

Mobile Technology for Older Adults: Protector, Motivator or Threat?

Lynne Coventry^(✉) and Pam Briggs

PaCT Lab, Department of Psychology,
Northumbria University, Newcastle upon Tyne, UK
{lynne.coventry, p.briggs}@northumbria.ac.uk

Abstract. New technologies offer an opportunity to improve the wellbeing and independence of older adults, but many of the potential benefits, have not yet been realised. Some technologies suggest a lifestyle of constant monitoring, controlling and nudging - transformations that could be perceived as threatening. To better understand older adult perceptions and attitudes to adoption of such systems, we describe a 3 week field trial of an application and view the results through the lens of protection motivation theory. Our participants identified a number of threats including not being able to live independently, fear of getting lost, being stigmatised and lack of privacy. Usability, accessibility, reliability, costs and usefulness all negatively impacted coping appraisal that would result in non-adoption, despite their stated intention to adopt the technology in the future.

Keywords: Older adults · Service design · Behaviour theories

1 Introduction

Many aspects of social policy address the ageing population, especially in relation to health, social care and housing [1] as the so called ‘Golden Generations’, e.g. individuals born between 1925 and 1945 [2] are living longer than those born prior to these decades [3]. The aging population is perceived as a burden on current health and social services and people are turning to technology as a possible solution.

Advances in wireless networks and mobile devices has supported the emergence of mobile health services. Technologies including smart homes [4] (Rodrigues and Rui 2013), personal alarms, GPS tracking and smart assistive and mobile technologies [5] offer the potential to support older adults remaining in their own homes for longer and may even lead to healthier behaviours.

More generally, computer use has been associated with a range of benefits for older adults, including: decreased feelings of loneliness [6, 7]; decreased levels of depression [8]; decreased feelings of stress [9]; increased feelings of personal growth and purpose in life [10]; and an increased feeling of independence [11]. While younger, higher-income, and more highly educated older adults in the US use the internet and broadband at rates similar to the general population; internet use and broadband adoption drop off dramatically around age 75 [12]. In this paper we explore these issues by capturing user attitudes and behaviours during a three week field trial of a mobile information support system for older adults, developed during the ‘Freedom to Roam’ project.

Freedom to Roam explored the services that would support older adults in maintaining independence and good local community engagement. The aim was to support most commonly held perceptions of aging well: having/maintaining physical health and functioning; taking part in leisure and social activities; maintaining mental functioning and activity and maintaining social relationships and contacts [13]. The project utilized a mobile tablet, linked to a carer control centre (market place) to provide a client (older adult) application that could be personalized with applications based on the location, interests and needs of the individual user. There was also a carer' application that provided the facility to communicate, monitor and manage user devices and that also provided the ability to monitor multiple devices. This system was deployed in a field trial as part of a participatory design study, where we worked with older adults to identify the services that might best support older adults. The aim of the field trial was to evaluate acceptance of this system by clients and carers and this paper presents the clients' experience, seen through the lens of protection motivation theory [14].

2 Background

Older adults do not just adopt new technology because it is 'out there' [15]. Whilst there may be good adoption if they see a use for it [16] the general opinion is that they prefer to stick to the tried and tested traditional approaches. Some designers stress the importance of the value or worth of offerings [17–20], where the emphasis is on creating services and systems that users perceive as worthwhile.

Early work on acceptance stressed both the usefulness and usability of a system was important for adoption [21]. Thus much of the research with older adults has been focused upon age-related perceptual and motor changes (usability/accessibility issues) with resulting designs that, *inter alia*, allowed users to enlarge text and button size or provide audio output. In other words, there has been a focus on mitigating the vision, hearing, and physical disabilities that accompany ageing rather addressing any of the cognitive impairments, perhaps because there has been little consensus as to how best to support the cognitive declines that accompany aging [22, 23].

However, usefulness and usability may tell only part of the story. Nutbeam [24] states that adopting services or an activity to promote, protect or maintain health should be considered within a health behavior framework rather than a technology acceptance framework, which suggests that theories such as Protection Motivation Theory may be a more appropriate lens through which to investigate these technologies for older adults.

Protection motivation theory (PMT) was first posited by Rogers [14] as a framework for understanding the impact of fear appeals and coping appraisals on attitudes and behaviours. The fundamental idea is that people may be motivated to change behaviour if they fear the consequences of inaction, but later versions of PMT [25] also recognize that other triggers to behaviour change involve the belief that the individual has both the resources and the self-belief to initiative and maintain a change. In short, then, people make a threat appraisal in which they assess both the severity of a threat (e.g. getting cancer from smoking) and their own vulnerability to it. They also make a coping appraisal where they assess their ability to deal with that threat. This in turn requires a belief that the behaviour change will reduce the threat (response efficacy) and

a belief that one is capable of performing the recommended behavior (self-efficacy). These are discussed in more detail, with relevant examples below.

2.1 Threat Appraisal

Presently, technologies for older adults general focus on accessibility and are marketed as a response to the negative aspects of ageing – e.g. “what if you have an accident and there is no one is around to help?” In other words, there is a fear appeal which means that an older adult must first make a judgement about their own vulnerability to the threat and secondly they must assess whether the response (pressing an alarm button) would constitute an adequate and effective coping response. They must also weigh up other costs – financial (‘it costs too much’) identity (‘it looks ugly’) or social (‘my friends don’t use one’). All these issues come into play as part of a health decision-making process.

We should not underestimate the role of fear in driving older adult behaviour. Consider fear of falling, for example, as an area where fear has been shown to lead to a maladaptive coping response. While previously changes in gait were cited as risk factors for falling, i.e., decreased stride length and speed and prolonged double support [26], illustrated that these adaptations were essentially maladaptive responses born out of a fear of falling. Contrary to common belief, a wider stride does not necessarily increase stability but instead seems to predict an increased likelihood of experiencing falls.

To take a different example, we see claims that GPS tracking systems are useful for people with dementia, but many individuals simply don’t see themselves in these terms – i.e. there is no perceived vulnerability and hence uptake is relatively poor even for people who would benefit from these services. Further, and counter-intuitively, adoption of the device itself can evoke fears of vulnerability, mistrust and lack of privacy Thomas et al. [27].

2.2 Coping Appraisal

Self-efficacy, i.e., the belief that one can complete tasks and reach goals [28], seems to be related to technology adoption [29–31]. This is closely related to a construct named “obsolescence”, defined as a gradual loss of social integration and perceived lack of competence to deal with the demands of modern society. Obsolescence is also related to technology use [32] and can mediate the relationship of technological experience and loneliness. People with higher feelings of obsolescence (for instance: “being antiquated”) make more errors, need more time to complete technology-based tasks and report more usability concerns [33]. Typically, feelings of obsolescence increase with age [34]. In effect, this can mean that the ‘response costs’ of adopting new technologies are simply too high (e.g. [35]).

We should also consider whether any rewards accrue from a maladaptive response, in this case, technology avoidance. These are often overlooked in research, but there are benefits in not having to learn new technology, not feeling stigmatized, not being monitored and individuals may often claim that they avoid new technologies because they prefer the rewards of face to face contact.

These are the kinds of issues we explore in this study. In the following sections we present more information on the design and functionality of the Freedom to Roam system before presenting data gained during a three week field trial. We use protection motivation theory as a framework for analysis, asking questions about how well mobile technologies could engage older users and address some of their fears.

3 System Design

The intention behind the Freedom to Roam application was to encourage older adults to engage in activities outside of the home through the provision of location and client specific applications which encourage social integration and activity, while providing communications between a carer and a client and between a client and friends with the aid of a remote tracking service. To encourage continued use some applications for use within the home entertainment applications were also provided.

The Freedom to Roam application provided a carer application called Marketplace and a mobile client device, managed by the carer application. It was designed to function on a tablet, with each client being in possession of a bespoke dashboard of applications depending on their interests and daily activities and independent living support needs.

The Marketplace application provided the capacity to manage multiple clients from a single care control centre. It had the following functionality:

Question and answer: broadcast multiple choice, questions, to one or several clients and coordinate answer, e.g. gather requests for meal options for the day.

Update client applications: install or remove applications from clients' devices. Applications can be selected for clients from a general app store (e.g. Google play) and added to the approved (for older adults) Freedom to Roam Marketplace. Thus each device is personalized to its owner.

Follow Organisations: This service allows carers to follow other care groups or individuals to see the applications they are recommending. For instance, Age UK may set up recommendations for older adults or the RNIB for visually impaired users.

Receive call-back/contact requests: The one touch call facility alerts the carer that their client requires a call back.

Track Freedom to Roam devices: The physical location of the device can be monitored. This can be used to check if the client is moving around as normal, or to find the client, should there be cause for concern.

3.1 Client Applications

Previous research had identified that certain activities interested older adults, such as reporting issues to their local council [36]. In addition we recognized a range of apps that could aid both mental and physical well-being and promote increased mobility [37, 38].

Further applications were identified through tea party focus groups with older adults [39]. Tea parties are considered to be an appropriate method as they provide a relaxing environment which encourages participants to engage with the technology and provide genuine opinions as opposed to feeling constrained by possible formal perceptions of social acceptable behaviour in a university environment. The final client applications were selected from the following themes;

- Health: health symptoms information, health location, order repeat prescriptions
- Entertainment: games, news, TV Guide
- Communication: Skype, email call back request, Multiple choice messaging
- Local Information: what's on in the vicinity, Report It
- Out and About: Local transport applications; My Nearest, I am Here, Where am I

4 Field Trial Method

Forty two older adults, with experience of using a computer took part in the trial (M = 14, F = 29) aged between 56 and 85 years (mean = 69.5 years). Experience of technology varied amongst the group with 40 participants having access to the internet at home and 7 being in possession of a mobile smart device. Twenty five Motorola Xooms were utilized in protective casing to encourage participants to take them with them at all times.

Pre-trial questionnaires ascertained technology use, types of online activities and attitudes towards using the device over the following three weeks. Diaries consisted of one daily task over a 21 day period for individuals to conduct and record their experiences, including ability to complete the task, ease of use, likelihood to use again and any general comments about what they particularly liked or disliked or would change. General overviews of the apps or internet sites were also obtained at the end of each week of the trial. Each week focused on a different set of applications. Of course they could use any of the applications at any point, but they had to complete at least the daily task. A post-trial questionnaire investigated opinions, attitudes and the impact of the device on their behaviour. Some participants then took part in a discussion group at the end of the trial.

4.1 Procedure

Stage 1 involved inviting the individuals to the lab to complete the pre-trial demographic questionnaires and introduce them to the technological device they were going to be using for the following three weeks. A training session lasting between 90–120 min was provided. Messages were sent twice daily throughout the trial. The researcher monitored the message responses and the time to respond throughout as an indicator of trial engagement, possible problems users may face and whether users were keeping the devices switched on. The researcher acted as the carer and users contacted the researcher when there were issues – either via telephone, the ‘Callback’ facility or

via an email. On return of each device and diary participants completed the post-trial questionnaire, took part in the focus group (if they so wished).

5 Findings

In making an analysis of participant responses, we asked two particular questions about the system that came from protection motivation theory, a threat question about how adoption might be motivated by the fears associated with ageing and a coping question about whether people felt empowered by the system or whether they felt the costs of using the system were simply too great.

Q1: Might the threat of ageing motivate people to adopt Freedom to Roam?

In a PMT framework, we would expect participants to be motivated to adopt assistive technology in part because they are fearful of the risks associated with ageing. We found that our participants were generally well aware of threats to health either through their own experiences or through friends with declining health. They acknowledged that ageing had affected general health, memory, dexterity and walking ability and recognized that the aging process was a threat to their independence. They were clear that some of the major threats associated with ageing were loneliness, being house bound, being unable to care for self and eventually ending up depending on other people or in a care home. This was certainly a future state they did not want for themselves – and so they were convinced of the overall severity of the threat, however they were much less convinced about their own personal vulnerability to that threat. In other words, they generally felt that they were ageing well, despite their lists of health issues, and in some cases, didn't want to be reminded through the Freedom to Roam Apps that they were, indeed, ageing. Thus, we saw some distancing of participants from the Newcastle Older Peoples Website, as they disliked the fact that it was for 'older people'.

One area which did tap into perceived threat in an interesting way was location tracking. Previous research has reported that older adults are resistant to location awareness and tracking [25], but in our own post-trial questionnaires over 90 % of individuals provided positive or neutral affirmations to the question "*It is good that my location is known to others.*" Participants could see that location tracking had the potential to support them if anything went wrong when they were out, however, this perception was modified by the system's lack of accuracy (response efficacy) which, in practice, meant that there was no way to mitigate the threat.

"If somebody has a heart problem and could collapse or something, it would be a way of finding where they are. Mind, mine wasn't very accurate."

"It wasn't terribly accurate that 'I am here', we could be 90 yards away."

In addition, one of the maladaptive effects of our system was that system use actually increased feelings of vulnerability associated with ageing. Thus, over a third of our sample reported that they felt that ownership of the device made them a target for crime whilst they were using it in public places.

"I felt a bit vulnerable when out, especially if sitting on a bench trying to do something. You hear about people pinching phones and this [device] is quite big & visible" "Because it's so big, it attracts attention"

"... I felt terrible with this thing. Terribly self-conscious and vulnerable. I photographed this lamppost and thought, "oh, I'm not sending it from here",

"The only thing I didn't like was having to take it out. I would lock it in the boot for security if I had taken it out – maybe if it was my own I wouldn't be as paranoid".

To a certain extent these issues were related to the size of the device, however they recognized that a smaller device would create accessibility issues – these were large devices that were meant to support ease of use, but in fact, as we can see below, this particular aspect backfired and became a usability problem.

Q2: Did people feel empowered by Freedom to Roam or were the costs too great?

Overall, people enjoyed many of the elements in the new system, but were most appreciative of those playful or newsy elements that were associated with positive ageing. Thus, for example, they viewed the games as useful with suggestions to incorporate more games such as Solitaire or Scrabble and some acknowledgement that they could play certain games for hours:

"I loved Word Push, the feedback was like a ray of the sun."

Many also enjoyed the daily messages which were generally seen as a positive element of the system:

"I sat up watching and waiting for it to come on."

The Top 3 apps enjoyed were those allowing individuals to keep up to date with the news (BBC News –48 %), obtaining information, (Information Now –43 %) and reporting issues to the local councils (Report It –29 %)

"I like Information Now, I thought that was really good..... kind of feel they're in the business of supporting you in some way."

"Easy to use, the pothole I photographed had been filled in, within 2 days."

However, the usability costs of the system were generally considered very high and not all apps were seen as useful. Picking up the point about device size above, the device was considered too heavy by 75 % of participants and too big by 50 % and many felt they were unable to carry it around on a daily basis with comments such as

"would you really be wanting to wander round the supermarket carrying this."

Glare was also an issue, surprisingly over 90 % claimed the device to be 'free from glare', one assumes they were answering from the perspective of using it indoors, as 55 % could not conduct the task that involved taking a photograph of a pothole and sending it to their local council due to sunshine glare:

"Took the photograph, sunny day, hardly could see pothole with the glare"

"The outside brightness/contrast of the screen made it difficult to use the camera."

Accessories created accessibility issues with the cases used highlighting dexterity issues and demonstrating accessibility issues.

"It's the device I found irritating actually; I couldn't easily take it out of its case to start it. That was a bit of a pain."

Reliability of the 3G access was also problematic, with 5 individuals experiencing difficulties within their homes, either due to overpopulated blackspots or due to living in semi-rural locations. In addition, a couple who were keen to take the device on outings with them became frustrated as they lost 3G connectivity,

"When I turned it on there was no coverage."

"Couldn't find me because I was beyond Rothbury."

"Mine didn't seem to connect to the internet at all"

"But I went for a walk and then nothing"

Some of the applications rated as less popular were also deemed hard to use or irritating. For example, Shopping List (scan items as they are used to build a shopping list) was the least favourite because it simply did not work effectively, i.e. *"nothing would scan"* and it was faster to *"just write my shopping list."* The messaging app was perceived as having limited usefulness for the more independent older adults, and receiving messages, to which they had to respond was irritating. When participants did not respond, it was not always clear to the carer if the message had been received or not and could create anxiety and, for some, the messages themselves were a source of irritation;

"one of the frustrations of the whole three weeks was your messages, morning and night, especially the ones that were asking about have you done so-and-so, and you can only tick one box. You can't then add to your answer, and I found that very frustrating, you know."

Overall, then, the response costs of using the system were simply seen as too high.

6 Conclusions

The issues with the different applications highlighted the benefit of a marketplace for older adults, that would highlight the most useful and usable technologies for older adults. The appropriateness, reliability and quality of applications is extremely variable. The marketplace would provide a sign post to the best applications rather than the current trial and error approach. This approach supports informal carers, who may not have the awareness of technologies available and save their time and effort.

Location Awareness was viewed as both a potential protector and a threat to personal privacy and so has to be well managed. There was evidence of a change of attitude towards location awareness within a single focus group session as one individual, initially resistant to the notion had *"distinct reservations, from a civil liberty point of view"* then shifted their opinion slightly to consider the notion, albeit conservatively, stating a need for *"tremendous guarantees of who controlled the information."*

Researchers and developers should consider a mixed methods approach to the evaluation of any technology. The general attitude towards the technology was quantitatively measured as positive. 75 % of the trial users responding positively to using this type of technology in the future and rated features highly. However this must be

interpreted with caution as a PMT lens on the comments suggests that this is probably not the case with the current instantiation of the device, but rather improvements on a number of dimensions are assumed to make this level of acceptance a reality. These issues include universal network coverage, size of device, usability, functionality offered and a change in attitude of older adults towards using technology in public.

When working with older adults in the future, it is important to consider when to involve older adults in the process. At the moment, they are brought in to respond to an existing solution, however, it may be more appropriate for the older adults to help decide what should be designed: i.e. don't bring them into a participatory design process when the decision about what to design has already been made. Consider participatory research, where the older adult supports the research to decide what problem should be addressed and how it should be addressed.

References

1. Harding, E.: Sustainable planning for housing in an ageing population: a guide for regional-level strategies. International Longevity Centre UK (2008). http://www.ilcuk.org.uk/files/pdf_pdf_49.pdf
2. Malley, J., Hancock, R., Murphy, M., Adams, J., Wittenberg, R., Comas-Herrera, A., Curry, C., King, D., James, S., Morciano, M., Pickard, L.M.: The effect of lengthening life expectancy on future pension and long-term care expenditure in England, 2007 to 2032. *Health Stat. Q.* **52**(1), 33–61 (2011)
3. Dunnell, K.: Ageing and mortality in the UK – national statistician's annual article on the population. *Popul. Trends* **134**, 6–23 (2008)
4. Rodrigues, H., Rui, J.: System implications of context-driven interaction in smart environments. *Interact. Comput.* **26**, 105–117 (2013)
5. Jara, A.J., Lopez, P., Fernandez, D., Zamora, M.A., Ubeda, B., Skarmeta, A.F.: Communication protocol for enabling continuous monitoring of elderly people through near field communications. *Interact. Comput.* **26**, 145–167 (2014)
6. Sum, S., Mathews, R.M., Hughes, I., Campbell, A.: Internet use and loneliness in older adults. *CyberPsychol. Behav.* **11**(2), 208–211 (2008)
7. White, H., McConnell, E., Clipp, E., Branch, L.G., Sloane, R., Pieper, C., Box, T.L.: A randomized controlled trial of the psychosocial impact of providing internet training and access to older adults. *Aging Ment. Health* **6**(3), 213–221 (2002)
8. Cotten, S.R., Ford, G., Ford, S., Hale, T.M.: Internet use and depression among older adults. *Comput. Hum. Behav.* **28**(2), 496–499 (2012)
9. Wright, K.: Computer-mediated social support, older adults, and coping. *J. Commun.* **50**(3), 100–118 (2000)
10. Chen, Y., Pearson, A.: Internet use among young and older adults: relation to psychological well-being. *Educ. Gerontol.* **28**, 731–744 (2002)
11. Stark-Wroblewski, K., Edelbaum, J.K., Ryan, J.J.: Senior citizens who use e-mail. *Educ. Gerontol.* **33**, 293–307 (2007)
12. Smith, A.: Older adults and technology use (2014). <http://www.pewinternet.org/2014/04/03/older-adults-and-technology-use/>
13. Bowling, A.: Enhancing later life: How older people perceive active ageing? *Aging Ment. Health* **12**, 3 (2008)

14. Rogers, R.W.: A protection motivation theory of fear appeals and attitude change. *J. Psychol.* **91**(1), 93–114 (1975)
15. Hanson, V.L.: Influencing technology adoption by older adults. *Interact. Comput.* **22**, 502–509 (2010)
16. Hogeboom, D.L., McDermott, R.J., Perrin, K.M., Osman, H., Bell-Ellison, B.A.: Internet use and social networking among middle-aged and older adults. *Educ. Gerontol.* **36**, 93–111 (2010)
17. Cockton, G.: A development framework for value-centred design. In: *Extended Abstracts on Human Factors in Computing Systems CHI 2005*, pp. 1292–1295. ACM (2005)
18. Cockton, G.: Designing worth is worth designing. In: *Proceedings of the 4th Nordic Conference on Human-Computer Interaction: Changing Roles*, pp. 165–174. ACM (2006)
19. Norman, D.A.: Human-centered design considered harmful. *Interactions* **12**(4), 14–19 (2005)
20. Sellen, A., Rogers, Y., Harper, R., Rodden, T.: Reflecting human values in the digital age. *Commun. ACM* **52**(3), 58–66 (2009)
21. Davis, F.D.: Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Q.* **13**(3), 319–340 (1989)
22. Czaja, S.J., Lee, C.C.: The impact of aging on access to technology. *Univ. Access Inf. Soc.* **5**(4), 341–349 (2007)
23. Gillespie, A., Best, C., O'Neill, B.: Cognitive function and assistive technology for cognition: a systematic review. *J. Int. Neuropsychol. Soc.* **18**, 1–19 (2012)
24. Nutbeam, D.: Health promotion glossary. *Health Promotion Int.* **13**(4), 349–364 (1998)
25. Maddux, J.E., Rogers, R.W.: Protection motivation and self-efficacy: a revised theory of fear appeals and attitude change. *J. Exp. Soc. Psychol.* **19**(5), 469–479 (1983)
26. Maki, B.E.: Gait changes in older adults: predictors of falls or indicators of fear? *J. Am. Geriatr. Soc.* **45**(3), 313–320 (1997)
27. Thomas, L., Little, L., Briggs, P., McInnes, L., Jones, E., Nicholson, J.: Location tracking: views from the older adult population. *Age Ageing* **42**(6), 758–763 (2013)
28. Bandura, A.: Self-efficacy: toward a unifying theory of behavioral change. *Psychol. Rev.* **84**(2), 191–215 (1977)
29. Bennett, J.: Online communities and the activation, motivation and integration of persons aged 60 and older. A literature review. Version 1.1 (2011)
30. Oudshoorn, N., Pinch, T.J. (eds.): *How Users Matter: The Co-construction of Users and Technologies*. The MIT Press, Cambridge (2003)
31. Silverstone, R., Hirsch, E. (eds.): *Consuming Technologies, Media and Information in Domestic Spaces*. Routledge, London (1992)
32. Chang, S.E.: Computer anxiety and perception of task complexity in learning programming related skills. *Comput. Hum. Behav.* **21**, 713–728 (2005)
33. Loos, E., Haddon, L., Mante-Meijer, E. (eds.): *Generational Use of New Media*. Ashgate, Farnham (2012)
34. Fagan, M., Neill, S., Wooldridge, B.: An empirical investigation into the relationship between computer self-efficacy, anxiety, experience, support and usage. *J. Comput. Inf. Syst.* **44**, 95–104 (2003)
35. Coleman, G.W., Gibson, L., Hanson, V.L., Bobrowicz, A., McKay, A.: Engaging the disengaged: how do we design technology for digitally excluded older adults? In: *Proceedings of the 8th ACM Conference on Designing Interactive Systems*, pp. 175–178. ACM, August 2010
36. Greathead, D., Arief, B., Coventry, L., van Moorsel, A.: Deriving requirements for an online community interaction scheme, In: *CHI 2012*, Austin, pp. 1541–1546, 5–10 May 2012

37. Resnick, B.: Health promotion practices of older adults: testing an individualized approach. *J. Clin. Nurs.* **12**(1), 46–55 (2003)
38. Aresu, M., Bécares, L., Brage, S.: Health Survey for England: Physical Activity and Fitness, vol. 1 (2008)
39. Coventry, L., Jones, E.: The role of tea parties to elicit technology requirements to support the mobility of older adults. In: Proceedings of the 5th International Conference on Pervasive Technologies Related to Assistive Environments, PETRA 2012 (2012)