A Collaborative Change Experiment: Telecare as a Means for Delivery of Home Care Services

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Abstract. This paper presents a collaborative change experiment that introduces telecare as a means for delivery of home care service. The television is used as platform for delivery of services from the home care nurses to the elderly care recipients. Through the collaborative change experiment, we seek to address the interdependent relationship between the home care nurses and the elderly by studying the usability and user experiences on both sides of the interaction. Our work includes usability testing with the aim of optimizing the design of telecare. This paper reports findings concerning the spatial design, compensation of declined motor skills, audiovisual considerations and control mechanisms.

Keywords: usability testing, elderly, telecare, collaborative change experiment.

1 Introduction

Norwegian health authorities have designated telecare as one of several welfare technologies that can be useful in future elderly care [1]. Increased focus on community care and follow-up assistance in the home is specifically aimed at those living in care homes or those who have recently returned from hospital admission [1, 2]. It is also important to encourage the home dwellers to partake in everyday preventive rehabilitation and keep them at a level of comfort and safety that postpones the admission to care home or nursing home. The main motivation of the government is the necessity of managing scarce health resources more efficiently in order to serve a rapidly growing elderly and chronically ill population. In addition, the municipal health care sector has been through major changes during the past decades, with home care services growing in scope of human resources and service tasks [1-3]. 40 years ago, the municipalities spent 80 percent of their operating expenses on retiring and nursing homes, and barely 20 percent on home care services [1]. Today, the annual operating expenditure of approximately 70 billion NOK is almost equally divided between the home care services (160 000 recipients) and nursing homes (40 000 nursing beds) [1]. The home care service struggles with the constant expansion of service tasks and increasingly need of staffing. According to an estimate from the Directorate of Health [2], the required personnel in health and care services will increase by approximately 50 percent, equal to 60 000 positions, within 2030. This illustrates the need to study alternative ways of delivering home care services, and how services can extend to professions other than merely skilled health care workers.

A. Marcus (Ed.): DUXU 2014, Part III, LNCS 8519, pp. 141–151, 2014.

Although telecare in the home is not a new invention, there is limited empirical research concerning practical usability testing of telecare interface. Hence, this paper contributes to the HCI-community by adding to existing research literature with findings from our usability study aiming to optimize the design of telecare. The study is based on fieldwork at Kampen Care+, a local care home building in Oslo, as well as studies of the work practice of the home care service in the district of Gamle Oslo. Kampen Care+ consists of 87 care homes for elderly who are unable to live independently. In order to introduce telecare as a means for delivery of home care services, we have designed a collaborative change experiment consisting of five activities. The change experiment is a part of a long-term study, and set to last for a period of nine months. We are currently six months into the experiment, and this paper reports from the three first activities of the collaborative change experiment with focus on findings from the usability testing.

The paper is organized as follows. Chapter 2 presents an overview of related HCI-studies including cooperative work, older home dwellers, television interfaces and telecare. Chapter 3 describes the collaborative change experiment. Chapter 4 lists the usability test results. Chapter 5 presents findings based on results and relates these to previous work within HCI.

2 Related Work

Several prior HCI studies have reported results and findings from collaborative or interactive services where elderly people use the television from their home as a platform to receive telecare or similar services.

In [4], the authors develop and test a social television system for the elderly that encourages increased communication among the elderly in the community. Their findings suggest that design process of the social network for elderly users should use a stepwise approach where the elderly begin by interacting locally with people they already know, before expanding the design to include larger user groups.

Several articles have addressed the age-related challenges when designing for the elderly [5-8]. [9] stress the importance of user-centered interface designs for the elderly and presents a number of challenges that may have impact on the design for the elderly including cognitive, physiological and psychomotor abilities. Since the call for research concerning how to make interfaces usable for older people in [9], several authors have contributed with new knowledge, e.g. [10, 11]. Further suggestions encourage studying elderly who already master the interface in the search for compensatory strategies that may be generally applicable to this user group in order to improve the user experience. [12] also bring attention to the user needs of elderly and the design implications for HCI. Their study is based on findings from structured interviews with health professionals and elderly people. The authors express concern about technologies used for monitoring brings very little attention to the social context of the home.

[13] continues the discussion on how the design of technology can meet the needs of the elderly. They point out that previous studies, e.g. [9], mainly deal with physical, sensory and cognitive limitations that come with aging, while they

themselves believe that one should also include aspects of *"privacy, acceptability, stigma, control, trust, choice and social alienation"* (p. 614) into the design process. Specifically, they believe that privacy and trust are key elements when HCI research enters private homes and communities. They also encourage exploring the need for user interfaces that stimulate *"healthy behavior such as exercise, medication management and social interactions"* (p. 619). [14] has taken a human factor approach in their study of HCI and telecare. Their contributions of the study are three guidelines for user experience that includes users' trust, their cooperation, as well as the service aspects of telecare.

[10] have studied elderly people's problems and experiences with interactive television (iTV). The authors point out that the television has evolved from a one-way monologue into a communications platform by offering more dialogue-based services. They also argue that an iTV provides more *"complex interaction paradigm"* (p. 13) since it usually involves additional equipment such as set-top box, additional monitor and media streaming device. Based on explorative interviews of 11 participants aged 60-69 years and a survey answered by 51 participants in a bingo center, they present 10 design guidelines for user interfaces of iTV services tailored for the elderly. Their guidelines include easy navigation, one universal remote control with simplistic design, use of certain colors to achieve optimal contrast between foreground and background, scaling of subtitles, as well as removing or hiding selected iTV services.

3 Collaborative Change Experiment

We have designed a collaborative change experiment consisting of five sequential activities. Through these five activities, we aim to experiment with alternative solutions to existing routines in the delivery of home care services. Our goal is not to bring in a permanent change, but rather to explore underlying issues and gain a deeper insight that may contribute to a future permanent change. To address the inter-dependency we have designed our collaborative change experiment in such a way that it captures challenges on both sides of the service.

Two traditional task-centered user evaluations make out the key activities in our change experiment, respectively one round of usability testing and one round of diagnostic evaluation. [15] mentions that few systems are mature enough when delivered to be accepted by the intended user group, and [16] mentions that technology-enabled assistive systems that aims to cover enhanced communication should include an extensive user evaluations. Common for both of these activities is that they have been expanded from a traditional user-observer setup to a parallel experiment where we have users and observers on both sides of the service simultaneously.

In addition to these two main activities, we have supplemented the collaborative change experiment with three supporting activities that we believe helps strengthen the design process, as well as make it more coherent. Through these auxiliary activities, we (1) address some of the challenges that are not directly covered by usability testing and diagnostic evaluation, and we (2) gain important input that contribute directly towards the facilitation of the usability testing and diagnostic evaluation. Figure 1 illustrates the five activities and their order.

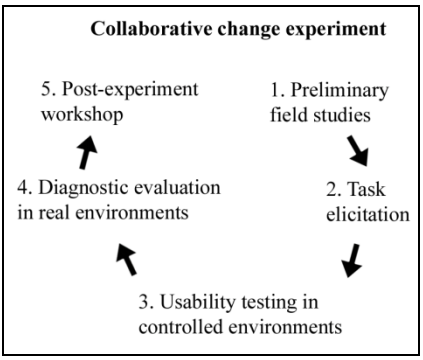

Fig. 1. Overview of the activities in the collaborative change experiment

3.1 Preliminary Field Studies

In [12], the authors present an approach to the design process where one sees past the ergonomic and purely physiological symptoms of aging, and rather focuses on addressing the actual needs of the elderly on a "higher level" (p. 674). Similar to (ibid) we wanted to approach our experiment with initial fieldwork on both sides of the service. On side of the elderly, we carried out fieldwork to get closer to the potential end-users. We wanted to immerse ourselves in the field in order to capture the social context in which we design. We also wanted to be as close to the actual use context of the technology, and as a result we did not only do interviews with them about where in the house they would prefer to have the technology placed, but we also had them invite us home and show us. They even let us move furniture and equipment around to explore different options. Furthermore, we also considered fieldwork necessary to establish confidence as it often takes time to gain acceptance in such a user group. [17] points out that it usually takes "a significant amount of time" (p. 69) to develop the local culture through which one wins their hearts and minds. By taking on the approach of [12], we simultaneously acknowledge that the elderly are individuals rather than one big homogenous group. Therefore, we demanded from ourselves that we do not overlook individual needs by generalizing the group as a whole, by rather aimed to address these individual challenges through the design. The elderly often struggle with explaining, and even understanding, their own declining functional capabilities, e.g. failing memory. Rather than having elderly non-technical people suffering from individual issues explaining challenges with the interface and interaction, we chose to look for these issues through observation.

On the other side of the interaction, the fieldwork mainly consisted of shadowing nurses during their work practice. We, along with our master students, have shadowed 30 visits into the homes of the elderly. With the exception of a few sensitive cases, we were invited along with home care nurses to watch and take notes, even though there were cases of partial nudity, heavy medication and bathroom assistance. Similar to the elderly, we do not see the home care nurses as one homogeneous group. To better understand their varying backgrounds we followed seven different home care nurses while they were delivering services, and how they experience it.

3.2 Task Elicitation

The purpose of the task elicitation was twofold. Firstly, we wanted to find representative tasks of home care nurses' work. By representative tasks, we mean tasks that (1) are often performed by nurses, preferably up to several times a day, and that (2) covers the needs of most residents in Kampen Care+. Secondly, we searched for tasks that were transferable. The home care nurses provide a range of services out of which only some are appropriate for telecare. By transferable tasks, we mean tasks that may be delivered without the physical presence of the homecare nurse, as opposed to certain tasks, e.g. helping the elderly take a shower or preparing their food, that necessarily require a physical interaction between the elderly and the home care nurse. However, transferable tasks are not guaranteed to be suited for delivery through the television. The goal of this task elicitation is only to filter out tasks that are both representative and transferable, and it is through the two activities of testing we determine which tasks better suit delivery through telecare.

Through our fieldwork, we registered difference in opinions about tasks frequency and task importance, even between nurses working within one team. The difference was mainly based on their professional responsibility as some were home care nurses and some were assistant nurses, although we also saw clear signs of difference in opinion between daytime nurses and nighttime nurses. To solve this difference of opinion we brought together representatives from all organizational units at the home care service. This gave us a forum in which all considerations could be taken, and the workshop yielded a list of tasks presented in Table 1.

Table 1. Overview of elicited tasks for the diagnostic evaluation and the usability testing

Task for diagnostic evaluation	Task for usability testing
1. Regular visit and examination of general condition	1. Answering a call 2. Registering calls at unscheduled times 3. Validating text sizes and readability 4. Zooming in on the body 5. Testing the sound level 6. Testing sound clarity during dialogue 7. Simultaneous movement 8. Testing picture clarity (color and sharpness) 9. Panning between feet and head 10. Turn and move the camera 11. Testing the light conditions
2. Help with taking medications	
3. Taking care of physical wounds	
4. Put on aid stockings to prevent edema	
5. Exercises from occupational therapists	

3.3 Usability Testing

The Setting. Kampen Care+ consists of 87 home care apartments, as well as 1 showroom apartment that have been dedicated to our research for testing purposes. It provides a near-real setting familiar to the participants and gives us the desired control over the environment without compromising the aspect of realism too much. The apartment is not very decorated, although we have recreated the sofa and television setting in which the interaction takes place.

The Design. The usability test is designed to include two participants at a time, one home care nurse providing a service from his office, and one elderly person receiving the service in our apartment. Both sides were equipped with 40-inch televisions and state of the art video conference wide-angle cameras. We have taken the role of observers on both side during the test and made parallel observations rather than forcing ourselves as evaluator to simulate realistic conditions and challenges. If we had chosen to either simulate one side of the interaction or conduct non-parallel observations, minor circumstantial changes could have given unfortunate bias in the measurement. Figure 2 illustrates the setup of the usability test, while Figure 3 shows photos taken during the usability testing.

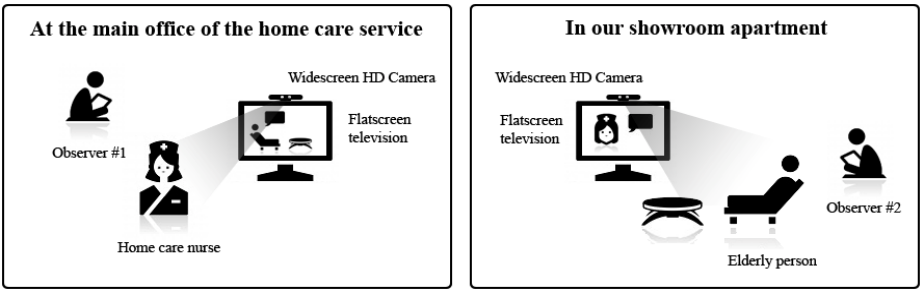

Fig. 2. Illustration of the setup of the usability test

Fig. 3. Photos taken during the usability test with the home care office on the left, and two participants from our showroom apartment on the right

Participants. We deliberately tried to avoid only including participants who were already well acquainted with various technology and different types of interfaces, even though some studies, e.g. [9], suggest making an effort to gather expert users. Very few of the residents at Kampen Care+ that would qualify to the definition given

of expert users in (ibid) currently receive any home care services. For this reason, including only such elderly would yield participants that would contribute well in regards to the technical aspects, but would simultaneously lack personal knowledge of the home care services. Their statements would then not be based on personal experiences, but rather be purely analytical. As a result, we chose to prioritize the recruitment of a representative user group that mainly consisted of elderly who currently received home care services. [17] point out that the introduction of telecare requires a system able to meet the varying needs of the participants. Our selection of participants consisted of elderly with various health issues, as well as various prior experiences with technology. In regards to differences in gender, we did not make a distinct effort to recruit an equal number of men and women, despite some research, e.g. [11] referring to a "gender gap" (p. 8). Given the high average age of 83 year at Kampen Care+ the proportion of women was slightly higher in our selection. Nevertheless, we did not notice any increased anxiety or increased uncertainty related to technology even though (ibid) suggests that these traits can be prominent for elderly women interacting with technology.

At the home care service's side of the interaction, the participants were all home care nurses and assistant nurses. The experiment took place during their regular working hours in their own workplace built around their daily routines. Even though these nurses should not be regarded as one homogeneous group, the recruitment of participants was still a much more trivial affair than the recruitment of the elderly who receive the service. There is much less fluctuation in this group in terms of background and technical expertise. All participants were employable and functionally healthy people. As a result, we anticipated little observable difference in their interaction with the system.

4 Results

This chapter reports the result from the usability testing described in the previous chapter. The results are based on data gathered from eight in-depth sessions where we tested the tasks elicited for the usability testing. All eight participants were originally scheduled to test with our setup, including the television-camera solution described in the previous chapter, although two participants had to test on tablet devices due to immobility of that rendered them unable to come to our showroom apartment. Three participants wore glasses due to vision loss, one participant had reading glasses. One participant used a hearing aid. One participant said that he had a hearing loss in the sense that he heard what was said, but struggled understanding the meaning of words. The participants were asked to rate the audiovisual quality on a scale from 1 to 10, where 1 was very poor and 10 is excellent.

The participants were given brief instructions ahead of usability testing session including instruction of how to operate the remote controller. Three participants needed additional instructions along the session; however, they all manage to operate by themselves afterwards. We found no user problems with the two tasks (9) panning between feet and head and (10) turn and move the camera. Table 2 gives an overview of the user problems identified with the remaining tasks.

Table 2. Overview of tasks and the identified user problems

Task	Comment
1. Answering a call	• Poor colors contrast between the black background and the off-white foreground on the buttons. • Difficulty understanding if the button push has been registered.
2. Registering calls at unscheduled times.	• Some preferred the low-frequency alternative ringtone. • Ringtone should not be too similar to other devices. • Default ringtone is too close to sounding like a fire alarm. • Too long response time for television to turn on after incoming call has been accepted.
3. Validating text sizes and readability	• The language was unclear in some cases.
4. Zooming in on the body	• The zooming does enlarge an area, but does not result in a clearer picture.
5. Testing the sound level	• Microphones are very sensitive and thereby susceptible to interference and noise.
6. Testing sound clarity during dialogue	• Impaired sound due to room acoustics and reverberating. • Few cases of the sound appearing to be choppy.
7. Simultaneous movement	• The picture sometimes became unclear in situations with rapid movement or too much rocking back and forth. • Movement that covers and uncovers light sources may cause disturbance that requires the camera to readjust the aperture.
8. Testing picture clarity	• Unclear picture in some cases due to network issues.
11. Testing the light conditions	• Camera is too sensitive to changes in the light levels. • Different preferences on amount of light. Some preferred blurry lighting, while other disliked too strong lighting.

5 Findings

5.1 Spatial Design – Lighting and Acoustic

A key finding in our study is that when using a television in combination with a wide-angle camera that covers a larger area, it requires us to factor in spatial issues that are not prominent when interacting via a computer, tablet or mobile phone. In our case, one example of how the spatial design and arrangement affected the user experience during the video consultation was the lighting in the showroom apartment. During the usability testing, the room was lit by one single ceiling light that was placed noticeably far away from the sitting area and where the television resided. While the camera was usually able to compensate for low-light settings by increasing the exposure, the amount of light and the placement of the light source in relations to the camera became a noticeable factor. Similarly, we have observed floor or wall lamps in all the apartments we have visited at Kampen Care+, and these may easily generate too much artificial light making the picture overexposed. We stress this point because bad exposure, in either direction, may prevent the home care nurses from getting all the visual information they need, e.g. when looking for swelling or bruises.

Another aspect of spatial design is the room acoustics. One of the participants quickly pointed out that the voice reverberated in the room. When using camera-microphones designed to capture voice from distance, i.e. the distance between the television and sofa, acoustical consideration should also be taken into account. Admittedly, our showroom apartment is very primitively furnished, yet it is a significant point that even physical non-technological elements of the room such as the furniture may affect the user experience. In addition, open windows may cause noise and interference that disrupts the conversation. This was very evident in our case since the balcony and all major windows are placed adjacent to the television outlet. Similarly, for the home care nurses who were in a meeting room we also observed minor disturbances in the room, e.g. noises from ventilation.

5.2 Television Helps Compensate for Declined Motor Skills

Many user problems arise due to the inability for technology to adapt to motor challenges, which is a very prominent challenge among elderly. Several studies, e.g. [9-11], points out the importance of recognizing the physical capabilities of the elderly. By choosing a solution that is based around the television, i.e. a stationary device, we prevent the elderly from being confronted with their declined motor skills when using the system. Despite the fact that most of our participants had clear physical challenges, no one struggled interacting with the system as a result of their declined motor skills; this was not only the case for those with walkers, even our participant who was partially paralyzed and only had one functional arm was able to operate the system. We noticed no difference in the way they interacted with the system in comparison to the more functionally healthy participants. However, this still imposes strict requirements for design of the interaction mechanism, e.g. the remote control, since some challenges like rheumatism, are not automatically solved with this setup.

5.3 Audio-visual Considerations

Two participants struggled to capture high frequency sounds, which may indicate and support finding from [9] that interfaces using sound to get the user's attention will need to use lower frequency sounds for elderly users. Ringtones and other sounds used for signaling should therefore be in a lower frequency range to support age-related hearing impairment, or at least allow for individual adjustments of sound.

We also found some interesting traits in regards to visual considerations. When the home care nurse moved too much or too abruptly, the elderly quickly commented that the movement was disturbing and one even mentioned dizziness as a potential symptom. In addition, for infrastructure with bandwidth issues, too much movement might result in a choppy video transmission. The elderly preferred a minimum of motion from the home care nurse, partly due to dizziness, but also because they felt it created an unbalance where one participant was sitting and the other was vastly moving, thereby creating a disturbance in the dialogue.

It should also be possible to adjust the quality of the image, both the choice of prominent colors, as well as the sharpness of the image. This design aspect is supported by [9, 10].

5.4 Control of the Camera and Lighting

The main feedback regarding the remote control was that elderly suffering from visual impairments found it unsuitable because of its lack of contrasting colors. [10] does not address the color contrasts directly, although encourages the use of certain colors such as red, orange and yellow rather than green, blue and violet. We also found the remote adjustability of the camera to be of importance. Normally, people only have control of the camera on their own side, e.g. the ability to zoom, pan and adjust light settings, although during our usability test it became clear that both sides requested the ability to adjust not on their own side, but rather on the other. Other non-tested options include heat or motion seeking cameras, but since we are not anticipating much movement on either side of the interaction, these options may be redundant.

6 Conclusion

This paper has reported from a collaborative change experiment with focus on usability testing of telecare as means for delivery of home care services. Preliminary results from this study indicate that use of television as a platform for video consultation can compensate for many of the elderly challenges with novel interfaces accentuated through bodily and cognitive barriers. Our findings also imply the need to acknowledge spatial issues such as lightning and room acoustic.

References

1. Ministry of Education and Research, NOU 2011:11 - Innovasjon i omsorg. Ministry of Health and Care Services, Oslo (2011)
2. Directorate of Health, Velferdsteknologi. Fagrapport om implementering av velferdsteknologi i de kommunale helse – og omsorgstjenestene 2013-2020. Helsedirektoratet, Oslo (2012)
3. Ministry of Health and Care Services, Meld. St. 29 (2012-2013) - Morgendagens omsorg, Oslo (2013)
4. Miyazaki, M., Sano, M., Mitsuya, S., Sumiyoshi, H., Naemura, M., Fujii, A.: Development and field trial of a social TV system for elderly people. In: Stephanidis, C., Antona, M. (eds.) UAHCI/HCII 2013, Part II. LNCS, vol. 8010, pp. 171–180. Springer, Heidelberg (2013)
5. Carmichael, A., Newell, A.F., Morgan, M.: The efficacy of narrative video for raising awareness in ICT designers about older users' requirements. Interacting with Computers 19(5-6), 587–596 (2007)
6. O'Neill, S.A., et al.: Development of a Technology Adoption and Usage Prediction Tool for Assistive Technology for People with Dementia. Interacting with Computers 26(2), 169–176 (2014)
7. Sayago, S., Sloan, D., Blat, J.: Everyday use of computer-mediated communication tools and its evolution over time: an ethnographical study with older people. Interacting with Computers 23(5), 543–554 (2011)
8. Weiner, M.F., Rossetti, H.C., Harrah, K.: Videoconference diagnosis and management of Choctaw Indian dementia patients. Alzheimer's & Dementia 7(6), 562–566 (2011)
9. Hawthorn, D.: Possible implications of aging for interface designers. Interacting with Computers 12(5), 507–528 (2000)
10. Baunstrup, M., Larsen, L.B.: Elderly's Barriers and Requirements for Interactive TV. In: Stephanidis, C., Antona, M. (eds.) UAHCI/HCII 2013, Part II. LNCS, vol. 8010, pp. 13–22. Springer, Heidelberg (2013)
11. van de Watering, M.: The impact of computer technology on the elderly. In: Human Computer Interaction (2005)
12. Blythe, M.A., Monk, A.F., Doughty, K.: Socially dependable design: The challenge of ageing populations for HCI. Interacting with Computers 17(6), 672–689 (2005)
13. Goodman, J., Lundell, J.: HCI and the older population. Interacting with Computers 17(6), 613–620 (2005)
14. von Niman, B., et al.: User experience design guidelines for telecare services. In: Proceedings of the 8th Conference on Human-computer Interaction with Mobile Devices and Services. ACM (2006)
15. Huldtgren, A., Detweiler, C., Alers, H., Fitrianie, S., Guldemond, N.A.: Towards Community-Based Co-creation. In: Holzinger, A., Ziefle, M., Hitz, M., Debevc, M., et al. (eds.) SouthCHI 2013. LNCS, vol. 7946, pp. 585–592. Springer, Heidelberg (2013)
16. Lee, C., et al.: Integration of medication monitoring and communication technologies in designing a usability-enhanced home solution for older adults. In: 2011 International Conference on ICT Convergence (ICTC). IEEE (2011)
17. Beale, S., et al.: The initial evaluation of the Scottish telecare development program. Journal of Technology in Human Services 28(1-2), 60–73 (2010)