Older Adults and the Appropriation and Disappropriation of Smartphones

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Abstract. Research in recent years has focused on examining the acceptance as well as the appropriation of technologies amongst older adults, especially in how technologies alleviate issues of functional declines, loneliness, and financial difficulties brought about by ageing. Yet such studies have often overlooked meaningful appropriation or disappropriation of technologies amongst older adults. By drawing on a longitudinal study of ten older adults who were given a smartphone under a corporate social responsibility program by a telecommunications company, we followed the use of smartphones by ten older adult users using in-depth interviews lasting one to two hours each. Our findings revealed a mix of appropriation and disappropriation, which are linked to everyday technological use and routines, attitudes to technology, and social support.

Keywords: Non-use · Technology appropriation · Older adults · Smartphones

1 Introduction

Ageing brings with it related and interdependent issues such as functional declines, loneliness, isolation, and financial difficulties. With the loss of social contacts, older adults often find themselves facing social isolation and loneliness [1]. This may be further compounded by their exclusion from participating in today's technologically-oriented and driven society. Having access to technology as well as the ability to use it has been argued and thought to bring older adults out of isolation and ensure that they remain active in society. Such gaps have been recognized by various societies and non-profit organizations, which subsequently seek to provide access and train older adults in using technologies in their daily lives.

As potential technological interventions, smartphones provide many opportunities to meet the needs of older adults [2]. As handheld devices with advanced computing capabilities, smartphones provide applications that can assist older adults in various aspects of their lives, such as medicine adherence, lifelong learning, and assisted living [3]. Yet certain functional declines of older adults can result in specific needs and requirements, and many smartphones and computing devices are designed to handle these needs.

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Yet despite the functionality, advances in the usability and usefulness of smartphones, some older adults do not use smartphones and computing devices. However, this may not always be a simple case of non-adoption, as the findings of this study would suggest.

2 Literature Review

Rogers [4] described technological adoption as a process "to make full use of an innovation as the best course of action available" (p.12). Beginning with awareness and access, it ends with the user embracing the technology and eventually using it for their functions and value. Acceptance, on the other hand, refers to attitudes towards technology. Acceptance is closely linked to adoption: acceptance is a precondition for adoption, and in cases where there is no acceptance, it is also unlikely for an individual to adopt the technology [5].

Whilst much has been written about the acceptance and adoption of technology by older adults, less has been written about their appropriation of technologies. Appropriation is a highly complex concept that is focused on the use of technology in a meaningful context. This is much harder to investigate compared to technological acceptance or adoption. As such, scholars, mostly guided by the postmodern traditions, have attempted to come up with frameworks to assist with their understanding and interpretation of technological appropriation by individuals in various sociological contexts.

2.1 ICT and Older Adults

Although there is much research and development done on technological innovations with the goal of assisting older adults and their specific needs, there is a lack of research exploring the needs of older adults in appropriating technology in the context of everyday tasks and life. This may be largely due to the following reasons: (a) older adults are hard-to-reach as research participants, (b) the goal of many studies is usually focused on the acceptance, adoption or use of technology, and older adults simply fall out of this scope if they do not use, adopt or have a negative attitude towards technology.

Scholars have tried to address the research gap in different ways. Some focus on the development of ICT innovations for older adults, and through such development argue for an increasing demand and usefulness of innovations that can help maintain current social ties or develop new ones [6, 7]. Communication devices such as mobile phones help older adults to maintain their ties, and smartphones, with potential connectivity and social networks available through games, apps, and social networking sites offer opportunities to forge new connections and social ties.

According to the Pew Research Center's Smartphone ownership report in 2013 [8], in the U.S., 14.6 % of people over the age of 55 own a smartphone, while in Europe, it is 18.9 % over the age 55. Research on the use of smartphones by older adults is largely focused on smartphones as new healthcare and assistive solutions for elderly [3, 9]. Apps to monitor falls [10], monitor and control food intake [11], advocate medication

adherence [12] or improving cognitive ability [13] are some of the common solutions that have emerged on the smartphone.

Studies on older adults and smartphones can be broadly classified in two streams: one that focuses on acceptance and use; the other is oriented towards the adoption of technology. Studies belonging to the first tradition are interested in the effect and impacts of specific functions or characteristics of smartphones (touch screen or interface for instance), seeking to understand their usability, use and acceptance by older adults [14–16]. A consistent finding from many of the usability studies conducted suggest that older adults have difficulties using smartphones [16–19] and guidelines to design better interfaces for older adults have been developed in response [20, 21].

The second tradition which is oriented towards adoption is focused largely on the factors influencing adoption. For instance, Williams [22] did a study on how older adults perceive iPhones using the Socioemotional Selectivity Theory (SST) and the Technology Acceptance Model (TAM) by interviewing of 12 participants over the age of 60, 2 of which do not own an iPhone. Perceived usefulness, communication, information access, entertainment, and perceived ease of use were found to be motivational factors for older adults to adopt and use iPhones.

Rahmati and colleagues [23] conducted a longitudinal quasi-experiment on 34 iPhone 3 users (aged 19 on average) over six months to demonstrate the influence of Socioeconomic Status (SES) on how the iPhones were adopted. Their results show that lower SES groups spent more money on apps and installed more apps as compared to other SES groups; the lowest SES group did not find their iPhones as easy to use as compared to other SES groups.

A problem of many acceptance studies is that technology is usually viewed or assumed to be static and non-changing, whilst adoption studies tend not to acknowledge structural properties of technology or social structures in users' adoption of technology. As a result, scholars such as Orlikowski [24] and DeSanctis and Poole [25] developed the concept of appropriation to address the gap.

2.2 Smartphone Appropriation by Older Adults

Appropriation is a socio-cultural concept linking perspectives of technology acceptance and use, and adoption. It argues for recursive relationships between social structures, technology and human agency. Since the emergence of the concept, scholars such as DeSanctis and Poole [25], Orlikowski [24] and Carroll [26] have offered models to help guide research in understanding technology appropriation by various individuals and communities.

Structurational models of technology typically argue that the use of technology by human actors is done through their understanding of rules and norms: "…human agents build into technology certain interpretive schemes (rules reflecting knowledge of the work being automated), certain facilities (resources to accomplish that work), and certain norms (rules that define the organizationally sanctioned way of executing that work)" (p. 410) [27].

Building on the appropriation literature, Carroll [26] suggests that the evaluation of technology by users results in four outcomes: appropriation, disappropriation

(abandonment), non-adoption, and simple adoption. It suggests that technology use result in outcomes that lie on a continuum, with simple adoption or non-adoption on the extreme end, and appropriation or disappropriation as outcomes that lie in between these extremes.

This model (Fig. 1) argues that a technology may be adopted or non-adopted at Level 1, and at Level 2, users start to explore and evaluate the technology even as they adapt to it. During this time, they may disappropriate and abandon, or appropriate and the technology becomes part of their everyday tasks and activities. All outcomes are conditional: many factors can trigger re-evaluation of the technology and result in changes in the outcomes.

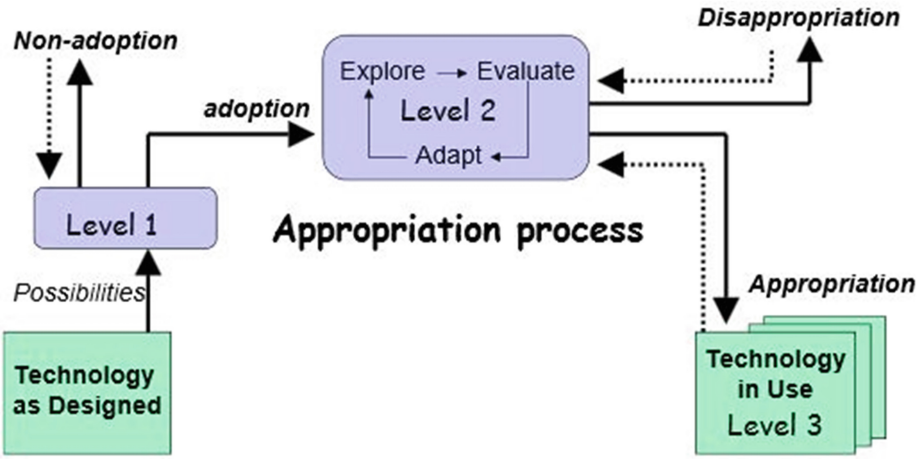

Fig. 1. Model of technology appropriation (Source: Carroll 2004, p. 3)

In our ongoing study of smartphone use by older adults, we have found instances of both non-adoption and disappropriation. Whilst confounding to our original research aims to evaluate smartphone appropriation, these have contributed to new research directions.

Research done on non-adoption and disappropriation is sparse with Selwyn being one of the most prolific in writing about non-use of ICT by older adults [28–30]. As he argued, little is known about the non-use phenomenon amongst older adults, especially in terms of the reasons and the outcomes of non-use [29]. Many of the conventional concepts of non-use are based on the technologically deterministic assumption that using ICTs is inherently beneficial for all including the older adults. Furthermore, most literature focused on use of ICTs rather than non-use and rendered non-use as a problem to be solved [28]. These resulted in a gap: the technological deterministic perspective has discounted the focus on the individual or the user who should be given, to a certain degree, a role to play in making the decision whether or not to use a technology. In other words, as Selwyn [28] advocated, it is important to understand how individuals use technologies. It is our intention to address this gap by examining the appropriation and disappropriation of smartphones by older adults.

3 Method

Using in-depth interviews, the study aimed to explore the use and non-use of the ten recipients of iPhones in a corporate social responsibility program by a telecommunications company in Singapore. The respondents received the phones in December 2012 and we conducted the first round of interviews in November 2013. The second round of interview was done with four participants six months later in May 2014. The remaining participants were either non-contactable or refused the second interview.

3.1 Data Collection

Silverline is a corporate social responsibility program by Singtel, a telecommunications company based in Singapore, to promote the use of ICT by older adults. Second-hand and refurbished iPhones were given away to selected older adults under the care of two non-profit organizations serving older adults in Singapore. The first batch of phones was given out to nine older adults in December 2013 with a free-of-charge one year data plan. We approached the project manager of Silverline and expressed interest in interviewing these nine recipients for the study. After IRB approval and agreement with Silverline were granted, we contacted the recipients for their permission to visit their homes or anywhere they wanted to meet for an interview. One of the nine interviewees was sharing the phone with her sister whom she is living together with and so we were able to interview ten older adults. The first round of interviews was conducted from 8th to 19th November 2013.

The mean age of N = 10 is 76.2 years old, most of them are single and living alone in a one-room apartment. Most live on their retirement pension and have fair health conditions with some chronicle illnesses. Table 1 presents a summarized profile of participants in our study.

A semi-structured in-depth interview approach was used, involving questions about the respondents' family background, health condition, employment (if any), and daily activities. Open ended questions revealed contexts of their use and non-use of the given iPhone, difficulties using the iPhone, reasons for non-use, their attitude towards older adults' using smartphones and the role that the iPhone plays in their lives, and their attitudes towards ageing.

Table 1. Overview of participants

Gender	Living arrangement	Marital status	Source of livelihood	Health condition[a]
Men (6) Women (4)	Alone (6) With a roommate (1) With family (3)	Married (3) Single (7)	Salary (part-time) (1) Retirement pension (7) Family/Relative members (2)	Excellent (2) Good (2) Fair (4) Poor (2)

[a] Simplified labeling based on health condition of participants as declared on their own. Excellent is without any illness or on-going medication. Good: with one illness or on medication with. Fair: with 2 illnesses and on medication. Poor: with more than 2 illnesses and on medication. Very poor: immobile.

A small audio recorder was used to record the interviews and transcribed each of them immediately after each visit. Observation notes were included in the transcripts as well and coded as memos in NVivo [31]. Photos were taken sporadically during the interview as the researchers felt the need to capture certain aspects such as photos taken in the iPhone. Some respondents could only speak Chinese so transcripts were translated into English. For the first phase of interviews in November 2013 with N = 10, a total of almost 9 h of recordings, 446 pages of transcripts and 156 photos were collected. For the second phase of interviews in May 2014 with N = 4, only observations and notes of differences in the usage or non-use as compared to the first phase were recorded.

3.2 Data Analysis

Using NVivo10, ten transcripts were coded in 3 stages: open coding, axial coding and selective coding [32]. Open coding was used to code each line of each transcript; responses associated with adoption, non-adoption, appropriation or non-appropriation were marked and labeled with codes. Next, similar concepts were grouped into categories and axial coding was used to explore the relations between the categories. The result of axial coding is a loose conceptual framework including casual conditions, context, and consequences of each kind of use or non-use. In the last stage of coding (selective coding), the categories were reexamined and synthesized into a series of grounded concepts of appropriation and disappropriation.

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) for most of the codes in all transcripts. A total of 1,544 responses were coded (open codes) and categorized into categories.

4 Findings and Discussion

4.1 Appropriation

Unsurprisingly, positive perceptions of smartphones are associated with appropriation. Participants also felt that being given the iPhone implied that they had to use it otherwise it would be taken back. This provides many of them the motivation to appropriate the smartphone into their everyday routines, or adapt to the smartphone, introducing new routines into their lives. For instance, many participants use the device to forage for information such as winning lottery numbers and send short messages. But some participants have also shared how new activities are introduced into their lives as a result of appropriation: *"…it eliminates my boredom…my life will be boring if I cannot play games [on his iPhone]."* (Participant CS) (Fig. 2).

Another participant, Participant YH, talks about his discovery of new functions on the iPhone: *"…the phone [the iPhone] contains a lot of interesting things. This one [pointing to his old mobile phone, a Nokia non-smartphone] doesn't. It [the iPhone] is fun…like the songs, I like the songs. This phone [is] like a friend"*.

Fig. 2. Some of the games played by participants (Source: Authors' own)

Games and getting onto social networking sites are the most common elements of the smartphone that appears to inject new routines and activities into their lives, whereas other functions such as making phone calls, messaging, camera, surfing the Web for information and music player are appropriated into the everyday lives of participants.

Social support from others in the appropriation of smartphones is crucial, with some participants relying on their neighbors for help. Participant CS described the importance of such social support in encouraging his persistent use: *"I will ask her [my neighbor] if it [the iPhone] is spoilt or when I want to install new games I will [also] ask her to help me"*.

The result of smartphone appropriation is associated with feelings of empowerment and status amongst participants in our study. Participant KL, for instance, shared about her experience getting noticed holding the phone on a bus: *"...people will ask me, 'Aunty, you use this?'"*. The smartphone is not simply a device, but something that is appropriated as part of ageing and being respected as an older person in society. Participant BM expressed his belief that the smartphone is a privilege accorded to him as an older adult: *"I think they respect this [pointing to his walking stick]...VIP treatment you know..."* and the iPhone is part of the package.

Such deep appropriation can be emotional, with one participant getting worked up by the hypothetical scenario of living without the iPhone again: *"I don't think I will give it back...if they take it back from me, I will ask them, "Why are you taking it away from me?" I will keep asking them, and discuss with them. I won't allow them to take it back from me easily. No way. You gave it to me!"* (Participant CC).

4.2 Disappropriation

Participants in our study reported substantial barriers to using the iPhones, resulting in disappropriation. 85.2 % of the data tagged with non-use are associated with barriers to using. These are further categorized into three main categories: (i) subjective barriers, (ii) technological barriers, and (iii) situational barriers. Subjective barriers are associated with individuals' attitudes and ability, such as the lack of knowledge on how to use, or about the smartphone. Participant YH said: *"I'm more familiar with others [Nokia phone], and they are easy to use… This [iPhone]… I see wrongly… press wrongly…"* Participant CS also pointed out: *"Most elderly… they only make and receive calls, they don't use the other functions."* In such cases, appropriation of the smartphone is not full and meaningful.

Social support was as important in the lack of appropriation as it was important in the appropriation of smartphones, as discussed earlier. All of the participants who reported disappropriation were living alone and had infrequent interactions with their neighbors, implying little external help from other smartphone users.

The lack of knowledge is compounded by declined mental and physical abilities due to old age (accounting for 25.8 % of non-use). Participant AT encountered the most difficulties with his iPhone because of his poor eyesight: *"the keyboard is too small for me to see. I can't see. Although this is small [pointing to the Nokia] but I suppose I'm used to it"*. Participant BM expressed that even though he would like to use the camera function, he could not use because of his shaky hands. Such disappropriation is contextual to the phase of ageing and condition of their wellbeing.

But disappropriation was not always related to physical or physiological barriers. Some participants were reluctant to use functions that they were just not keen on taking up. One example is the use of social networking sites such as Facebook, even for very competent smartphone users. Participant NW said: *"I know what it [Facebook] is, I just don't want to use it."* The fact that she uses certain elements of the smartphone but chooses not to use other elements reflects how in this case, disappropriation is an exercise of choice, a reflection of empowerment and strong internal locus of control over the smartphone.

Technological reasons for disappropriation are associated largely with interface issues. Participant GC relayed a story of how he once bought an Android smartphone for a friend: *"…and the next day she sold [the smart phone], saying [she] doesn't know how to use. Then I bought an old Nokia for her, and she said 'this was easy, the other [phone] I have to look at so many places to figure out how to call'"*.

Cost is one of the greatest obstacles to persistent appropriation especially to this group of interviewees because they are considered the below average class (live mainly on retirement pension, one-room apartment on monthly rent). Participant KL, in talking about gaming on the smartphone, explained to us the barrier to her fully appropriating the smartphone: *"…although I want to play [the games], I don't dare to…I am afraid that I need to pay if I keep on playing."* Participant NW echoed this sentiment: *"…my friends do not use the iPhone even if they have one, they say [it is] expensive"*. This fear of being charged is mainly because they do not have enough financial resources.

The eventual disappropriation is also associated with fear. Participant BM, for instance, always kept his iPhone in a pouch and then the pouch is further protected in a plastic bag. He explained that he does not want to drop it, and so he had to be very careful about using it.

5 Discussion

Our study showed that iPhones are used and appropriated/disappropriated in a variety of ways. Some respondents appropriate them meaningfully, in the fullest sense of what they are as smartphones, others do not. The concepts of appropriation and disappropriation are especially meaningful for the profile of older adults in our study. Appropriation and disappropriation emerged as concepts that can help to explain the ways participants interacted with their iPhones. For instance, Participant CS was so into playing games that he turned it into a gaming device to help him alleviate loneliness; he did not use other communication functions of the phone. But iPhones were not designed to only play games. Still, this was how Participant CS appropriated the iPhone into his daily life.

Our findings echo Chen et al.'s [33] study on elderly's use and non-use of gerontechnology which includes various technologies like ATM, computers, mobile phones, and smartphones. Respondents in Chen et al.'s study did not use certain gerontechnology due to social support, lack of knowledge and ability, cost, and interface which are similar reasons for how respondents in our study appropriated/disappropriated the iPhones they had. That older adults are unable to use smartphones due to ageing physical and mental ability also mediates the use of the iPhones is consistent with other studies' findings on ICTs' usage by older adults [34, 35]. Knowledge on how to use is especially important as one of the respondents repeated over and over again throughout the interview: "…I'm not familiar yet. I must learn slowly. Must learn…Once I am familiar with it I can use it." Other studies have found that knowledge plays a key role in technology usage too [36, 37].

Many studies have found that positive attitude towards using technology is the most influential factors to technological usage [33, 38, 39]. However, this factor did not seem to influence the appropriation/disappropriation of iPhones very much in our study, as participants with positive attitudes towards technology may not always appropriate meaningfully. Besides, the fact that these studies looked at gerontechnology [33] or technology in general [38] makes it difficult to grade the level of influence of the factors to specific technologies.

We found other factors associated with meaningful appropriation/disappropriation: fear of losing the iPhone, considering the iPhone as a social status, and using the iPhone to pass time and decrease loneliness. Our findings also reinforced Selwyn's argument [30] that non-use is mediated by conscious decision. For example, one of the participants knew about Facebook but does not use it at all because she insisted that she did not need it. Such individual and conscious choice to not use certain functions of smartphone reflects her human agency and her exercise of choice over the smartphone.

This notion applies to almost any technology, not only smartphone, as proven in Selwyn's earlier study on older adults' use of computers [29]: some of them just do not see a need in using computers and not tempted to use one either.

6 Conclusion

Our paper reports results on the appropriation and disappropriation of smartphones as part of an ongoing study about smartphones and older adults. Our in-depth interviews revealed insights on the factors behind both appropriation and disappropriation, and how appropriation or disappropriation of the smartphone is integrated into everyday routines and tasks. Some constraints exist, such as the limited number of participants. However, given that older adults are hard-to-reach as research participants and it is relatively hard to reach older adults who have had the opportunity to adopt a smartphone, our study provides rare insights on how older adults can appropriate or disappropriate a smartphone when given access.

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References

1. Chen, Y., Hicks, A., While, A.E.: Loneliness and social support of older people in China: a systematic literature review. Health Soc. Care Community **22**(2), 113–123 (2014)
2. Plaza, I., Martin, L., Martin, S., Medrano, C.: Mobile applications in an aging society: Society and trends. J. Syst. Softw. **84**(11), 1977–1988 (2011)
3. Boulos, M., Wheeler, S., Tavares, C., Jones, R.: How smartphones are changing the face of mobile and participatory healthcare: an overview, with example from eCAALYX. BioMed. Eng. Online **10**, 24 (2011)
4. Rogers, E.M.: Diffusion of Innovations, 5th edn. The Free Press, New York (2003)
5. Renaud, K., van Biljon, J.: Predicting technology acceptance and adoption by the elderly: a qualitative study. In: Annual Research Conference of the South African Institute of Computer Scientists and Information Technologists on IT Research in Developing Countries: Riding the wave of technology, pp. 210–219. ACM, New York (2008)
6. Greathead, D., Arief, B., Coventry, L., van Moorsel, A.: Deriving requirements for an online community interaction scheme: indications from older adults. In: CHI Conference on Human Factors in Computing Systems, CHI 2012, Extended Abstracts, pp.1541–1546. ACM, New York (2012)
7. Berkowsky, R.W.: Internet use and mental health/well-being in old age: exploring the roles of social integration and social support. Doctoral dissertation, The University of Alabama at Birmingham. ProQuest LLC, UMI No. 3618429 (2014)
8. Pew Research Center: Smartphone Ownership, http://www.pewinternet.org/~/media/Files/Reports/2013/PIP_Smartphone_adoption_2013.pdf
9. Gill, P.S., Kamath, A., Gill, T.S.: Distraction: an assessment of smartphone usage in health care work settings. Risk Manage. Healthc. Policy **5**, 105–114 (2012)

10. Mellone, S., Tacconi, C., Schwickert, L., Klenk, J., Becker, C., Chiari, L.: Smartphone-based solutions for fall detection and prevention: the FARSEEING approach. Z Gerontol Geriat. **45**(8), 722–727 (2012)
11. Martin, C.K., Correa, J.B., Han, H., Allen, H.R., Rood, J.C., Champagne, C.M., Gunturk, B. K., Bray, A.G.: Validity of the remote food photography method (RFPM) for estimating energy and nutrient intake in near real-time. Obesity **20**, 891–899 (2012)
12. Federico, B., Fernando, B., Joaquin, J.M.: Safer virtual pillbox: assuring medication adherence to elderly patients. In: 3rd ACM MobiHoc Workshop on Pervasive Wireless Healthcare, pp. 37–42. ACM, New York (2013)
13. Dufau, S., Dunabeitia, J.A., Moret-Tatay, C., McGonigal, A., Peeters, D., Alario, X.F., Balota, D.A., Brysbaert, M., Carreiras, M., Ferrand, L., Ktroi, M., Perea, M., Rastle, K., Sasburg, O., Yap, M.J., Ziegler, C.J., Grainger, J.: Smart phone, smart science: how the use of smartphones can revolutionize research in cognitive science. PLoS ONE **6**(9), e24974 (2011)
14. Zhou, J., Rau, P.P.L., Slvendy, G.: Older adults' use of smartphones: an investigation of the factors influencing the acceptance of new functions. J. Behav. Inf. Technol. **33**(6), 552–560 (2014)
15. Zhou, J., Rau, P.P.L., Slvendy, G.: Older adults' text entry on smartphones and tablets: investigating effects of display size and input method on acceptance and performance. Int. J. Hum. Comput. Interact. **30**(9), 727–739 (2014)
16. Kobayashi, M., Hiyama, A., Miura, T., Asakawa, C., Hirose, M., Ifukube, T.: Elderly user evaluation of mobile touchscreen interactions. In: Campos, P., Graham, N., Jorge, J., Nunes, N., Palanque, P., Winckler, M. (eds.) INTERACT 2011, Part I. LNCS, vol. 6946, pp. 83–99. Springer, Heidelberg (2011)
17. Dale, O., Schulz, T.: JusFone: A smartphone for everyone. http://publ.nr.no/5658
18. Judge, T., Neustaedter, C., Harrison, S., Blose, A.: Family portals: connecting families through a multi- family media space. In: Annual Conference on Human Factors in Computing Systems, pp. 1205–1214. ACM, New York (2011)
19. Lippincott, B., Morris, J., Mueller, J.: Keeping in touch: smartphone touchscreens and customers with disabilities. http://include11.kinetixevents.co.uk/4dcgi/prog?operation=author&id=1245
20. Fisk, A.D., Rogers, W.A., Charness, N., Czaja, S.J., Sharit, J.: Designing for Older Adults: Principles and Creative Human Factors Approaches. CRC Press, Boca Raton (2009)
21. Pak, R., McLaughlin, A.: Designing Displays for Older Adults. CRC Press, Boca Raton (2011)
22. Williams, L.E.: Perceptions of Older Adults toward iPhones. Master Dissertation, Purdue University, Indiana. ProQuest LLC, UMI No. 1529848 (2012)
23. Rahmati, A., Tossel, C., Shepard, C., Kortum, P., Zhong, L.: Exploring iPhone usage: the influence of socioeconomic differences on smartphone adoption, usage and usability. In: MobileHCI 2012 Proceedings of the 14th International Conference on Human-Computer Interaction with Mobile Devices and Services, pp. 11–20. ACM, New York (2012)
24. Orlikowski, W.J.: Using technology and constituting structures: a practice lens for studying technology in organizations. Organ. Sci. **11**(4), 404–428 (2000)
25. De Sanctis, G., Poole, M.S.: Capturing the complexity in advanced technology use: adaptive structuration theory. Organ. Sci. **5**(2), 121–147 (1994)
26. Carroll, J.: Completing design in use: closing the appropriation cycle. In: 12th European Conference on Information Systems (ECIS 2004), Turku, Finland, p. 11 (2004)
27. Orlikowski, W.: The duality of technology: rethinking the concept of technology in organisations. Organ. Sci. **3**(3), 398–427 (1992)

28. Selwyn, N.: Apart from technology: understanding people's non-use of information and communication technologies in everyday life. Technol. Soc. **25**, 99–116 (2003)
29. Selwyn, N.: The information aged: a qualitative study of older adults' use of information and communication technology. J. Aging Stud. **18**, 369–384 (2004)
30. Selwyn, N.: Digital division or digital decision? a study of non-users and low-users of computers. Poetics **34**, 273–292 (2006)
31. Strauss, A., Corbin, J.: Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory. Sage Publications, Thousand oaks (1998)
32. Flick, U.: The Sage Qualitative Research Kit. Sage Publications, Los Angeles (2007)
33. Chen, K., Chan, A.H.: Use or non-use of gerontechnology - a qualitative study. Int. J. Environ. Res. Public Health. **10**, 4645–4666 (2013)
34. Johnson, R., Kent, S.: Designing universal access: web-applications for the elderly and disabled. Cogn. Technol. Work **9**(4), 209–218 (2007)
35. Werner, J.M., Carlson, M., Jordan-Marsh, M., Clark, F.: Predictors of computer use in community-dwelling, ethnically diverse older adults. J. Hum. Factors Ergon. Soc. **53**(5), 431–447 (2011)
36. Ham, D.H.: A model-based framework for classifying and diagnosing usability problems. Cogn. Technol. Work **16**(3), 373–388 (2014)
37. Broady, T., Chan, A., Caputi, P.: Comparison of older and younger adults' attitude towards and abilities with computers: Implications for training and learning. Br. J. Educ. Technol. **41** (3), 473–485 (2010)
38. Mitzner, T.L., Boron, J.B., Fausset, C.B., Adams, A.E., Charness, N., Czaja, S.J., Dijkstra, K., Fisk, A.D., Rogers, W.A., Sharit, J.: Older adults talk technology: technology usage and attitudes. Comput. Hum. Behav. **26**(6), 1710–1721 (2010)
39. Pillemer, K., Meador, R.H., Teresi, J.A., Chen, E.K., Henderson, C.R., Lachs, M.S., Boratgis, G., Silver, S., Eimicke, J.P.: Effects of electronic health information technology implementation on nursing home resident outcomes. J. Aging Health **24**(1), 92–112 (2012)