Introduction

Our aging population presents new challenges for the economy and healthcare systems particularly as the number of caregivers per elderly is expected to decrease (e.g. Acosta-Calderon, 2011; Michaud et al., 2007; United Nations, 2006). The fields of telemedicine and telecare have the potential to provide solutions which are particularly attractive for countries with low population densities. In such countries, social isolation could decrease the possibility of elderly people to remain independent and therefore, increase their need for institutional care. While technology can be of help, the uptake of solutions will be highly dependent on the conviction that the technology meets the needs of elderly as well as primary and secondary caregivers while maintaining adequate quality of care. In order to ensure that developed solutions meet the needs of a diverse group of end users, a common approach is to perform extensive end user evaluations to assess the attitude from elderly and/or caregivers. The caregiver and healthcare professionals in particular are an important group as their willingness to accept new technology is determinant in providing the technology to the elderly and ensuring that it is used. In this regards it is therefore important to consider the high variations in professions and roles of primary caregivers when assessing their feedback. In addition, within the different professional roles, there are also differences that depend on experience, age, work processes and tools, exposure to technology etc.

In this study we consider an organizational perspective in the evaluation of a technology solution which has not yet penetrated the market but is seen as a close to market solution, if meeting the requirements of end-users (primary and secondary). The system that is evaluated is Giraff, a system for social robotic telepresence. The Giraff in Fig. 1 provides a means for achieving remote communication between two parties. The communication shares similarities with a traditional phone call, i.e. a call is made and this is either accepted or rejected by the owner of the robot. On one end, there is a 163 cm high robot and on the other end there is a client interface from which a remote user can pilot the robot while speaking through a microphone and a web camera. The Giraff unit consists of a screen and web camera that are mounted on a tilt unit attached to the robotic base. .The Giraff also has its own charging station to which the remote user docks before terminating a call. The owner of a Giraff is not required to have any technological knowledge since the handling of the Giraff is done remotely, (see Fig. 2). **INS FIG. 1 and FIG. 2**

In the evaluation study of the Giraff robot, we consider three categories of primary caregivers (audiologists, nurses and occupational therapists). Within each category we focus on two groups, teachers and students. The evaluation is conducted by presenting a video where a scenario in which Giraff was used to communicate with an elderly was shown to the various evaluation groups. After viewing the video, all teachers and students filled in a questionnaire assessing how the system was perceived and could potentially be used. Our hypothesis was that such a device would be viewed positively as it provides an enhanced social interaction whilst addressing some of the key challenges in providing care for elderly in widespread areas. Additionally, we hypothesized that the students within each profession would show a more positive response with respect to their teachers and that a greater exposure to similar technologies would influence positively the perception of the proposed solution. Contrary to our hypothesis, the results presented in this article show that the device was in fact negatively viewed due to a concern that it would substitute human contact. In general students were more negative to using the device than their teachers, and exposure to certain types of technology did not necessarily increase acceptance. This article provides indications of the major concerns from healthcare professionals (both those who are working in the field and those who are about to enter the profession) in relation to social robotic telepesence. Further, the article outlines a number of guidelines in terms of increasing acceptance from an

organizational perspective. These guidelines are intended not only to apply to robotic telepresence solutions per se but could be extended to other new forms of technology which aim to promote distributed care.

The article begins with showing results from other studies on attitude towards new assistive technologies among caregivers after which related work around the concepts of video mediated communication and social robotic telepresence is briefly outlined. We then present the video-evaluation methodology used within the study before detailing the experiment. Finally we present our obtained results and conclude the article.

Caregivers' Attitudes to Assistive Technologies

Examples of assessment of caregivers' attitude to new technologies being implemented or suggested for the future include (Broadbent et al., 2011; Chiu & Eysenbach, 2010; Cohen-Mansfield & Biddison, 2007; Paré et al., 2011; Pfortmiller, Mustain, Lowry, & Wilhoit, 2011; UnitedHealthcare, 2011).

Pfortmiller et al. (2011) have found that repetitive surveying is needed because attitudes change during long-term usage. Paré et al. (2011) report about a successful implementation of a new mobile computing application, but some technologies have been less successful, for example Bjørn and Balka (2007) report on a computerized system to aid triage being withdrawn again after 18 months of use due to the program being problematic, time consuming and a feeling that patients were being placed at risk. Cohen-Mansfield and Biddison (2007) try to examine elderly and caregiver views on assistive technologies. Their study reveals that there is an unawareness of existing new technologies manifested by requests for already existing technologies. According to the authors, focus groups should be encouraged in helping inventors and manufacturers design and refine innovative assistive devices. Further, one of the ways to inform the elderly is via primary caregivers but also the primary caregivers themselves need to be informed about the technology.

Chiu and Eysenbach (2010) present a multiphase, longitudinal study in which Chinese family caregivers taking care of people with dementia received an e-health intervention. The caregivers who became frequent users were more positive toward technology and perceived themselves as less competent than the ones who stopped using the system. UnitedHealthcare (2011) reports on a study in which the perceived potential of different technologies was assessed among 1,000 technology-using family caregivers. It was found that 54% said they were likely to use a video phone system. There were concerns that the video phones would (1) be too expensive, (2) not solve issues relating to care giving, (3) be resisted by relatives and (4) diminish the sense of independence or lessen privacy.

Also the attitudes towards health-care robots among caregivers have been investigated previously (Broadbent et al., 2011). Overall, the residents' attitudes towards health-care robots were more positive than the relatives' and staffs' attitude. Concerns implying a worry about the quality of care were raised among caregivers and relatives. Caregivers expressed a fear of losing their jobs and the relatives were afraid that robots would replace staff. Further, concerns about robustness were raised. It had to be "robust enough to withstand a human falling or leaning on it". On the other hand, the robots could be used to help "maintain independence by providing reassurance, monitoring and alerting for help, medical assessments and promoting exercise".

Video Mediated Communication

Research specifically related to video media technologies is vast and includes studies of use of static video conference systems that can be used in people's homes (Harper, 2009; Kirk, Sellen, & Cao, 2010); comparisons of group discussions communication (Barkhi, Jacob,

& Pirkul, 1999; Bos, Olson, Gergle, Olson, & Wright, 2002; Sellen, 1995) and studies on video telephony in the context of mobile phones (O'Hara, Black & Lipson, 2006).

Kirk et al. (2010) explore practices surrounding the use of video media technologies (VMC). The study revealed differences between young adult users who wanted to control what was in the image and parents who had a desire to be able to see not just the person but also the surroundings while interacting with their adult children. Kirk et al. and Harper (2009) found that a common use is for communication between grandparents and grandchildren.

O'Hara et al. (2006) analyze everyday practices with mobile video. "Mobility potentially overcomes some of the barriers of spontaneity and setup which have hindered traditional telephony." However, consistent with previously reported work about use of VMC-systems; mobile video calls were only done for special circumstances and relationships such as between couples being separated or to take part in daily routines at home. The study found that users had difficulties switching between the two cameras on the phone when trying to show the other something.

Mobile robotic telepresence - the combination of teleoperation and telepresence - offers an additional "walking around" capability compared to the VMC-systems. While mobile video telephony allows the users to walk around while communicating, both users need to direct the cameras in use. There are examples of telerobots specifically developed for social interaction called mobile remote presence (MRP)-systems which include Giraff (Giraff Technologies), QB (Anybot), Texai (Willow Garage) and Vgo (Vgo Communications) which all provide suitable platforms for a multitude of possible uses.

A MRP-system is basically a phone through which the pilot can move around in a remote environment and interact with its inhabitants. It is steered remotely by a pilot who navigates it via a computer interface. The pilot drives the MRP-system into a docking station in which it is charged when not in use. The MRP-systems have a potential to enable visitation and consultation of caregivers directly in the home of the patients. The caregivers may visit an elderly by being embodied in a MRP-system enabling them the ability to move around in the home environment of the elderly through teleoperation. Devices as shown in Fig.1 are motivated by the added benefit of placing a low requirement on the elderly patient - he or she may move about and behave as if receiving an actual visitor. However, the MRP-systems do not only have the potential to enable caregiver visitation but also the visits of relatives and friends that could decrease the feeling of isolation for the elderly. Yet another possible use is as a complement for alarm services where the elderly are the majority of the customers. From studies on VMC-systems (e.g. (Harper, 2009; Kirk et al., 2010; O'Hara et al., 2006); a likely use for the elderly is for enhanced communication with grandchildren.

While previous studies of telepresence robots (e.g. Michaud et al., 2007) have focused on navigational and interface aspects, it is important to assure acceptance from potential users regarding the more personal and practical aspects of the devices. Recent evaluations of MRP-systems, i.e. physically embodied videoconferencing systems studied in a coworker perspective include e.g. Lee & Takayama (2011) and Tsui, Desai, Yanco, and Uhlik (2011).

Also studies of the use of MRP-systems from an elderly perspective are emerging, for example Beer & Takayama (2011). Kristoffersson, Coradeschi, Severinson-Eklundh, and Loutfi (2011) investigated the perceived social and spatial presence when health care personnel and alarm operators were trained in how to steer the Giraff MRP-system.

Mutlu and Forlizzi (2008) report that organizational factors affect the way its members respond to robots and the changes engendered by their use in a longitudinal study at an American hospital. One of the differences in response was due to the fact that the robot relieved some workers from part of their work tasks while others were given more tasks. This is in line with Grudin (1988) who points out that many computer-supported cooperative work (CSCW)-applications will directly benefit certain users, often managers, while requiring

additional work from others. Further as pointed out by Orlikowski (2000), “technology per se can't increase or decrease the productivity of workers' performance, only use of it can”.

Methodology

Apparent from previous research on caregivers' attitudes to new technology, it is advisable to probe potential users of a new device for feedback already in the prototype phase in order to investigate how they believe they could benefit by using the product.

While live human-robot interaction studies would be preferable they are time consuming and because of practical limitations, they are difficult to replicate and the number of participants is typically low according to Chatley et al. (2010). In their work, they present results from a methodology making use of theatre to facilitate feedback from possible user audiences. The authors show that it can be used to effectively lead discussions; however the evaluation was done with a small audience and required a reorganization of the setting for the theatre. The discussion was mainly between facilitator and members of audience rather than in between members of it. However, the authors say that “theatre is not a perfect medium for dispersing information to a wider audience, but it does give a relatively high level of interaction and feedback compared to other HRI user study methods”.

In the study presented in this article, we wanted to gain input on a MRP-system from several different groups of potential users and to compare the acceptance of such a system between the groups which according to our hypothesis would be higher among the students than among their teachers. The study involved 150 participants in total and an efficient way to evaluate the system with large groups of users simultaneously was needed. The locations in which this study took place were assembly halls and classrooms in which no changes to the seating could be made making realistic repeatable experiments similar to the theatre with an actor and a robot difficult. In order to obtain comparable response from all participants, the choice fell on using a video-evaluation methodology. However, we acknowledge that “video-based experiments cannot replace live experiments” (Dautenhahn, 2007), but serve as a complement to gain feedback before implementing new features who may or may not be wanted by the targeted end-users.

In the design of products and systems, video has long been used as a valid medium for visualizing, prototyping and user testing in a wide range of products (Ylirisku & Burr, 2007). Woods, Walters, Koay, and Dautenhahn (2006) found that people’s attitudes towards approach directions by a robot were broadly equivalent for both live and video based HRI suggesting that HRI studies could use videotaped scenarios as opposed to live interactions for new exploratory studies. Video-evaluations provide a complementary methodology which studies with many participants simultaneously. The methodology has several advantages for HRI according to Walters et al. (2011) who summarized them as they can be used to: (1) reach larger numbers of participants, (2) easily incorporate participants' ideas and views into later video trials (or prototypes), (3) carry out trials in which groups of participants are exposed simultaneously, (4) prototype proposed live trial scenarios to test assumptions and avoid wasted effort. It also (5) allows greater control for standardized methodologies (i.e. the same scenario for all participants).

A video-evaluation methodology was also used in order to obtain a comparable analysis in a study in which Italian and Swedish elderly were faced with eight different scenarios representative to daily situations in which elderly people may be involved (Cortellessa et al., 2008). The situations were hypothetical and ranged from being emotionally involved to less critical and emotionally neutral and were presented with a robotic or camera interface as well as a female or male actor. The study is one example showing that a video-evaluation methodology making use of prototype robots can be used to test assumptions and to receive feedback on future developmental ideas of assistive robots. This implies that, one

way of collecting information to develop design theories when developing MRP-systems is to use video-evaluations to probe potential users of the system before development of new features or major changes.

Details of Experiment

Five trials have been conducted at the School of Health and Medical Science at Örebro University, Sweden. Each trial consisted of showing a video of the intended system in a scenario to a specific group of teachers or students where:

T1. teachers at the nursing program

T2. teachers in health subjects (such as occupational therapy *S2* and audiology *S3*)

S1. students at the nursing program

S2. students at the occupational therapist program

S3. students at the audiologist program

These different types of primary caregivers are examples of caregivers who have different current work behaviors and processes which could influence the acceptance or reluctance of new technologies. The teachers at the nursing program are registered nurses but are currently working with teaching. The teachers in health subjects have insight in different areas of expertise such as for example occupational therapy and/or audiology and are therefore treated as one group. The participants in this study include those who grew up with computers and internet as well as those who did not encounter them until in their working age.

Experimental Procedure

Each of the five trials, which was either part of an ordinary meeting or a lecture, took place in a classroom or lecture hall. The participants were given a short instruction to why the study was to be done. This background included an introduction on smart home environments in which many cooperative technological tools can be integrated and cooperate as well as information about the longitudinal ExCITE-project[1].

During the presentation of the project, we specifically emphasized that the MRP-system Giraff is mainly meant to be used for social interaction with acquaintances and off-springs as well as with caregivers and not to replace caregivers. After the information, the participants viewed a video in which a nurse visits an elderly via a Giraff, and holds a friendly conversation with the elderly. The trials ended with participants filling in questionnaires.

The Movie

The movie used in the experiment[2] is 3 minutes and 26 seconds long and presents a scenario illustrating a conversation between the nurse Paula and an elderly woman named Pat enabled by the usage of a Giraff (see Fig. 3). For the participants in this study, the majority of the Giraff functionalities were in a ``black box''. They were informed that the MRP-system was controlled remotely by Paula but they did not see the Giraff until Paula approached Pat, i.e. they did not see the full similarity between the Giraff system and a phone or the remote interface. **INS FIG. 3.**

[1] ExCITE is an Ambient Assisted Living project which purpose is - in an in-situ, longitudinal, and pan-European scale - to evaluate user requirements for robotic telepresence employing the Giraff platform. For more information please visit: http://www.excite-project.eu.

[2] The ``Hello Pat''-movie used in the experiment is available online at: http://www.oru.se/ExCITE/Part-3/Demos/.

The Questionnaire

The questionnaire consisted of a demographic section including age, gender, origin and self-rated experience of technical tools followed by questions concerning habits of playing computer games, the use of technology in work now and in the future. The reason to include questions about how accustomed to Skype and Wii people were that they represent new technologies that have reached out into people's homes and other places in society. While Skype can be considered a communication tool suitable for working situations and private conversation, Wii is mainly a gaming tool. The questionnaires also included questions concerning how aesthetically appealing and usable the Giraff system was perceived to be. The remainder of the questionnaires concerned possibilities to use the system in the real contexts and whether it could fit previous working habits. The majority of the questions in the questionnaires were to be answered on a Likert scale from 1 = *I fully agree* to 5 = *I do not agree at all*.

Due to the different work tasks for the groups involved in this study, several different versions of a basic questionnaire were developed to target the specific work tasks for each group. To make the questionnaires most relevant for each profession, additional questions were asked depending on the group. For example, occupational therapy students were asked to respond to a number of questions regarding use of Giraff in rehabilitation and nurses were asked about how they would appreciate adding different sensors to measure e.g. temperature on to the Giraff. When appropriate, the participants were also asked to write their opinions in free text. This data was later analyzed in order to complement numerical findings with possible explanations for them. Each group of users and questions were analyzed separately.[3]

Results

After all trials were performed all numerical data was analyzed first for each group separately and then in comparison between the teachers and their students. Multiple one-way ANOVA F-tests were run between the teachers and their respective students in order to see whether there were significant differences in how the Giraff was perceived and accepted. Also the free text comments made by the respondents were analyzed.

Demographics

Demographic information about the participants from each group is presented in Table 1. There is a notable but not significant difference regarding the habit of using Skype between the two teacher groups. The data also indicates that the teachers at the nursing programs *T1* are more used to Skype than their students *S1*. The response from the nursing students is in line with Swedish statistics for the age group[4] (previously reported in Section 6) but the response from the teachers at the nursing program is not. The nursing teachers have answered they have a much higher experience in using Skype than what is typical for Swedish people in their age group. The responses from the teachers in the remaining health subjects *T2* are in line with Swedish statistics. The audiology students *S3* have the highest experience of using Skype followed by the occupational therapist students *S2*. **INS TABLE 1**

The use of Computers at Work

We asked the participants in the video evaluation if they regarded use of computers and internet as a natural part of their current and future work. As can be seen in Table 1, all

[3] It should be noted that the results presented in this study can only give a Swedish perspective on the matter of acceptance of MRP-systems. Only eight participants in the study were not born in Sweden, and they had lived the majority of their lives in Sweden.

[4] In Sweden, 39% of the 16-24 year olds but only 20% of the 45-54 year olds have used the internet to communicate orally or audiovisually, for example with Skype. (Statistics Sweden, 2011).

groups state that they see the use of the computer and the internet as a natural part of the current/future work. They further believe that the use thereof will increase in the future. All groups respond that they do not regularly play video games such as Playstation, Wii or XBox.

The Aesthetics and Usability

The participants were asked to state their opinions considering the following questions concerning the perceived aesthetics (see also Fig. 1) and usability of the Giraff system. Table 2 presents the questions and results. There is a significant difference regarding perceived usability between the group all teachers (*T1+T2)* and the group all students (*S1+S2+S3)*; $F(1,147) = 19.06, p < .01$ as well as between the nursing teachers *T1* and nursing students *S1;* $F(1,98) = 12.29, p < .01$ and between health teachers *T2* and occupational therapy students *S2;* $F(1,36) = 10.55, p < .01$. The teachers perceive the system as more usable than the students in all three cases. The audiology students *S3* perceive the system to be the most aesthetically appealing whereas the nursing students *S1* perceive it to be the least aesthetically appealing. The audiology students *S3* and health teachers *T2* perceive the system to be the most usable while the nursing students *S1* and occupational therapy students *S2* perceive it the least usable. Potentially, the Giraff was not considered a novelty for the audiologists and health teachers since systems to aid people with hearing deficiencies with similarities to today's video conferencing systems existed already when the phones were still analogous.

INS TABLE 2

Comments about aesthetics and usability The participants were allowed to comment in free text on why they *did not* think the Giraff was aesthetically appealing or usable. In total, 55 comments concerning the aesthetics and 39 comments concerning the usability were given. However, the majority of the comments about aesthetics and usability were in fact unrelated to aesthetics and usability; the Giraff was perceived as being impersonal and a replacement of actual face-to-face contacts. This is indicating there is a worry of the implications that the presented tool may have. The nursing teachers *T1* and nursing students *S1* commented on the Giraff being an object/appliance and having an ugly shape. The nursing students were more illustrative in their comments than the nursing teachers and claimed the design could increase the risk of falling for the elderly if they leaned towards the Giraff (as in Example 1 and 2).

> ***Example 1.*** There is a risk that the elderly could grab it and that it would roll away.
>
> ***Example 2.*** Because it rolls. Old people who are a bit unstable on their legs often grab things to support them. If the Giraff starts rolling, the elderly could face an increased risk of falling. Need to have a brake!

Comments saying that the Giraff was looking too plastic, having the wrong color as well as being too big and taking up too much space were also given. One of the occupational therapy students *S2* commented illustratively on risks in the design of the Giraff as shown in Example 3.

> ***Example 3.*** I think it looks unstable and unsteady. The wheels looked a bit too small to get over thresholds and rugs. What was good was that it had a thin neck which minimizes the risk of driving into tables.

Another frequent comment regarded economy and fear of unemployment, see Example 4. The nursing teachers *T1* and nursing students *S1* also mentioned that the robot was a threat to the integrity of the patient. Again, this is indicating there is a worry of the implications that the presented tool may have.

> ***Example 4.*** Does not feel personal at all. Better to employ more nurses. Should be cheaper than many robots.

Comments on possible use cases of the Giraff All participants were asked to suggest what the Giraff could be used for based on the information received. A total of forty-eight

comments were given. Here, the purpose of the Giraff as proposed by us during the introduction to the video evaluation, namely social interaction, finds some support in the response from nursing teachers *T1* and nursing students *S1*. One of the most frequent comments given is that the Giraff can be used to socialize and to increase safety for people that are being distant to their caregivers (as in Example 5 and 6). Other possible uses mentioned by the nursing students *S1* are together with an alarm service and surveillance/control as in Example 7.

Example 5. Conversation with somebody who lives far away. Presence over long time with somebody who is living alone.

Example 6. To complement the social visits, in other words the real visits in the home. May absolutely not replace important people!

Example 7. Only for alarms, to be able to assess quickly what has happened to the patient.

Usage in Nursing

There were seven questions or statements related to the context of nursing. These were given only to the nursing teachers *T1* and nursing students *S1*. Three of these were about how the Giraff could be used for communication, alarms and rehabilitation while four were related to the integration of sensors. Table 3 shows the questions and response. There are significant differences in the response between the nursing teachers *T1* and the nursing students *S1*. The nursing teachers are more positive towards the Giraff as an opportunity to visit the elderly in need of home care more often $F(1,98) = 13.95, p < .01$; as a tool for alarm operators to make quick assessments of the situation $F(1,98) = 4.82, p < .05$ and to use it for showing forgotten movements during rehabilitation when the patient is not at the ward $F(1,98) = 16.69, p < .01$. They are also more accepting towards using the Giraff with sensors to make a preliminary health assessment $F(1,96) = 18.26, p < .01$ and to measure environmental values in the home of the elderly $F(1,98) = 12.57, p < .01$. **INS TABLE 3**

Comments about usage in a nursing context In many of the questionnaires, comments related to the Giraff as being impersonal and emphasis is placed on a concern that it will replace real contact See Example 8 from a nursing student and Example 9 from a nursing teacher.

Example 8. Worse care! Not qualitative care! Too impersonal! Technology not reliable.

Example 9. Impersonal. May not replace the relation and the meeting between people.

From a nursing perspective, the respondents were asked what sensors could be used along with the Giraff. In total, 21 comments were given concerning the use in a nursing context. However, a few of the comments made by the nursing students were stating they did not know what sensors could do. The comments from the nursing teachers were related to medical measurements as well as checking on wounds and edema. These comments existed also among the nursing students but these mentioned other types of sensors such as ManDown[5] or in risk of falling as well as an alcometer.

Usage in Occupational Therapy

In total four questions were asked in the context of occupational therapy. These were given only to the health teachers *T2* who teach occupational therapy subjects and to the occupational therapy students *S2*. Table 4 presents the questions and results received. Due to a low number of health teachers *T2* teaching occupational therapy subjects, no statistical comparisons between them and the occupational therapy students *S2* were made, although the numbers indicate that there is a difference also between these groups. The health teachers

[5] A ManDown-sensor can detect if its carrier is in a horizontal position and be used to detect that the carrier is laying on the floor.

answered more positively than the occupational therapy students on all questions related to the occupational therapy context. **INS TABLE 4**

Comments about usage in an occupational therapy context In total, 52% of the occupational therapy students *S2* commented on possible use in the context of occupational therapy while none of the health teachers *T2* chose to comment. The most common comment about usage in an occupational therapy context was that the Giraff could be used to decrease the number of visits and to follow up on the patient. Although the Giraff was perceived as a complement, as in Example 10, it was suggested to be used by people having difficulties coming to the ward as in Example 11.

> ***Example 10.*** Maybe I could avoid some of the home visits. I could also use it to check with the patient how it is going.
>
> ***Example 11.*** It can surely be used well if the patient is far away from the hospital or a care facility in order to communicate. Maybe it can be used to assess how the home looks like and judge what needs to be changed.

Usage in Audiology

There were four questions or statements related to an audiology context. Table 5 presents the questions and results. Due to a low number of health teachers *T2* in audiology subjects, no statistical comparisons between them and the audiology students *S3* were made, although the numbers indicate there is a difference also between these groups. The audiology students answered more positively than the health teachers on all questions related to the audiology context. **INS TABLE 5**

Comments about usage in an audiology context Fourteen comments were given on possible use cases of the Giraff from an audiologist perspective. The main use mentioned was to follow up on the patient and to evaluate the use of hearing aids. It was also suggested it could be used to instruct and to evaluate. The majority of the comments regard the uses of the Giraff to evaluate/follow up as in Example 12.

> ***Example 12.*** For example to follow up on whether or not the hearing aid works as it should.

Conclusions

This article summarizes a video-evaluation performed to investigate the acceptance and perception of mobile robotic telepresence. A sample consisting of teachers and students was used and the results reveal that the acceptance and perception vary in between groups of teachers and students.

The important results of the study, is that it gives indications on several directions to take in order to gain acceptance of the technology. At some stage there must be an understanding that the technology is not a replacement of people and actual visits but rather that it can be used as tool to increase social interaction. Secondly, the studies indicate that the reluctance for technology uptake will not simply be reduced as a result of new generations entering the market. Rather, this study suggests that the tools that are used in the work processes are determinant for acceptance. Therefore, an integration of technology tools is necessary already in an early stage of education. In fact, this is shown in the results from the audiology students who are responding positively to the proposed technology.

The differences of opinion between the groups of users show that it is necessary to include potential users early on in the development process of a new technological tool to assure their acceptance as the feedback will likely impact changes in design as well as development directions. Further, the fact that nursing teachers and teachers in occupational therapy subject were are more positive than their students implies they could play a large role in introducing new technologies to their students based on their experience and attitude.

It should be noted that asking for the habituation to Skype instead of video communication and Wii instead of computer games was met by confusion from a minority of the participants who did not know what Skype or Wii was. It should also be noted that their habituation to Skype may be only orally as in an interaction occurring with a telephone connection. An improvement to this study would be to clarify how Skype is normally used (with or without video feed). Further, the use of a video-evaluation methodology to assess the opinion about the Giraff generated similar concerns as previous studies on attitudes towards technology among caregivers (e.g. Broadbent et al., 2011; UnitedHealthcare, 2011). In future work, we plan to study the Giraff robot also in a longitudinal manner to assess its acceptance in both the perspective of the elderly and of the remote users.

References

Acosta-Calderon, C. (2011). Elderly Tele-care in the Singapore Context. *HRI'11 Workshop on Social Robotic Telepresence*, 29-35, url: http://aass.oru.se/~ali/hri2011ws/camera/HRI_Workshop_Acosta_final.pdf.

Barkhi, R., Jacob, V., & Pirkhul, H. (1999). An Experimental Analysis of Face to Face Versus Computer Mediated Communication Channels. *Group Decision and Negotiation, 8*, 325-347, url: http://www.springerlink.com/content/mk14q64602142x8w/.

Beer, J., & Takayama, L. (2011). Mobile Remote Presence Systems for Older Adults: Acceptance, Benefits and Concerns. *HRI'11*, 19-26, doi:10.1145/1957656.1957665.

Bos, N., Olson, J., Gergle, D., Olson, G., & Wright, Z. (2002). Effects of Four Computer-Mediated Communications Channels on Trust Development. *CHI 2002*, 135-140.

Broadbent, E.; Tamagawa, R.; Patience, A.; Knock, B.; Kerse, N.; Day, K.; MacDonald, B.A. (Online first 21 July 2011). Attitudes Towards Health-care Robots in a Retirement Village. *Australasian Journal of Ageing*, doi:10.1111/j.1741-6612.2011.00551.x.

Chatley, A., Dautenhahn, K., Walters, M., Syrdal, D., & Christianson, B. (2010). Theatre as a Discussion Tool in Human-Robot Interaction Experiments. *Advances in Computer-Human Interactions*, 73-78, doi:10.1109/ACHI.2010.17.

Chiu, T., & Eysenbach, G. (2010). Stages of use: consideration, initiation, utilization, and outcomes of an internet-mediated intervention. *BMC Medical Informatics and Decision Making , 10, doi:10.1186/1472-6947-10-73*.

Cohen-Mansfield, J., & Biddison, J. (2007). The Scope and Future Trends of Gerontechnology: Consumers' Opinions and Literature Survey. *Journal of Technology in Human Services , 25*, 1-19, doi:10.1300/J017v25n03_01.

Cortellessa, G., Koch Svedberg, G., Loutfi, A., Pecora, F., Scopelliti, M., & Tiberio, L. (2008). A Cross-Cultural Evaluation of Domestic Assistive Robots. *AAAI Fall Symposium on AI and Eldercare.*

Dautenhahn, K. (2007). Methodology and Themes of Human-Robot Interaction: A Growing Research Field. *Journal of Advanced Robotic Systems , 4*, 103-108, url: https://uhra.herts.ac.uk/dspace/bitstream/2299/3814/1/902281.pdf.

Grudin, J. (1988). Why CSCW Applications Fail: Problems in the Design and Evaluation of Organizational Interfaces. *CSCW 1988*, 85-93.

Harper, R. (2009). From Tele Presence to Human Absence - the Pragmatic Construction of the Human in Communications Systems Research. *23rd British HCI Group Annual Conference on People and Computers: Celebrating People and Technology*, 73-82, url:http://dl.acm.org/citation.cfm?id=1671011.1671020.

Kirk, D., Sellen, A., & Cao, X. (2010). Home Video Communication: Mediating 'Closeness'. *CSCW 2010*, 135-144, doi:10.1145/1718918.1718945.

Kristoffersson, A., Coradeschi, S., Severinson-Eklundh, K., & Loutfi, A. (2011). Sense of Presence in a Robotic Telepresence Domain. *HCI (6)'11*, 479-487, url: http://dx.doi.org/10.1007/978-3-642-21663-3_51.

Lee, M., & Takayama, L. (2011). "Now, I have a body": uses and social norms for mobile remote presence in the workplace. *Proceedings of the 2011 annual conference on Human factors in computing systems*, 33-42, doi:10.1145/1978942.1978950.

Michaud, F.; Boissy, P.; Labonté, D.; Corriveau, H.; Grant, A.; Lauria, M.; Cloutier, R.; Roux, M.-A.; Iannuzzi, D.; Royer, M.-P. (2007). Telepresence Robot for Home Care Assistance. *AAAI Spring Symposium on Multidisciplinary Collaboration for Socially Assistive Robotics*, doi:10.1.1.68.3822.

Mutlu, B., & Forlizzi, J. (2008). Robots in Organizations: the Role of Workflow, Social, and Environmental Factors in Human-Robot Interaction. *HRI'08*, 287-294, doi: 10.1145/1349822.1349860.

O'Hara, K., Black, A., & Lipson, M. (2006). Everyday Practices with Mobile Video Telephony. *CHI'06*, 871-880, doi:10.1.1.92.9926.

Orlikowski, W. (2000). Using Technology and Constituting Structures: A Practice Lens for Studying Technology in Organizations. *Organization Science , 11*, 404-428, doi: 10.1287/orsc.11.4.404.14600.

Paré, G., Sicotte, C., Moreault, M.-P., Poba-Nzaou, P., Nahas, G., & Templier, M. (2011). Mobile Computing and the Quality of Home Care Nursing Practises. *Journal of Telemedicine and Telecare , 17*, 313-317, doi:10.1258/jtt.2011.101204.

Peters, J. (1999). *Speaking into the air: a history of the idea of communication.* Chicago: University of Chicago.

Pfortmiller, D., Mustain, J., Lowry, L., & Wilhoit, K. (2011). Preparing for Organizational Change. *Computers, Informatics, Nursing , 29*, 230-236, url: http://www.nursingcenter.com/pdf.asp?AID=1159934.

Sellen, A. (1995). Remote Conversations: the Effects of Mediating Talk with Technology. *Human-Computer Interaction , 10*, 401-444, doi:10.1.1.75.4018.

Statistics Sweden. (2011). Use of Computers and the Internet by Private Persons in 2010, ISSN:16547624.

Tsui, K., Desai, M., Yanco, H., & Uhlik, C. (2011). Exploring use cases for telepresence robots. *HRI'11*, 19-26, doi: 10.1145/1957656.1957664.

United Nations. (2006). *World Population Prospects: the 2006 Revision - Comprehensive Tables.* New York, ISBN: 9789211514292.

UnitedHealthcare. (2011). *Bringing Caregiving into the 21st Century*, url: http://www.caregiving.org/data/FINAL_eConnected_Family_Caregiver_Study_Jan%202011.pdf.

Walters, M.L.; Lohse, M.; Hanheide, M.; Wrede, B.; Syrdal, D.S.; Koay, K.L.; Green, A.; Hüttenrauch, H.; Dautenhahn, K.; Sagerer, G.; Severinson-Eklundh, K. (2011). Evaluating the Robot Personality and Verbal Behaviour of Domestic Robots using Video-Based Studies. *Advanced Robotics (RSJ)*, In press.

Woods, S., Walters, M., Koay, K., & Dautenhahn, K. (2006). Methodological Issues in HRI: A Comparison of Live and Video-Based Methods in Robot to Human Approach Direction Trials. *RO-MAN 06*, 6-8, doi:10.1.1.66.5735.

Ylirisku, S., & Burr, J. (2007). *Designing with video.* Springer.

Figures

Figure 1. A Giraff prototype.

Figure 2. Remote interface of the Giraff system.

(a) The nurse Paula is sitting in front of a computer.

(b) Pat is sitting in her sofa at home.

(c) Paula, embodied in the Giraff drives to Pat. Pat says she is much better now with a new sleep medication.

(d) Pat thinks it is difficult to keep track of everything so she got a "box-like thing" from her daughter which helps her to keep track. Pat shows Paula the box.

(e) Pat walks and Paula sees that Pat is walking much better after the hip surgery and compliments her.

(f) Pat says there is a problem with the coffee machine and shows by telling what buttons she pushes.

(g) Paula sees what is wrong and tells Pat she has forgotten the coffee lid. Pat says "oh how can I be so stupid" and laughs.

(h) Paula sees something is cooking on the stove which looks good.

(i) Together they decide to turn it of so that Pat does not forget it.

(j) Paula has seen a drawing lying on the table and compliments Pat about it by saying it is looking lovely.

(k) Paula reminds Pat about a medical appointment; Pat says thank you and that she will write it down.

(l) Paula says she will come and visit Paula physically next Friday and the conversation is over.

Figure 3. Snapshots from the "Hello Pat"-movie.

Tables

Table 1 Participant Information

Group	Age	Gender	Skype	Wii	Current work	Future work	Playing
T1	*M* = 54	F = 95.5%	*M* = 0.43	*M* = 0.10	*M* = 1.36	*M* = 1.36	*M* = 4.41
***N* = 22**	*SD = 2.85*	M = 4.5%	*SD* = 0.71	*SD* = 0.55	*SD* = 0.97	*SD* = 0.95	*SD* = 0.92
T2	*M* = 53.38	F = 85%	*M* = 0.23	*M* = 0.08	*M* = 1.23	*M* = 1.23	*M* = 4.23
***N* = 13**	*SD* = 3.29	M = 15%	*SD* = 0.66	*SD* = 0.53	*SD* = 0.77	*SD* = 0.66	*SD* = 1.17
S1	*M* = 24.70	F=89.9%	*M* = 0.38	*M* = 0.30	*M* = 1.32	*M* = 1.59	*M* = 3.35
***N* = 79**	*SD* = 2.30	M = 10.1%	*SD* = 0.70	*SD* = 0.68	*SD* = 0.77	*SD* = 0.85	*SD* = 1.23
S2	*M* = 25	F = 80%	*M* = 0.48	*M* = 0.28	*M* = 1.44	*M* = 1.46	*M* = 3.36
***N* = 25**	*SD* = 2.78	M = 20%	*SD* = 0.71	*SD* = 0.68	*SD* = 0.88	*SD* = 0.88	*SD* = 1.20
S3	*M* = 23.70	F = 90.9%	*M* = 0.60	*M* = 0.40	*M* = 0.82	*M* = 1.40	*M* = 3.36
***N* = 11**	*SD* = 2.35	M = 9.1%	*SD* = 0.72	*SD* = 0.72	*SD* = 0.82	*SD* = 0.84	*SD* = 1.14

Note: The table presents demographic information about all participants in the video-evaluation. It includes information about their age and gender (F = Female, M = Male) and their habituation to Skype and Wii (1 = *habit of using*, 0 = *no habit of using*). It also shows the participants habits in game playing and whether or not they regard the use of computers and internet as a natural part of current and future work (1 = *I fully agree*, 5 = *I do not agree at all*).

Table 2 Perceived Aesthetic Appeal and Usability

	I think the Giraff is aesthetically appealing.	Based on the information I have received, I think the Giraff is usable.
T1	*M* = 3.00	*M* = 2.00
	SD = 1.13	*SD* = 1.09
T2	*M* = 2.69	*M* = 1.77
	SD = 1.09	*SD* = 0.85
S1	*M* = 3.44	*M* = 2.86
	SD = 0.98	*SD* = 0.98
S2	*M* = 2.80	*M* = 2.88
	SD = 0.93	*SD* = 0.98
S3	*M* = 2.09	*M* = 1.82
	SD = 0.84	*SD* = 0.87

Note: 1 = *I fully agree*, 5 = *I do not agree at all.*

Table 3 Perception Concerning Use of Giraff in a Nursing Context

	T1	S1
Could you see using the Giraff for communicating as a possibility to visit elderly in need of home care	*M* = 2.29	*M* = 3.20
more often?	*SD* = 1.11	*SD* = 1.00
Could you see using the Giraff as a tool for alarm operators to make a quick assessment of the situation?	*M* = 1.71	*M* = 2.25
	SD = 1.03	*SD* = 0.94
Do you think that the Giraff could be used to show movements that a patient needs to perform during	*M* = 2.05	*M* = 3.05
rehabilitation? For example show a movement like in Wii when a patient is not at the ward and has	*SD* = 0.89	*SD* = 1.00
forgotten how it should be performed.		
Can you think of sensors that could be used by a nurse to make a preliminary assessment of the health	*M* = 2.57	*M* = 3.62
of the patient?	*SD* = 1.15	*SD* = 0.97
I think one could integrate a thermometer on the Giraff to measure body temperature.	*M* = 3.33	*M* = 3.62
	SD = 1.16	*SD* = 1.09
One could integrate something similar to the Wii vitality sensor on the Giraff to measure blood pressure	*M* = 2.86	*M* = 3.16
and pulse. In other words a spirometer.	*SD* = 1.22	*SD* = 1.09
One could integrate a sensor to measure environmental moist and temperature.	*M* = 1.95	*M* = 2.82
	SD = 1,10	*SD* = 1.11

Note: 1 = *I fully agree*, 5 = *I do not agree at all.*

Table 4 Perception Concerning use of Giraff in an Occupational Therapy Context

	T2	S2
Do you think that the Giraff could be used to show movements that a patient needs to perform during rehabilitation? For example show a movement like in Wii when a patient is not at the ward and has forgotten how it should be performed.	*M* = 2.23 *SD* = 1.10	*M* = 3.08 *SD* = 1.19
Could you see yourself using the Giraff to make more visits to elderly in need of homecare?	*M* = 2.50 *SD* = 1.10	*M* = 2.92 *SD* = 1.05
Could you see yourself using the Giraff to enthusiate and motivate patients to continue their rehabilitation?	*M* = 2.17 *SD* = 0.99	*M* = 3.09 *SD* = 1.09
Could you see yourself using the Giraff to control that the movements that you have shown your patient are performed in a correct way?	*M* = 2.17 *SD* = 0.98	*M* = 3.45 *SD* = 1.10

Note: Amount om teachers responding is six. 1 = *I fully agree*, 5 = *I do not agree at all.*

Table 5 Perception concerning use of Giraff in an Audiology Context

	T2	S3
Could you see yourself using the Giraff to enthusiasm and motivate such patients?	*M* = 2.40 (5) *SD* = 0.94	*M* = 2.18 *SD* = 0.90
I would like a function where what I say to the patient is texted on the Giraff.	*M* = 2.00 (7) *SD* = 1.00	*M* = 1.64 *SD* = 0.90
I would like a function where what the patient says is texted on my computer.	*M* = 3.00 (7) *SD* = 1.00	*M* = 2.36 *SD* = 1.10
I think Giraff could work to communicate with sign language.	*M* = 2.17 (6) *SD* = 1.21	*M* = 1.45 *SD* = 0.96

Note: The amount of teachers responding per question is given in parenthesis. 1 = *I fully agree*, 5 = *I do not agree at all.*