

# Coping with Ageing Issues: Adoption and Appropriation of Technology by Older Adults in Singapore

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**Abstract.** Older adults are facing various challenges while using technology. With an ageing society, it is desirable to develop senior-friendly innovations to empower older adults to lead enjoyable and fulfilling lives. This study examines ageing issues of older adults in Singapore and their coping strategies through adoption and appropriation of technology in the form of smartphones and wearable devices. Data was collected through in-depth interviews (10 participants) and focus groups (26 participants in 4 groups). Health problems, financial difficulties, loneliness and security concerns were the major ageing –related issues emerged from our analysis. The current status of technology use, adoption barriers and desired functions are discussed.

**Keywords:** Ageing · Technology adoption · Older adults · Smartphones · Wearable devices

## 1 Introduction

Technology adoption is becoming imperative to function in today’s society, as it is pervasive across all domains of daily life and societal contexts, such as work, communication, healthcare, education and entertainment [1]. Not having access to or inability to use technology may put older adults at a disadvantage in the society. Czaja and Lee [2] pointed out that although use of technology such as computer and the Internet was found to be increasing among older people, an age-based digital divide still exists. Older adults usually feel more anxious while less confident and willing to use technology [2].

Like many other societies in the world, the population in Singapore is ageing with low local birth rates and longer life expectancies. With an ageing society and shrinking workforce, there are increasing opportunities for information and communication technology (ICT) to empower older adults left out by technology to lead fulfilling lives, to play active roles in the society, and to develop or sustain relationships with other people.

It is critical to understand their needs, preferences and expectations, as well as the existing barriers for older adults' technology adoption.

This study explores ageing issues and coping strategies of older adults in Singapore through interviews and focus groups, especially those living alone. Smartphones, which is widely adopted by younger adults, and wearable devices, which is an emerging mobile technology, were used as examples for discovering the current status of technology usage, and identifying adoption barriers and desired functions.

## 2 Literature Review

### 2.1 What Ageing Brings

The ageing process has rarely been portrayed as a positive experience by both scientific and humanistic scholars [3]. It is often described as a constant state of decline, which may result in considerable fear and anxiety [3]. Lasher and Faulkender [4] defined ageing anxiety as “combined concern and anticipation of losses centered around the ageing process” (p. 247). Ageing anxiety is not only an important mediating factor in attitudes and behavior toward older adults, but also a mediating factor in adjustment to one's own ageing processes [4].

**Functional Decline.** Ageing is often described as a constant state of decline. Bodine [5] pointed out that around 80 % of older adults had certain type of functional impairment. For vision, the changes include color perception, visual acuity and susceptibility to glare; for hearing, older adults have greater interference from background noise and difficulty in perceiving high-pitched sounds; for mobility, the decline in motor skills due to disease like arthritis may change the way older adults physically interacting with technology, such as keyboard and a mouse device [6, 7]. Memory span [8] and spatial cognition [7] are also found to be declined with age. Reduced capacity in working memory may result in poor performance in reasoning and procedural tasks [9], and declines in spatial ability may lead to navigation related problems [10].

**Loneliness.** Loneliness is a depressing, pervasive and debilitating condition due to the discrepancy between a person's social and/or emotional needs and their social reality [11, 12]. Loneliness may occur in people of all ages, but it is often associated with ageing and regarded as a serious problem for older adults [13]. With loss of social contracts due to decreasing health and age-related losses, older adults are facing higher risk of loneliness [14]. Finding new mates may not be desirable or easy for those being widowed. Diggs [15] pointed out that ageing people may have limited ability to continue social activities due to lack of self-esteem or interpersonal skills, which results from their functional decline or disability. Moreover, they may not have the skills or financial resources to seek alternative activities in today's continuously changing, technology-driven society.

**Financial Strain.** Financial strain is one of the major issues for older adults, as incomes tend to decline in late life, while health-related expenses tend to rise [16, 17]. Despite partial subsidy of healthcare expenses they could receive from Medicare and private insurance, older adults have to spend more on health as compared to other age

groups, with the greatest concern of managing costs associated with long-term care for chronic and life-threatening disease [18].

## 2.2 The Role of Technology in Ageing

**The Positive and Negative Impacts.** Older adults' inclusion in the digital era could positively impact their economic and social welfare and on their quality of life [19, 20]. Technology has been argued to enable older adults to live independently, and support their ageing in place [1]. For example, technology can make daily tasks, such as cleaning, cooking, shopping and banking, easily manageable for older people [2]. Technology also allows older adults to play a more active role in their own healthcare: reminding them to take medications on time and enabling them to have a better sense of control over their health conditions. There are also a number of new developments in assistive technology which have made an important contribution to the care of older people at home, e.g. video-monitoring, fall detectors, hip protectors, door alerts and pressure mats [21].

Technology also offers the potential for enhancing older adults' quality of life by augmenting their ability to access information, to communicate with family and friends, to participate in various social activities [22, 23], and even to enhance their educational and employment opportunities [2]. Older adults could also use Internet as a platform to access more specific health information, and engage in patient-to-patient or patient-doctor conversations [24].

However, Dickinson and Gregory [25] noted that technology may also have some negative effects on older adults' well-being. For example, some systems allowing autonomous use may make people isolated and feel more lonely and depressed. Usability studies of smartphones or tablets with touch-screen interface have just begun for older adults [26]. Given the unfriendly interface design, older people may feel frustrated and become more reluctant to use the systems. The increment of task complexity will place greater demand on user's working memory, and hence leads to lower task performance [27, 28]. Therefore, with declining working memory, older adults are affected by increased task complexity, which will result in greater comprehension error and inconsistency in decision making [29].

**Current Research on Technology Designed for Older Adults.** Older adults are very often depicted as weak, bumbling and indecisive [30]. General stereotypes of older adults reflect low levels of competence, not as capable as younger adults [31], and they are consistently grouped with disabled and developmentally retarded people [32]. Researchers tend to have the bias as well. Usability of technology has been extensively investigated for older adults [33]. The underlying assumption seems to be that usability is the major concern for older adults' acceptance of technology [34]. However, some prior studies found that improved usability was not enough to guarantee older adults' technology acceptance [35].

In the context of older adults' adoption of mobile technology, the research focus has also been usability issues. The problems revealed included small buttons and screen, complex menus and functions [36, 37]. The role of smartphones in ageing, i.e. its daily usage by older adults, remains largely unexplored. As for wearable devices,

the leading industry players (e.g. Microsoft, Samsung) continue flocking to a saturated market filled with devices gathering reams of largely superficial information for young people whose health is not in question or at risk [38]. Given the limited number of wearable devices designed for older adults, there is lack of research to find out whether their requirements are addressed and their level of acceptance, as usually the wearable was created through a conventional process of brainstorming, conceptualizing, and prototyping [39]. There is a need to identify the real desired functions of older adults.

### 3 Methodology

The work described in this paper is informed by a case-based program of research within our on-going work with older adults living in community dwellings in Singapore. Many of them live alone, and are beneficiaries of community welfare organizations for their physical and social needs. The project is focused on understanding the adoption and appropriation of technology by older adults. In this paper we describe two studies that were put together to understand the needs and aspirations of older adults towards technology.

#### 3.1 Recruitment of Participants

In order to maintain a more controlled environment for collecting data, instead of random household or street sampling, we contacted Lion Befrienders Service Association (LBSA)<sup>1</sup> to seek their collaboration. It is worth noting that LBSA's SACs are commonly located at the void decks of selected 1-room (35 to 45 m<sup>2</sup>) rental blocks. Older adults living in these blocks tended to have lower income.

Recruitment guidelines were provided to the person-in-charge to ensure that participants were qualified for the interview and focus group respectively, and their participation was voluntary. For the in-depth interviews, all the participants were recipients of iPhones in a corporate social responsibility program known as "Silverline"<sup>2</sup>. For the focus groups, we targeted to recruit older adults that were active and able to express themselves clearly.

#### 3.2 Data Collection

The interviews and focus groups were both semi-structured, covering topics of attitude towards ageing, ageing-related issues, as well as perceptions of technology in ageing. They were conducted in participants' preferred languages (i.e. Mandarin, English and Malay). A audio recorder was used to record the interviews and discussions.

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<sup>1</sup> LBSA is a voluntary welfare organization founded in 1995 to provide friendship and care for older adults to age in place with community participation, enabling them to enjoy enriching and meaningful lives.

<sup>2</sup> To reduce isolation and open their world to new experiences, Singtel, a local telecommunication company, initiated the project calling for the donation of used iPhones and chargers to needy older adults.

Observation notes were made to record participants' body languages, expressions and patterns of interaction.

**Interviews.** Face-to-face interviews, ranging between 1–2 h, were conducted with 10 iPhone recipients from 8th to 19th November 2013. For this group of participants, smartphone was used as an example of technology for discussing its impact on ageing. Photos were taken sporadically during the interviews as the researchers felt the need to capture certain aspects such as photos taken in the iPhone. The average age of the interviewees was 74.8 years old, and 6 of them are female.

**Focus Groups.** In March 2015, follow-up focus groups were carried out with 26 older adults in one of LBSA's SACs. The 26 participants were divided into 4 groups: Group 1 (11 participants) and Group 2 (8 participants) were conducted in Mandarin; Group 3 (4 participants) and Group 4 (3 participants) were conducted in Malay.

For these 4 groups, wearable devices were used as examples of mobile technology for discussion. To ensure a better understanding, before the start of each session, presentation slides and a short video on wearable devices were played, and two samples of wearable devices, i.e. Pebble Watch and Mio Alpha 2, were passed around for the participants to try out. Pebble Watch is a smart watch that can communicate with smartphones for displaying caller ID, text messages, calendar alerts etc. [40], and Mio Alpha 2 features functions such as heart rate sensor and speed accelerometer [41].

### 3.3 Data Analysis

The audio records were transcribed and translated into English (as needed) immediately after each visit. The 14 transcripts were coded in 3 stages: open coding, axial coding and selective coding [42]: Open coding was used to code each line of all the transcripts; next, similar concepts were grouped into categories and axial coding was used to explore the relations between the categories; in the last stage of selective coding, the categories were re-examined and synthesized into a series of related concepts.

A code book was developed to include code definition and their hierarchies. Using the code book, 2 coders started coding separately and then the files were merged together in NVivo. The inter-coder reliability was satisfactory (Cohen's kappa = 0.75). In total, 1,544 responses were coded and categorized for the interview transcripts, and 931 for the focus group transcripts.

## 4 Findings and Discussion

This section presents results of analysis. Respondents were shown as R# for the interviewees and G#R# for the focus group participants. The face-to-face interviews gathered more in-depth data, while the focus groups collected broader views on the discussed topics.

#### 4.1 Attitudes Towards Ageing

The respondents tended to have different attitudes towards ageing. Some were positive with satisfaction of their current life, believing that there was nothing to be afraid of and trying to keep themselves happy everyday (e.g. R1, R3 and R9). One respondent (R4) expressed his enjoyment as a senior citizen, as he could sense more care and respect from others: *“I think they respect this [thumping his walking stick]...Bus drivers are very good to old people... VIP treatment.”*

However, it is worth noting that respondents (e.g. R2, R5) showed pessimistic attitudes towards life, focusing on the negative impacts of ageing, e.g. unable to work, closer to death. As shown in the literature, the age people feel of themselves could be an important phenomenological variable which determines whether they take into account their aging attitudes when evaluating their own lives [43].

These articulated attitudes towards ageing may also influence attitudes towards technology. Although it was not our original intention in our research to draw the links between attitudes towards ageing and attitudes towards technology, this link, if any, is important to understand. With positive attitudes, the level of technological efficacy may be higher and consequentially, the desire to learn and use technology. On the other hand, a negative outlook on ageing can influence attitudes in other areas of life, including attitudes and intentions to use technology.

#### 4.2 Ageing-Related Issues

Four major ageing-related issues emerged from our analysis: health problems, financial difficulties, loneliness, and security concerns.

All of the participants mentioned about the health problems they were facing, such as heart disease, high blood pressure, high cholesterol and asthma. Some of them raised issues such as the inconveniences (e.g. R3, R5) and concerns over falling (e.g. G4R3, G4R1) caused by their physical declines.

Although such needs are opportunities for technological interventions (for instance, applications on the smartphone can be designed to send alerts to caregivers or health workers when necessary), technology must also consider the impacts on their health issues from technology use while studying how older adults interact with technology to come up with relevant design implications and improve technological accessibility.

Nearly all of the participants expressed concerns about financial issues, either explicitly or implicitly. Some of them (e.g. R2, G3R1) worried about not having enough money to spend, while the rest used the words “expensive”, “cheap”, “save” frequently during the interviews (e.g. R5, R9).

The points raised under this theme involve understanding the social structure in which technology is made accessible to older adults. Many community organizations serving the needs of older adults are often caught up with what they perceive to be bread and butter needs, like improving the infrastructure and living environments of older adults, providing food and other supplies, and technology is regarded as a nice to have, but not an essential solution. The other pragmatic consideration for many of such organizations is that technology can be expensive, and there are always concerns about the sustainability of technological solutions especially when donations and funding are

already limited. This implies that improving accessibility to technology for older adults must be a concerted effort with the involvement of stakeholders in the caregiving value chain. Design accessible interfaces and technology are crucial, but the impacts are limited on their own.

Loneliness is another issue shared among the majority of the participants, as they were living alone and their children and relatives seldom came to visit them (e.g. R2, R7, and G4R1). As one participant (R2) shared, loneliness is a fundamental reality that comes with ageing: *“I feel very lonely at home. Who can I talk to?... If I go down, I will also sit there quietly...They (my relatives) don’t care about me. We seldom meet.”*

The immediate implication is that technology may be used as a way to connect to others and meet such social needs. In our interviews participants have also articulated their habits of using smartphones to connect to social network sites such as Facebook (e.g. R1), and using it to play games (e.g. R5, R8). However, there may also be the implication that using technology for such means can also further augment loneliness.

Three interviewees (R4, R7 and R10) and one of the focus group participants (G4R3) raised security issue and potential risks for living alone: *“If you stay alone, the others won’t know what happen to you...One of my neighbors passed away without anyone knowing.”* (R10).

The findings of this and other studies have led to the development of our concept of UbiCuts in the research center which can function like a life-logging device to capture images in the environment of the wearer. It is not the intention of this paper to focus on the utility and impacts of the solution, but it is an example of how understanding the needs of older adults can help inform the design of technological solutions for this group. There are many other innovations that have been designed with the aim of addressing this problem, such as those aimed at actively monitoring the motions and behaviors of older adults in their homes. For example, Ghasemzadeh et al. [44] developed body sensor networks worn by older adults at multiple joint positions to recognize their movements; Klack et al. [45] invented sensitive floor with sensor units installed under floor tiles to detect falls.

### 4.3 Perceptions of Technology in Ageing

Participants of the interviews and focus groups shared their perceptions of smartphones and wearable devices respectively, covering their attitudes, adoption and expectations.

**Perceptions of Smartphones in Ageing.** Six of the interviewees thought that smartphones were not meant to be used by older adults, but it is interesting to note that all of them considered themselves as exceptions as they were not really old (e.g. R1): *“For me it’s easy, but for the old people I would say... (shaking head), as it’s quite hard to use.”* Nevertheless, the majority (7) of them still felt that older adults can learn to use smartphones (e.g. R3, R4).

Still the reflections should be understood in the context that these participants have already been exposed to the smartphone for at least a year, and received basic training in using it before they were given a smartphone. The ‘others and me’ distinction in terms of technological efficacy is interesting, and leads to more research questions which we hope to address in future work: what factors other than exposure contribute to higher levels of

technological efficacy? Will greater use result in “use-effects” – in the sense that using a technology more will persuade themselves that technology has a role in ageing?

The most frequently mentioned barriers to the adoption of smartphones are listed in Table 1. They are mainly objective factors which the older adults cannot try to control or avoid, such as high price of smartphone, declined mental and physical abilities. The subjective factor is the lack of skill or knowledge to use smartphones, which can be overcome by learning and practicing. These barriers provide practical clues in terms of designing programs and services to improve the accessibility of smartphones for older adults.

As for the role of smartphones in ageing, 8 interviewees mentioned they were playful and enjoyable, which could help them to eliminate their boredom and even became part of their lives (e.g. R1, R5, and R7): “[*It has become*] part of my life. Because I stay at home, I [*have*] nothing to do. I play games [*to*] pass my time.” (R1).

Half of the interviewees also mentioned that using iPhone also provided a chance for them to learn new things, to exercise their brains, hands and even legs (e.g. R1, R2). In addition to meeting their entertainment needs, their informational needs are satisfied which also connects to their desire to connect with the rest of the society, as captured in the following reflection: “*It keeps me young, keep me connected with young people. There is this saying: You are as young or old as you think. So it is all in here [pointing to his head]. I keep myself alert.*” (R3).

**Perceptions of Wearable Devices in Ageing.** Smartphones have been around for some years now, so even though it may not have been adopted much by older adults in our research, there is prior exposure to it. In order to understand how older adults perceive “new” technology, we went on to conduct focus groups on wearable technology. Only 2 out of the 26 focus group participants had seen or heard about wearable devices with limited knowledge of their functions and usage. The rest did not even know that such technology was available before the briefing. Nevertheless, 11 of them showed interest in the devices and willingness to adopt it in their daily lives (e.g. G2R1, G2R4, and G4R1), as articulated by one participant: “*Yes, it’s best if I can wear it. It will tell me if my blood pressure goes up or down... I want to buy something like this.*” (G2R1).

**Table 1.** Barriers to the adoption of smartphones

Barrier	No. of interviewees	References across transcripts	Example
Lack of skill or knowledge	9	99 (41.25 %)	“I don’t know how to use this... I’m not familiar with it.” (R5)
Financial issue	8	41 (17.08 %)	“Because it’s very expensive...I’m concerned about the money.” (R4)
Declined mental ability	6	38 (15.83 %)	“Sometimes I will forget... When I want to pick up the phone, I will forget which button to press.” (R8)
Declined physical ability	6	24 (10.00 %)	“I can’t see clearly if the words are too small.” (R2)



**Table 2.** Desired functions of wearable devices

Function	No. of participants	References across transcripts	Example
Health monitoring	8	27 (27 %)	“I hope there’s a watch, most importantly it needs to tell us about our blood pressure, whether it’s high or low.” (G2R1)
Safety alert	3	28 (28 %)	“If we have such device, we can wear it when we are out. If there’s anything we can press a button and let people know where we are.” (G1R8)
Physical support and protection	4	20 (20 %)	“Improve our physical strength, leg strength, support my waist.” (G1R8) “Able to protect from sunrays. Help us to see things clearly.” (G2R4)
Navigation	2	7 (7 %)	“I’m quite ‘blur’. I always alight at the wrong stops when taking bus.” (G1R3)
Communication	2	4 (4 %)	“With these devices we can update our children where we are going. If anything happens, they will know.” (G4R1)

According to the collected responses, the desired functions of wearable devices can be summarized into 5 categories (Table 2). Meeting navigational needs is notable with participants expressing challenges in understanding changes to the transport system with information being too complex for them. These responses provide practical implications for wearable innovations for older adults, but also reflect their aspirations for the technology.

## 5 Conclusion

Drawing on our on-going research with older adults, we report findings in this paper on salient issues in ageing and discuss their implications for the design, attitudes and intentions to use technology. We also explore realities of technology use in ageing, highlighting both the barriers and aspirations of older adults for technological interventions.

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