Additionally, technology-adoption research tends to dichotomise users/non-users; and although the nuanced study of use/non-use among other age groups is emerging, this approach to technology in later life remains scant (Wyatt, 2014). We believe the recursive approach can help overcome limitations of standard adoption models and use/non-use dichotomies.

Within this recursive approach, we draw on Strong Structuration Theory (SST) as developed by Rob Stones (2005) to refine Anthony Giddens' Structuration Theory (1984). Giddens links social structure and human agency by conceptualising social structures as internalisations of how people make sense of the world, which are then externalised by their actions. Critics argue, however, that structure and agency must be separated, as social structures are external to individuals – SST responds by considering internal and external aspects of social structures (Stones, 2005). Adapted to technology (Greenhalgh and Stones, 2010), SST postulates the relationship between agency, structure, and technology by focusing on:

(1) external structures (conditions of action)
(2) internal structures (one's knowledge and capabilities)
(3) active agency (individual action)
(4) outcomes (intended/unintended impacts).

By combining these elements, we are able to analyse the interconnection of agentic and structural elements as well as different personal, social, and technological contexts in technology adoption and use – often missing in standard adoption models. As such, SST sheds light on the sociotechnical processes embedded in technology development, implementation, and use. Though expanding on other recursive approaches such as Actor-Network Theory (ANT), which posits that human and non-human agents must be considered symmetrically to avoid dualist accounts of technology and society (Latour, 2005), SST does not eliminate different levels of structure and agency as does ANT. SST acknowledges that having technologies and people as part of the network as advanced by ANT is critical for technology studies, but does not follow ANT's principle of symmetry between them: humans and technologies act differently and must be analysed accordingly (Greenhalgh and Stones, 2010).

Methods

Data and design

We draw on mixed-methods studies conducted in Canada and Australia to provide four narratives of technology adoption and use by frail institutionalised and community-dwelling older adults, using a case study approach. This approach allows for multi-layered and rich exploration of complex phenomena in real-life settings (Yin, 2013). The four case studies have been selected from the larger studies because they match the categorisation of older adults least likely to use digital technology. Nevertheless, the cases will be contextualised within the overall findings.

Study one

The Canadian app was deployed with 16 older adults (aged 74–95) living in a long-term care facility (2014, n = 4) and a multi-care retirement community (2015, n = 12) in Toronto. The study's timeframe was restricted to two months in the first site and three months in the second site, as negotiated with each institution and ethics committee due to ethical concerns with frail institutionalised older adults. The study had a pre-, mid-, and post-deployment stage. Pre-deployment included an individual training session to demonstrate the tablet and the app, administration of the Abbreviated Duke Social Support Index and Short UCLA Loneliness Scale, and a baseline interview to collect social network composition, social interaction levels, socio-demographics, and experience/perceptions about digital technology. Participants were then given a tablet with the app to use as they saw fit. Four to six weeks after the initial training, in mid-deployment, the scales were re-administered and usability and accessibility tests conducted (which included tasks to perform with the app and rating questions). During post-deployment, the scales were repeated and semi-structured interviews conducted to gauge app experience and use/non-use. Throughout the study, participants were visited weekly to collect field observations. Interviews, field notes, and tests were analysed with qualitative profiling and thematic analysis, which allowed crafting and contextualising individual profiles and identification of patterns and themes within and across-participants (Baecker et al., 2014; Neves et al., 2015, 2017, 2018).

Study two

The Australian photo-sharing app was deployed with older adults in three field studies (varying in length from 3 to 12 months, 2011–14). In total, 16 older adults (aged 67–93) took part. Participants did not know each other prior to the project, getting to know each other by attending monthly face-to-face gatherings and sharing photographs/messages through the app. Participants lived independently (some with family) but were assisted by an aged-care organisation. They were frail or had complex needs that required support to enable them to continue living at home. Participants' use of the app was evaluated through interviews, focus groups, observations, and content analysis (Waycott et al., 2012, 2013, 2014). Interview data and content shared via the app were analysed using thematic analysis. In addition, narratives of use/non-use were constructed from observation field notes and interviews (Waycott et al., 2016). As in study one, this in-depth approach allowed for a holistic investigation of technologies-in-use aligning with SST.

Participants

There were 32 participants when combining both studies. This article focuses on the in-depth experiences of four of these participants (two Canadian, two Australian) whose circumstances align with our aims of giving voice to a group who seem least likely to adopt new technology. They were frail (as defined by care staff according to biomedical/psychosocial factors such as physical weakness and low resilience), dependent on aged-care support, and from low socioeconomic/educational backgrounds. Other participants

Table 1. Socio-demographics of participants.

Participant*	Age	Gender	Marital status	Previous occupation	Health situation	Living setting
Evelyn	93	F	Widowed	Farmer	Visual and motor limitations	Long-term care facility***
Pam	86	F	Widowed	Homemaker	Motor and visual limitations	Multi-care retirement home***
Gary	67	M	Divorced	Farmer	Bed-bound amputee	Lives with extended family**
Jill	82	F	Widowed	Maternal nurse	Motor and speech limitations	Lives alone**

*All names are pseudonyms.
**Dependent on aged-care support to remain living at home.
***Institutionalised.

had higher education levels, higher income, or lower levels of frailty, and could be considered more likely to adopt the new technology. Table 1 provides sociodemographic information of the four cases (mean age = 82, *SD* = 10.9).

Results

Here we describe each participant's life circumstances, use/non-use of the apps, as well as broader use/non-use of the tablets and their perceived benefits and challenges. The first two cases (Evelyn and Pam) relate to the Canadian study, the other two to the Australian study (Gary and Jill). Findings are also contextualised within the larger studies.

Evelyn was a Chinese-Canadian woman living in a long-term care facility. Aged 93, she was one of the oldest participants in the Canadian project. She was illiterate and had never used digital technology before. Evelyn was a widow and most of her family lived in China, although her daughter was a frequent visitor. Notwithstanding her frailty, she tried to 'move around'. Despite several social activities at the facility, Evelyn's interaction with other residents was low and she saw them as 'strangers'.

Her daughter guided her use of the app and encouraged communication with relatives. This support led her to use the app on average three days per week, becoming a frequent user during the two-month deployment. Yet, Evelyn was a passive and dependent user – she preferred to receive rather than send messages and 'just to look at pictures', constantly requiring her daughter's assistance because she 'forgets' and perceived herself as 'old and … dumb'. She used the app as a 'photo-album', to see her grandchildren 'growing up in China' via the weekly picture/video messages she received from them. Contrary to most users (13 of the 16 participants), who preferred receiving text and sending out audio messages, Evelyn preferred to receive pictures due to her illiteracy.

Evelyn only used the app in her room to avoid being seen by other residents as they could 'take it away' or think she was being 'favoured'. In her room, shared with three residents, she only used the app when roommates were resting or not present. Evelyn

perceived the outcomes of the technology as positive: keeping in touch with family in China; having more to 'talk about' with her daughter; and a sense of 'personal discovery' as she learnt something new that she thought impossible. Conversely, it also rekindled negative perceptions about her residential setting, age, and health. At the study's conclusion, Evelyn just wanted to use the app; she did not want to learn to use the tablet for internet browsing and never tried other functions. Evelyn was part of a group (n=5) that did not want to explore further options. She felt her digital accomplishments and what the app provided were enough.

Pam was a Canadian woman living in a multi-care retirement home (aged 86). She had vision and motor impairments and could only use one hand. A widow and former homemaker, Pam had a daughter and son living in different provinces. She saw her son once a year and rang him 'every three weeks', but only 'occasionally' phoned her daughter as she 'was always busy'. Pam had lost most of her close friends '[e]ight friends in one year …', but made a friend among the residents. She had never used digital technology before – although her husband had, which she explained as men being more 'mechanical'. Because of health issues, Pam could only write/call people in the morning, limiting her ability to talk to her son who lived 'in another time zone'. She hoped to use the app to overcome these communication restrictions. She started by learning 'slowly': 'Mentally I was afraid of trying something so very new…. But I do it on my own when I'm alone and that's very important for me, to take my time and get onto it.' In the first month of the study, her daily use of the app was mostly to practise. Pam then integrated it into her routine and used it weekly to communicate with her son, daughter-in-law, and friends.

Like a number of other participants, Pam preferred the audio and picture messages. Using the app allowed her to feel closer to her son and daughter-in-law, as its asynchronicity meant she could connect when it suited her. Her son was sick and she was trying to balance her mothering role while coping with her own health limitations. The technology helped: 'I really feel much safer knowing that I can be in touch with him' regardless of time. The app also allowed her to keep in contact with old friends and reach out to her resident friend: 'I send her a message to see if she is here or if I want to ask something quickly.'

Despite earlier technology-related anxiety, Pam became a frequent and active user (able to send and receive messages) as a result of her need to communicate with family. The app enhanced her sense of competence, motivating her to want to learn internet browsing. During the project she would only use the app, but after the final interview she asked for a 'few pointers to use Google'. Although, throughout the study, only 2 of the 16 participants used the tablet (and not just the app), most participants – including Pam – saw their experience as a gateway to other features/technologies. Yet, Pam still felt some app's functions were difficult; for example, she struggled to take videos because of the iPad's weight and her dexterity issues. This made Pam more aware of her impairments though she was 'getting used to it'. Of the 16 Canadian participants, 8 were able to fully use the app's functions.

The app increased perceived levels of social connectedness for most participants (n=14), even among those who were passive users, such as Evelyn, or those who only used some functions of the app, such as Pam.

Gary was the youngest participant in the Australian project (aged 67), but his complex health circumstances meant he was bed-bound and highly dependent on aged-care assistance. In his younger years Gary had been a farm labourer but he became a quadriplegic in his 40s due to illness and then lost both legs following an accident. Although he lived with three generations of his family (daughter, grandchildren, and a great-grandson), he had limited opportunities to socialise either inside or outside his home. He could not access the family's computer in the living room or join his family to watch television there. His family interactions mostly revolved around personal care.

Gary lived in a poor neighbourhood and had low socioeconomic status. He was protective of the iPad; he feared dropping it (he 'gets the shakes') and did not take it when in respite care because belongings had previously been stolen there. He initially expressed enthusiasm about using the photo-sharing app. However, during the project he experienced a long period of illness during which he stopped sharing content. He explained: 'I was in a mess, couldn't concentrate. It was a miracle I got to all the meetings – enjoyed them immensely.' Gary shared a small number of photographs/messages with other participants, but was limited in what he could photograph because he generally stayed in one room. Poor literacy also made it difficult to write messages: 'I was near illiterate when I left school'; so he relied on his daughter to help him create messages. Gary enjoyed seeing other participants' contributions on the shared display, but felt guilty about not responding.

Although Gary's app use was limited, he found using the iPad more broadly opened up a new world. Grandchildren helped him sign up to Facebook, allowing him to follow the activities of his children and grandchildren. He used the iPad to track dog races, watch fishing programs, and play games. The iPad had a positive impact on his feelings of isolation: it 'made a difference to me – even though I've got immediate family, they're not always here'. Once he gained confidence in its use, Gary said he would be 'lost' without the iPad.

Jill, aged 82, lived alone in a rural Australian setting. She had limited mobility, was dependent on home care services and felt socially isolated, although she had relatives living nearby. Jill had been a midwife in her younger years and raised her children on a farm, where she still lived. She was now largely housebound due to health problems, including painful osteoarthritis, which limited opportunities to engage in activities she enjoyed. She also had a significant tremor affecting her motor skills, but was able to use the iPad touch-screen.

Like Gary, Jill only occasionally shared photos, but used the iPad extensively, primarily to play card games, which she enjoyed ('just love it!'), although she also felt guilty about not being more 'productive' doing housework and 'making jam'. Jill indicated her 'addiction' to games on the iPad prevented her from making more use of the app; although she was open to connecting with others: 'I think it would be nice to have someone [to play against] – see who was the fastest.' Jill used the internet to research things she was interested in, such as history about her rural town. She also made use of the iPad to photograph and digitise mementos, including an obituary of her late husband's grandfather that showed the family's historical connection to the area.

Jill said she used the iPad 'at least every day', beginning with checking if there was anything new on the app, and then playing Solitaire. She used the iPad sitting at the

kitchen table, but sometimes carried it outside to take photographs; although she found it awkward to carry around due to her walking frame ('Though it's alright when I get there because I can sit in the walker').

Jill and Gary's experiences suggest the iPad was more valuable than the photo-sharing app. But for many other participants in the Australian study, the app provided a valuable means of creative self-expression and facilitated a sense of social connection (Waycott et al., 2013). For Jill and Gary, the iPad itself enabled them to feel connected to the world. Other participants had similar experiences (Baker et al., 2016), but ultimately each participant individualised their use of the app and iPad.

Discussion

The four cases provide insight into the complexity of technology adoption and use among older adults who are more likely to be digitally excluded (Barnard et al., 2013; Czaja and Lee, 2007; Neves et al., 2015, 2017; Tsai et al., 2015; Vroman et al., 2015). The interplay of personal, social, and technological contexts led to different sociotechnical contexts of use (Waycott et al., 2016). Personal contexts related to individual circumstances, including literacy, health, attitudes, preferences, and aspirations. Evelyn perceived herself to be 'old' and 'dumb.' Although she had not been diagnosed with cognitive impairments, she believed age made learning difficult, fostering dependency on her daughter to use the app. This learning anxiety echoes experiences of disengaged participants in the Australian study (Waycott et al., 2016). In contrast Gary, who was also illiterate, came to use the iPad extensively, motivated by his sense of social isolation as a bed-bound amputee. Social contexts encompassed interactions with social ties (family, friends), such as the engagement of Evelyn's family in the project, which was critical to her app adoption and use, and Pam's motivation to use the app to keep in contact with her son. Living settings also played a role, as either a facilitator or hindrance: Jill and Gary's isolation was a factor for technology adoption, whereas Evelyn's care home (its social environment and her distrust of fellow residents) hampered her use. Technological contexts included digital literacy/illiteracy and previous experiences with technology. Inexperience did not always equate with technology resistance – Pam's anxiety towards technology and her belief that men were more 'mechanical' did not preclude her from becoming a frequent user. Similarly, Gary and Jill were both previous non-users who came to use the iPad extensively.

By drawing on SST to study technology adoption and use, we uncovered different contexts (personal, social, technological) and examined their interplay through SST's four elements – external structures, internal structures, agency, and outcomes. First, *external structures* were linked to participants' social context (social interaction with ties and their influence on norms and expectations; living arrangements). Second, *internal structures* comprised participants' personal but also technological contexts (attitudes, digital literacy, physical conditions). Third, *agency* was linked to different forms of adoption and use that drew on internal and external structures. We found different types of use regarding frequency and functions among these four cases and our overall participants: some were active users, others more passive; some were independent, others needed assistance; some only used the app, others also used the tablet or mostly used the

tablet instead of the app. 'Use' also meant sometimes just receiving messages or practising (e.g. recording video messages) and not necessarily actively interacting with people. As use encompasses different understandings, the studies show a continuum between use/non-use rather than a strict differentiation, which underlines the need to conceptualise these concepts more flexibly (Wyatt, 2014). Fourth, *outcomes* in this case related to specific use and implications:

(1) intended positive perceived impact on social connectedness (meaningful social interaction and reduction of feelings of loneliness/isolation);
(2) unintended positive impact on perceived self-efficacy/self-competence; and
(3) unintended negative impact on self-perception (impairments, sense of guilt) and awareness of social contexts (limitations of living settings, 'otherness' of other residents as in the case of Evelyn, or in the case of Gary, fear of using the iPad in a respite facility).

Taken together, these elements influenced technology adoption and showed that context is both a *cause* and *outcome* of adoption (Greenhalgh and Stones, 2010). The case studies illustrate how different elements influence and evolve through adoption and use; they demonstrate that technology adoption and use is characterised by the interplay between personal, social, and technological contexts, aligned with the SST elements. Although these four cases are unique in their combination of factors associated with non-adoption, general findings regarding the strong interaction of contexts and SST elements are similar across the Canadian and Australian studies.

It is not easy to isolate contexts (personal/social/technological) as they rest on a close connection between social and agentic processes, including perceptions of age-related norms, status, social expectations, and gender. For instance, Evelyn's statements on age/cognition connect age-based social norms with self-presentation in later life; Jill mentions wasting time with technology while she should be doing household chores; and Pam talks about men as more 'mechanical'. In some cases, these contexts would also compensate for each other. For example, Evelyn's contexts were counterbalanced by her daughter and grandchildren's support (main motivation for her adoption); Pam's digital illiteracy was offset by her need to communicate with her son and her learning attitudes; Gary's family provided support to help overcome his digital illiteracy; and Jill's personal interest (local history) motivated her iPad use, while her guilt about not doing housework was offset by her enjoyment of digital games. SST proved to be a fruitful theoretical and analytical framework to integrate these interconnections.

Conclusion

Our Canadian and Australian research emphasises the need for a more contextualised study of technology adoption in later life and highlights the need to give voice to older adults who seem at the centre of digital exclusion. By exploring their lived experiences and contexts, it is clear the age-based assumption of non-use (and even types of use) cannot be universally applied and should be contested. The interplay of contexts and agentic

and structural processes means the digital divide is intersectional (including gender, social class, living settings, practices, norms, etc.) and not merely age-related (or 'grey' as often ageistically defined). The growing link between social and digital inequalities thus requires acknowledgement of these multiple processes to help close the digital divide in later life; particularly given the increasing reliance on using technology to access information concerning age-based services. SST can offer researchers a comprehensive model to study these intersectional layers. Additionally, re-thinking categorisations of technology use/non-use is essential to provide a better understanding of meanings and practices of usage, non-usage, and its continuum.

Funding

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