

Technology Use in Everyday Life: Implications for Designing for Older Users

Niamh Caprani, Julie Doyle*, Michael J. O'Grady, Cathal Gurrin, Noel E. O'Connor, Brian Caufield, Gregory M.P. O'Hare

CLARITY: Centre for Sensor Web Technologies

Dublin, Ireland

*CASALA, Dundalk Institute of Technology, Dundalk, Ireland
ncaprani@computing.dcu.ie

ABSTRACT

This study examines the experience and attitudes of older adults towards technology and how they compare with younger age groups. Two hundred and thirty seven participants completed an extensive questionnaire exploring their daily lifestyle, use of technology, attitudes towards technology, and perceived difficulty of household devices. The main findings from the study were; (1) there was a strong motivation to learn or to continue learning to use computers by the older group; (2) social connectedness influenced how the older group used or would like to use technology and also why some preferred not to use it; and finally (3) there was an age-related increase in perceived difficulty for many household devices, however some devices maintained intergenerational usability. These findings can be used to inform the design of future intergenerational household technologies.

Keywords

Older adults, technology, lifestyle.

1. INTRODUCTION

There has been a simultaneous development in society between the growth of older populations and the prevalence of technology [4]. It is a natural progression that technology is proposed as a potential solution to tackle issues concerned with a rapidly ageing population. Assistive technologies and information communication technologies (ICTs), that address the physical, cognitive and social aspects of ageing, have the potential to enable older adults to live independently as they age, increasing their quality of life and reducing healthcare costs.

Society is becoming increasingly reliant on technology and the necessity of using ICT to access certain services is increasing. This reason, coupled with the potential of independent living technologies, means it is crucial to ensure these systems are designed in such a way as to be intuitive and thus approachable to older people. However potential barriers to technology use by older adults, such as physical, cognitive and sensory problems, can result in increased complexity in designing technologies that they can and will use.

The main purpose of the research presented in this paper is to understand peoples' lifestyles, how people of different ages use the technology in their lives, and as a consequence, better understand how we could design new technology that is accessible by and acceptable for older adults. We present findings from phase 1 of our requirements gathering process - a

questionnaire study, the goal of which was to gauge peoples' experience, subjective confidence, and attitudes towards technology. This questionnaire helps us to answer a number of research questions such as what technologies older people are currently using for their daily activities compared to their younger and middle-aged counterparts. Other questions are concerned with ascertaining where technology is used, how frequently it is used, as well as lifestyle factors that affect access to technology and technology use or non-use.

2. RELATED WORK

2.1 Older Adults' Use of Technology

With population projections estimating a rise in the old dependency ratio and increasing technological developments, it is no surprise that researchers are looking at how technologies can be used to support older adults in their homes [1]. These include ambient assisted living technologies [24], technologies to monitor activities of daily living [2], health management systems [8], and interactive 'wellness' technologies such as applications delivered through interactive television [6] or standalone devices [12], [14] to name but a few. Some studies have shown the promise of ICT interventions in facilitating independent living and reducing social isolation. For example, Findlay [15] found that Internet usage seemed to alleviate feelings of social isolation and loneliness in older adults. Other studies have illustrated the receptiveness of older adults in using email as a form of communication and that such communication is a contributing factor to the ability to live independently [11]. Examples of home technologies which are currently being developed and trialled in the homes of older adults are the Great Northern Haven [13] and the Ambient Kitchen [22]. Assistive technologies also present great promise for supporting caregivers in their roles.

2.2 Acceptance and Adoption

Older people typically have less experience and familiarity with technology. The willingness of older adults to adopt technology is dependent on numerous factors, including familiarity [26], computer self-efficacy [10], relevance to their lifestyle [25], and interest [27]. A study by Czaja et al. [10] found that older adults were less likely to use technology than younger adults. Their findings indicated that computer anxiety, unfamiliarity, inaccessible technology, and cognitive abilities are important factors in predicting technology usage. In a household survey of ICT use among older adults in England and Wales, Selwyn et al. [26] found that age, gender, marital status and education impact

significantly on a person's usage of technology. Computer non-use was attributed to older adults' opinion that computers had low relevance to their lifestyle.

Bouwhuis [5] maintains that the interaction with technology in younger years when learning and cognitive functioning is at its peak, allows the user in later years to transfer the existing knowledge to new technologies. Similarly, Mayhorn et al. [21] believe that acceptance of a device can be achieved by introducing the technology into the older adult's home when they have high cognitive functioning, increasing the level of technological support as motor control, perceptual and cognitive abilities decline.

3. METHOD

Our study used a questionnaire method to gather information across four different age groups. The questionnaire was divided into two sections. The first section was concerned with the participants' experience with technology and the types of technology they use to complete everyday tasks, such as shopping or communication. The second section related to the attitude of the participants towards computers. Some of the questions included were influenced by the technology and computer experience questionnaire developed by the CREATE Center [10] and the Computer Anxiety Questionnaire [17]. Responses were structured on a Likert scaling system and analysed using non-parametric tests. Kruskal-Wallis and Mann Whitney tests were used to explore whether there were significant differences between variables.

The participants were recruited through an advertisement sent to universities, community centres and various organisations in cities around Ireland involved with older adults. Snowball sampling was used whereby participants were asked to send the questionnaire to one other person. In total 237 people responded to the questionnaire (male N= 83, female N= 154). The participants were divided into four age groups; 18-29 years (N=63), 30-49 years (N=65), 50-64 years (N=61) and over 65 years (N=48). Participants were offered the choice of completing the questionnaire online or in printed form.

4. RESULTS

In this section we present our results focusing on (1) Internet, ICT and mobile phone experience; (2) Anxiety towards computers and (3) Use and attitudes towards everyday technologies.

4.1 Internet, ICT and Mobile Phone Experience

4.1.1 Internet and ICT experience

To investigate the level of Internet experience between the four age groups we asked the participants to tell us whether they had used or would like to use different Internet features, such as email, online banking or voice calling (e.g. Skype). The most popular Internet features used by all age groups were email and Internet search applications, followed by photographic applications (see Figure 1). Very few older adults (65+ years) said that they stored music on a computer and only 1% of this age group said that they would want to. We found that Internet voice calling was the most popular of the Internet features that participants said they would like to use. Non-parametric tests showed that there were significant age-related differences for all currently used Internet features ($p < 0.05$). There were fewer differences between the younger age groups (18-29 and 30-49 years) except for Skype use.

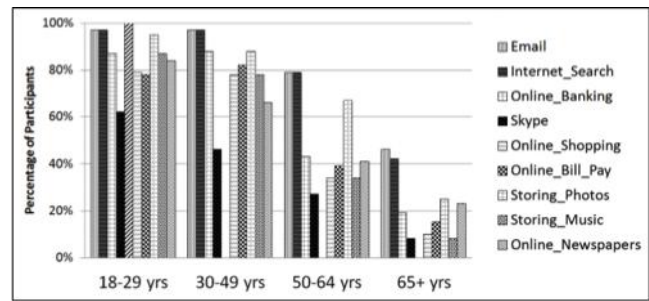


Figure 1. Percentage of participants in each age group using different Internet features.

Although older adults typically have less experience using the Internet and ICT, this does not imply that they do not own a computer or that they are not willing to learn how to use them. Therefore, we were interested in learning whether people owned their own computer, or if not whether they used one in another location and what level of training, if any, they would like in order to learn how to use computers. When asked whether they owned a computer in their home, 95% of people aged 18-29, 98% aged 30-49, 80% aged 50-64, and 50% 65+ years and over said that they did own a computer. Unexpectedly, the over 65 age group were the only age group to show an interest in owning a computer if they did not already have one. Half of this age group did not own a computer but 23% said they would like to own one.

With regard to training, nearly three quarters (72%) of all participants said that they would like some level of training. More people in the older groups said that they would like a higher level of training compared to the younger age groups. This is very encouraging feedback as, although individuals in the older groups are less exposed to computer use, they expressed a keen interest in learning and developing their ICT skills.

4.1.2 Mobile phone experience

Research has shown that older adults are less likely to use mobile phones than younger adults [9]. With a multitude of mobile phone features currently available we were interested in knowing to what extent people are using various features on their mobile phones. We asked participants to rate whether they had ever or would like to use various mobile phone features including: the call function, text messaging, camera, picture messaging, radio, Internet, Bluetooth and music functions. The participants' responses showed that the call function and text messaging were the most frequently used functions for all age groups (see Figure 2). The 50-64 age group used less functions than their younger counterparts, however the utility of the camera function and picture messaging was relatively high. A further drop could be seen for the oldest age group. Only 20% of the over 65 age group said that they used the camera function on their phone compared to 70% in the 50-64 age group, 91% in the 30-49 age group and 82% in the 18-29 age group. These results are consistent with previous research studies that found that older adults' use of mobile phones is limited to basic functions such as making calls and sending text messages [19].

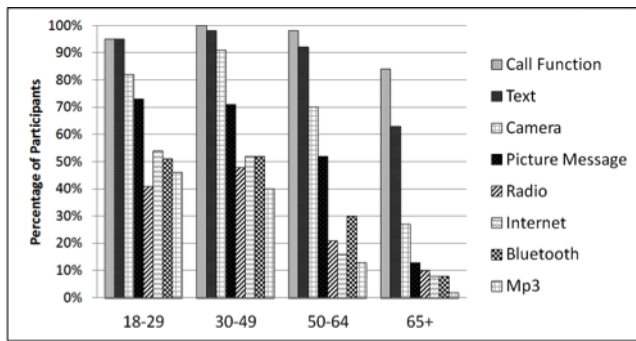


Figure 1. Percentage of participants across all age groups using mobile phone features.

4.2 Anxiety towards Computers

It is often cited that anxiety and unfamiliarity are two common factors of non-use of technology amongst older people. For example, Jay and Willis [18] examined older peoples' attitudes toward computers before and after computer training, and they found that experience modified attitude. However, previous studies have shown that older adults are more likely to report feelings of anxiety toward computers compared to younger people [3]. Similar results were found in our study of anxiety toward computers which included questions taken from the Computer Anxiety Questionnaire [17]. Participants who had access to a computer responded positively to the statements in the questionnaire, however there were no differences between positive and negative responses for participants who did not have access to a computer.

Non-parametric tests showed that there were significant age-related differences for; not being confident of being able to learn computer skills [$\chi^2(3, N=220) = 13.30, p=0.004$]; feeling apprehensive [$\chi^2(3, N=220) = 17.92, p= 0.00$]; a fear of making mistakes [$\chi^2(3, N=220) = 19.4, p = 0.00$]; a feeling of not needing to use computers [$\chi^2(3, N=220) = 13.57, p = 0.00$]; and being unsure how computers would benefit them [$\chi^2(3, N=220)=13.22, p = 0.004$]. In general, the older group felt confident that they could learn how to use a computer. For example, 59% felt they were confident in learning computer skills while only 12% felt they would not understand computer terms and jargon. Only 14% were afraid of becoming dependent on computers whereas 80% felt that anyone could learn to use a computer if patient and motivated.

4.3 Use and Attitude towards Everyday Technologies

4.3.1 Technology use for everyday tasks

More than half (55%) of the participants said that they conducted *financial transactions* on a weekly basis. There was an age-related decline for participants who reported daily financial transactions. Looking more closely at the methods it could be seen that younger participants (18-29 and 30-49 age groups) were most likely to use Internet banking, whereas older participants (50-64 and more so 65+ age groups) preferred conducting financial transactions face-to-face with a banking employee. Automated teller machines were popular with all age groups however the frequency of use declined with age.

The majority of participants (84%) said that they *communicated* with other people on a daily basis, with a slight age-related decline (25% age 18-29; 23% age 30-49; 20% age 50-64 and 16%

age 65+). Younger participants (18-29 and 30-49 age groups) most frequently used mobile phone and email to support communication. Participants in the 50-64 group favoured mobile phones, followed by the house telephone and email, whereas participants aged 65+ used the house telephone more often than their mobile phone, while only a small proportion frequently used email.

The majority of participants said that they *shopped* on a weekly basis. Older adults were the least likely to use technology to support shopping activities, with 60% of those aged 65 and over never using online shopping and 45% of this age group never using a supermarket self-checkout. Although the younger age groups reported using these technologies they did not use them frequently.

A moderate 47% of participants said that they carry out a *hobby based activity* on a daily basis and 38% said they do so on a weekly basis. We asked the participants if they had ever used devices to support these activities and if so how frequently. Again, older adults were the least likely to have ever used technology to support their hobbies. The most popular devices used by all age groups were recording and playback devices (mp3, CD, or DVD player). A digital camera was the second most popular device used and was used most often by younger age groups. A small proportion of older adults said they played video games (23%), used a digital camera (32%), fitness device (19%), or a computer for hobby specific use (31%) either sometimes or often.

There are many technological options for people *travelling* from place to place. 70% of the participants owned their own vehicle and mostly drove on a daily basis. There was no age-related difference. The youngest age group used public transport the most frequently and were the most likely to use technology such as Internet travel schedules, self purchase ticket stations and airport check-ins. Parking self-payment was regularly used by all age groups.

4.3.2 Attitudes towards everyday technologies

To understand how people of different ages perceive the difficulty of ICT and household technologies, we asked our participants to rate on a 5-point scale whether they found items very easy or very difficult to use. These items included a computer, Internet, email, mobile phone text and call, microwave, digital camera, radio, house alarm, television and DVD/VCR player. A similar trend was seen for all age groups, with more participants finding the technologies easy or very easy to use than those who found them difficult (see figure 3). It was found, however, that as age increased there was a higher number of respondents who perceived the technologies to be difficult to use. Surprisingly, one type of technology which seemed to cause considerable difficulty for the participants was a DVD/VCR player, despite this being the most popular entertainment device used by all age groups. Radio and televisions were rated as the easiest technologies to use. Respondents aged 65+ found the radio, television, microwave and the call function on a mobile phone to be very easy to use.

Non-parametric tests were carried out to explore whether there were significant differences for the perceived difficulty of devices in the home in relation to age. The results show a significant increase in perceived level of difficulty with age for computers, Internet and email use, mobile phone texting and calling, digital cameras and DVD or VCR player ($p < 0.05$). There was no age difference for the perceived difficulty of the radio, house alarm, television or microwave ($p > 0.05$). There were no differences

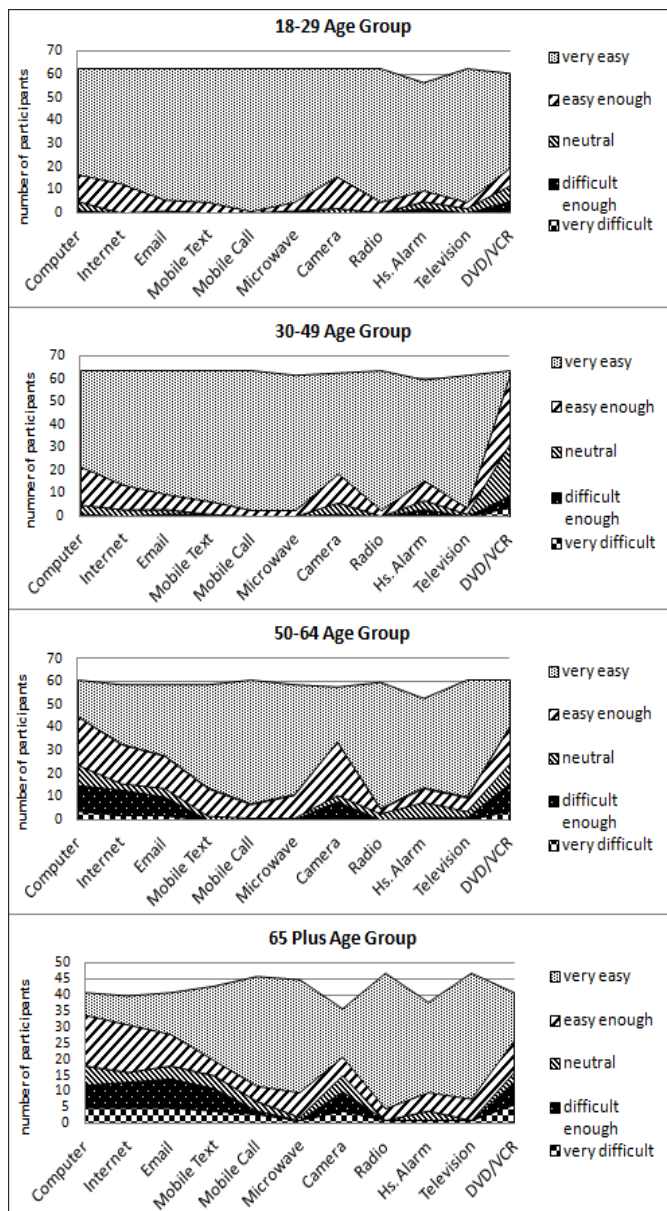


Figure 3. Perceived difficulty of devices for each age group; 18-29 years (top), 30-49 years (middle-upper), 50-64 years (middle-lower) and 65+ years (bottom).

between the 18-29 and 30-49 age groups and very little differences were found between the 50-64 and 65+ age groups. However there were significant differences between the 18-29 and 30-49 age groups with the 50-54 and 65+ age groups.

5. DISCUSSION AND FUTURE WORK

Understanding older adults' lifestyles and how technology fits into their everyday experiences is fundamental for guiding the design of technology. The goal of our questionnaire study was to explore the use and acceptance of everyday technologies across different age groups and to consider how the findings can be implemented into the design of future household technologies. The factors that exhibited most prominence from the results of our questionnaire were:

- A large majority of the older adults either own a computer or would like to own one. The findings emphasised not only the awareness of older adults of the different types of technologies but also a willingness to learn how to use them given the opportunity.
- There was a focus on social interaction for the older age group in relation to the methods that they used to carry out everyday tasks and the technology features that they were most interested in learning.
- Although there is an age-related increase in perceived difficulty of some types of technologies, many household technologies maintain intergenerational usability. We now discuss these findings and their implications for future technology design.

5.1 Technology Experience and Acceptance

Overall the findings from the questionnaire study showed that a higher number of younger adults are using more types of devices compared to older adults. However, there was a lot of variance for technology experience and attitude within the older age groups. A large number of the older respondents said that they were confident in their abilities to learn computer skills and the majority believed that anyone could learn provided they had the time and patience. This response is very encouraging as it shows that older adults do not feel defeated by the rapid evolution and ubiquitous nature of technology. The issues that did concern the older group were how computers could be of benefit to them and not feeling that there was a need to use them. Technology companies tend to target their products, such as mobile phones or computers at younger generations emphasising a multitude of functions for entertainment or business purposes. It is not surprising therefore that older adults are not aware of how they can benefit from commercially available devices.

There were age-related differences reported for feeling apprehensive using technology and being afraid to make mistakes. Providing better support for training such as documentation or visual demonstrations on screen displays could support this need. Providing adequate training is also key to successful adoption [7].

5.2 Technology to Support Social Interaction

Throughout the analysis of this questionnaire a common thread was the importance of social connectedness and an interest to learn to use communication applications, such as mobile phones and Internet voice calling (e.g. Skype). The benefits of communication devices are that they can fulfil a number of roles, including a sense of security and peace of mind, connectedness to the outside world and enjoyment. Although many older adults wish to live independently in their homes [7], social interaction remains an important factor for everyday well-being. The results of this study suggest that the key to a successful assisted living environment is to integrate technology that will support the older user through social connectedness.

From our study we have discovered that older adults are aware of modern technologies, and many are already using them. We found that Internet voice calling and video conferencing emerged as the two most popular features people would like to use, across all age groups. These findings further highlight that older adults perceive communication technologies as worth learning.

Mobile phones are another example of the popularity of communication devices. With regard to mobile phone experience, calls and texts are the most used functions by older participants, with all other features rarely used. Again, this highlights the

importance of communication. A study conducted by Mallenius et al. [20] found that older adults used mobile phones for increased feelings of security and to be reachable. They also found that perceived benefit was the largest contributing factor to usage of a mobile phone by this age group.

Services such as shopping, making reservations and performing financial transactions are becoming more accessible through online or interactive kiosk methods. In fact some banks now only work with online banking transactions. Some of the benefits of these digital services are that they can be carried out in your own time, you can quickly shop around different stores for comparisons, products can be delivered to the door and people with mobility difficulties can conduct their business from their home. From our study we found that younger adults (18-29 and 30-49 years) were the most likely to use technology to support everyday tasks. The 65+ age group were the least likely, favouring face-to-face transactions. Although there are benefits of technology-mediated services for people of all ages, usage is still low amongst older adults who may be at risk of being left behind if such digital services do not take account of their needs. There may be other factors to consider aside from the accessibility of online services. For example, we have mentioned that communication and social interaction is important to older adults. Therefore, conducting face-to-face transactions may be an important part of their day. One possible solution could be to offer a video-call service for online transactions to allow older users to interact with service providers. With 80% of respondents aged 50-64 and 50% of those 65 years and over owning a computer this service should be feasible to implement.

The evidence associating social interaction with various health metrics (physical, mental, mortality rates) has been well documented over many years. This association occurs across the entire age spectrum, but is particularly prevalent in older adults where there is evidence linking meaningful and sustained social interaction to reduced risk of diseases and conditions such as dementia [28] and coronary disease [23]. Despite this, few people realise the health risks associated with social isolation. Communication technologies are a way of maintaining existing social connections as well as facilitating the creation of new ones. Such technologies have huge potential to increase the wellbeing of older people, without being perceived as medically necessary or 'assistive'. This lack of associated stigmatisation, coupled with the fact that survey respondents in the older age groups expressed an interest in communication technologies, increases the likelihood that such technologies will be both accepted and adopted.

5.3 Intergenerational Usability of Household Technologies

Considering the needs of older adults when designing technology increases the accessibility and ease of use for all users. Hanson [16] on the other hand believes that understanding the strengths of the older age group, rather than focusing on weaknesses and disabilities, should be the way forward in technology design for older people. For example, we found that older adults had little or no difficulty using household technologies such as the radio, house alarm, microwave or television. Using these technologies to support assistive applications is a potential method to increase usability. A first step to utilising these household technologies as platforms for other applications has already been made. For example, Carmichael et al. [6] investigated the use and acceptance of a physical exercise application on a digital television platform

for older users. Although there was not a significant health benefit found from using the application there was a positive impact on mood and well-being. The CASALA centre in Dundalk is also currently exploring how to use interactive television to increase the accessibility of the Internet for older adults. We envisage that by integrating assisted living technologies with these familiar, easy-to-use technologies, the probability of user acceptance and adoption would increase.

Usability is not always a predictor of frequency of use. Interestingly we found that although DVD/VCR players were the most frequently used device for entertainment/hobby purposes (when compared with computers, video games, digital cameras or fitness devices), according to our respondents they are not necessarily easy to use. All age groups reported having difficulty using this device. This finding suggests that even poorly designed technology will be used if the functionality is found to be useful. However, with good design and training documentation, technology in the home should be accessible to all users.

6. CONCLUSION

By identifying current practices, problems and preferences for everyday tasks we can design technologies that can offer support to people within their lifestyles. The aim of this questionnaire study was to gain an understanding of what technologies people are using or not using, and what factors influence their experience. A significant amount of information was gathered in relation to these factors, in particular regarding technology experience and acceptance, supporting social interaction and intergenerational usability of household devices. These findings will be used to guide and support phase 2 of our research project towards the design of future devices for intergenerational use.

7. ACKNOWLEDGMENTS

This research is funded by the Science Foundation Ireland under Grant No. 07/CE/I1147. Author Niamh Caprani is supported by the Irish Research Council for Science Engineering and Technology, Embark Initiative.

8. REFERENCES

- [1] Alm, N., Gregor, P., Newell A.F. (2002). Older people and information technology are ideal partners. *Paper presented at the International Conference for Universal Design 2002*. Yokohama, Japan.
- [2] Bieber, G., Koldrack, P., Sablowski, C., Peter, C., & Urban, B. (2010). Mobile physical activity recognition of stand-up and sit-down transitions for user behaviour analysis. *Paper presented at PETRA 2010*. Samos, Greece: ACM.
- [3] Bjorklund, B.R., & Bee, H.L. (2008). *The journey of adulthood* (6th Ed). Upper Saddle River, NJ: Pearson Prentice Hall.
- [4] Bouma, H., Fozard, J.L., Bouwhuis, D.G., & Taipale, V. (2007). Gerontechnology in perspective. *Gerontechnology*, 6(4), 190-216.
- [5] Bouwhuis, D.G. (2003). Design for person-environment interaction in the older age: A gerontechnological perspective. *Gerontechnology*, 2(3), 232-246.
- [6] Carmichael, A., Rice, M., MacMillan, F., & Kirk, A. (2010). Investigating a DTV-based physical activity application to facilitate well-being in older adults. *Paper presented at BCS HCI 2010*. Dundee, Scotland: ACM.

- [7] Charness, N., & Jastrzembski, T.S. (2009). Gerontechnology. In P. Saariluoma & H. Isomaki (Eds.), *Future interaction design II* (1-29). London: Springer-Verlag.
- [8] Coughlin, J.F., Pope, J.E., & Leedle, B.R. Jr. (2006). Old age, new technology, and future innovations in disease management and home health care. *Home Health Care Management Practice*, 18, 196-207.
- [9] Cullen, K., Dolphin, C., Delaney, S., & Fitzpatrick, M. (2008). *Survey of older people and ICTs in Ireland*. Retrieved from www.ageaction.ie/userfiles/.../survey-of-older-people-andicts-in-ireland.pdf
- [10] Czaja, S. J., Charness, N., Fisk, A. D., Hertzog, C., Nair, S. N., Rogers, W. A., & Sharit, J. (2006). Factors Predicting the Use of Technology: Findings from the Center for Research and Education on Aging and Technology Enhancement (CREATE). *Psychology and Aging*, 21, 333-352.
- [11] Czaja, S., Guerrier, J., Nair, S., Landauer, T. (1993). Computer Communication as an Aid to Independence for Older Adults. *Behaviour and Information Technology* 12(4), 197-207.
- [12] Doyle, J., Bailey, C., Dromey, B., & Ni Scanail, C. (2010). BASE – an interactive technology solution to deliver balance and strength exercises to older adults. *Paper presented at Pervasive Computing Technologies for Healthcare 2010*. Berlin, Germany: IEEE.
- [13] Doyle, J., O’Mullane, B., O’Hanlon, A. & Knapp, B. (2011). Requirements gathering for the delivery of healthcare data in aware homes. In *5th Intl Conference on Pervasive Computing Technologies for Healthcare*, IEEE.
- [14] Doyle, J., Skrba, Z., McDonnell, R. & Arent, B. (2010). Designing a touch screen communication device to support social interaction amongst older adults. *Paper presented at HCI 2010*. Dundee, Scotland: ACM.
- [15] Findlay, R. (2003). Interventions to reduce social isolation amongst older people: where is the evidence? *Ageing and Society*, 23(5), 647-658.
- [16] Hanson, V.L. (2010). Influencing technology adoption by older adults. *Interacting with Computers*, 22, 502-509.
- [17] Heinszen, Jr. R., Glass, C., & Knight, L. (1987). Assessing computer anxiety: Development and validation of the Computer Anxiety Rating Scale. *Computers in Human Behaviour*, 3, 49-59.
- [18] Jay, G.M., & Willis, S.L. (1992). Influence of direct computer experience on older adults’ attitudes toward computers. *Journal of Gerontology: Psychological Science*, 47(4), 250-257.
- [19] Kurniawan, S. (2008). Older people and mobile phones: A multi-method investigation. *Int. J. Human-Computer Studies*, 66, 889-901.
- [20] Mallenius, S., Rossi, M. & Tuunainen, V.K. (2007). Factors affecting the adoption and use of mobile devices and services by elderly people – results from a pilot study. Proceedings of 6th Annual Global Mobility Roundtable, Los Angeles.
- [21] Mayhorn, C.B., Stronge, A.J., McLaughlin, A.C., & Rogers, W.A. (2004). Older adults, computer training and the systems approach: a formula for success. *Educational Gerontology*, 30(7): 573-585.
- [22] Olivier, P., Xu, G., Monk, A., & Hoey, J. (2009). Ambient kitchen: designing situated services using a high fidelity prototyping environment. Paper presented at PETRA 2009. Corfu, Greece: ACM.
- [23] Rosengren, A. (2004). Coronary disease in relation to social support and social class in Swedish men: A 15 year follow up in the study of men born in 1933. *European Heart Journal*, 25, 56-63.
- [24] Sainz-Salces, F., Baskett, M., Llewelyn-Jones, D., & England, D. (2006). Ambient interfaces for elderly population at home. *Ambient Intelligence in Everyday Life*, 256-284.
- [25] Selwyn, N. (2004). The information aged: A qualitative study of older adults; use of information and communication technology. *Journal of Ageing Studies*, 18, 369-384.
- [26] Selwyn, N., Gorard, S., Furlong, J. & Madden, L. (2003). Older adults’ use of information and communication technology in everyday life. *Ageing & Society*, 23, 561-582.
- [27] Umemuro, H. (2004). Computer attitudes, cognitive abilities and technology usage among Japanese older adults. *Gerontechnology*, 3(2), 64-76.
- [28] Wang, H., Karp, A., Winblad, B., & Fratiglioni, L. (2002). Late-life engagement in social and leisure activities is associated with a decreased risk of dementia: a longitudinal study from the kungsholmen project. *American Journal of Epidemiology*, 155, 1081-1087.