A Cross-Cultural Evaluation of Domestic Assistive Robots

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Abstract

This paper presents the first steps in a series of on-going user evaluations of intelligent environments for supporting elderly users at home. We specifically focus on a comparison of elderly perceptions of social assistive domestic robots between Italian and Swedish user groups. The evaluation was carried out in Rome, Italy and Örebro, Sweden, including surrounding towns. The results, obtained through a video-based methodology, highlight the variety in level of appreciation of domestic robots for elderly care as it relates to a number of aspects of culture which are not necessarily trivial to identify. Our results suggest some specific factors as important for interpreting the difference in perception, e.g., the user's acquaintance with ICT (Information and Communication Technology) and the social policies implemented in the two countries. Also, the results show interesting commonalities, such as the general agreement among Swedish and Italian user groups on the physical aspect of the robot.

Introduction

In this paper, we report our current efforts in evaluating social assistive domestic robots. Specifically, our aim is to assess the user perceptions of current domestic robotic technology. Our work focuses on elderly users, and stems from two research projects that have lead to implemented and deployed prototypical environments, namely the ROBOCARE Home (Cesta et al. 2007b) and the PEIS Home (Saffiotti and Broxvall 2005). As a means to affect further technology development within these projects, we have adopted user-group evaluation methodologies to conduct detailed experiments on the perception of the specific segment of population for which the research conducted in the two projects is relevant (henceforth, demographic). The results obtained during that past two years have primarily focused on users from Italy (where the ROBOCARE project was developed). A number of interesting trends have been described in (Cesta et al. 2007a), and will be briefly summarized in this paper. More recently, we have extended our demographic to other European countries. In this paper we present the first results obtained form this new demographic located in Sweden, and in particular we focus on the cross-cultural features that emerge by comparing Swedish and Italian responses. These results highlight the bias of differences in culture among the two societies about domestic robotic technology. This work is the first step in a larger evaluation effort, of which an overview is provided in (Cortellessa, Loutfi, and Pecora 2008).

Our study is motivated by strong differences between Italian and Swedish cultures with respect to technology uptake, acquaintance with ICT and elderly care policy and culture. In Italy, just 2.8% of households of people aged over 65 has access to the Internet, while 45% of them own a mobile phone; in Sweden, the percentage of households having access to the Internet at home was 73% in 2005, and the percentage of individuals in the 55-74 age range using the Internet at least once a week is 51%[1]. This may suggest a very different level of confidence in smart home technology, and possibly different expectations with respect to the potential benefit of living in a smart home.

Another factor may distinguish Swedish and Italian user perceptions of smart home technology, namely different national elderly care culture and policy (Sundström and Johansson 2005). In Sweden, 98% of elderly people lived either alone or with their spouse in 2002, while 35% of the Italian elderly lived with other family members or within communities in the year 2000. Even more interestingly, only 17% of the elderly in Nordic countries (Sweden, Denmark, Finland and Norway) received care from family members within their own household in 1992, while 67% of the elderly residing in Southern European countries (Italy, Portugal, Spain, Greece, Ireland and Austria) relied on family care.

Finally, cross-cultural aspects are becoming increasingly important in technology development. By 2050, the share of elderly people in the population is projected to increase to around 30% at the EU25 level[2]. In order for technology, in particular home care solutions, to be tailored to this segment of society while affording scalable pan-European production, cross-cultural aspects need to be well understood and accounted for.

[1] Data taken from the "Supporting Policy Development for e-Inclusion" project — see the the EU country reports section on http://www.ipolicy.eu/.

[2] Eurostat news release 129/2006 — 29 Sept. 2006.

Evaluating Social Assistive Robots: Related Work

The emphasis in social assistive robotics is to support human users through social rather than physical interaction (Feil-Seifer and Matarić 2005). A key aspect in the development of social assistive robots is the evaluation of social interaction between human users and robotic agents. A number of guiding principles exist in the literature. For example, (Sabanovic, Michalowski, and Simmons 2006) highlights how observation and behavioral analysis of human-robot social interaction in real environments is necessary in order to take into consideration all the divergent factors pertaining to the design of social robots. The design of social robots also raises a number of ethical issues that need to be discussed within the research community to provide guidance to system designers. (Turkle et al. 2006) considers some of the ethical implications of human-robot interaction, mainly related to the kind of authenticity we require in our technology as well as to the choice of the most appropriate relationship between children/elders and relational artifacts.

The evaluation of relational agent technology has been the focus of a number of studies. One relevant direction within this context is the study of how realism determines the acceptability and effectiveness of relations agents. Although a large body of literature suggests that realism (in the sense of human resemblance) is an important factor in how users respond to assistive relational agents, it has also been shown that the relationship is indeed more complex: (van Vugt et al. 2007) provide evidence that realism does not necessarily affect task performance, and that several factors related to appearance and task can contribute to user engagement and satisfaction. Users respond differently to artefacts with a relational agent interface (the so-called "persona effect" (Lester et al. 1997)). While the importance of this effect is widely recognized, various studies show conflicting results on how the effect occurs[3]. It has been shown that interface characters can steer user attention positively or negatively, that they can enhance task performance or introduce the feeling of another person, which in turn can affect memory recall (Beun, de Vos, and Witteman 2003), and that the effectiveness of human-like relational agents may affect the perception of successful interaction but do not necessarily directly contribute to the actual success of the interaction (Catrambone, Stasko, and Xiao 2002). Overall, the literature seems to point to the fact that user response and effectiveness of relational agent interfaces are strongly dependant on the specific domain and function the interfaces are deployed in. The present study aims to complement these results by providing insights into (1) the perception of an embodied relational agent for domestic elderly care, and (2) the cultural factors that affect the perception of Italian and Swedish user groups.

In this paper we present results obtained through a video-based evaluation methodology. Relevant work in the field of user group evaluation methodologies includes (Woods et al. 2006), in which this evaluation techniques is compared to live evaluation. It is pointed out that video-based trials can constitute a valid means to overcome some of the drawbacks of live evaluation (e.g., reliability and replicability of complex robot behaviors). Other literature (e.g., (Kidd 2003)) shows evidence of no significant differences between video-based and live trials. Overall, using videos of robots (as opposed to virtual characters) can result in HRI trials that are closer to real live interactions (Woods et al. 2006). Such advantages of video-based evaluation represent one of the principal motivations for the methodology we chose to follow in the present study, with the added benefit of ubiquity: performing a cross-cultural evaluation requires the user groups to be exposed to the same experience, a condition that is greatly facilitated by the use of videos rather than deployed prototypical systems.

We should also mention that there has been some specific work on cross-cultural issues in socially intelligent agents (e.g., (Kido 1998)). As suggested in (O'Neill-Brown 1997), cultural influences play a significant role in determining user preferences in relational agent technology, influencing individual communication style, personality and cognitive mechanisms. The present study aims to contribute to our understanding how users with different cultural backgrounds perceive robotic technology in the specific domain of embodied domestic robotic helpers.

Video-Based Methodology

As mentioned, this and previous analyses have used a video-based methodology to evaluate users' perceptions as opposed to bringing the users to a specific laboratory for user testing. In addition to the obvious advantage of enabling the reproduction of the same procedure in different geographical settings, the methodology has the added benefit of portraying more realistically, without the bias of a laboratory setting, the social and cultural context within which this technology is deployed. This is in line with current recommendations for the evaluation of complex assistive technology. For instance, it is recognized in (Hutchins 1995) that human-robot interaction is to be evaluated on socio-culturally constituted activities outside the design laboratory. In this light, the aim of our research is to analyze the potential reactions of final users to real life interactions between elderly people and an assistive robot.

The present analysis considered eight different scenarios, which were meant to be representative of daily situations in which elderly people may be involved. The situations were selected with reference to previous research on this topic (Giuliani, Scopelliti, and Fornara 2005), ranging from the most emotionally involving to less critical and emotionally neutral, with the aim of exploring elderly people's evaluations of the potential role of a domestic robot as a useful support to ageing people. Specifically, the study focuses on three main aspects.

First, we perform an evaluation of how meaningful each scenario is with respect to the respondents' every day life. This allows us to understand how useful state-of-the-art assistive technology can be in real situations. Moreover, it provides a precious indication as to whether we are employing

[3]Complete citations here are not possible, but the interested reader is referred to (van Vugt et al. 2007) for a brief overview of relevant results.

(a) Face version (b) No-Face version

Figure 1: The two versions of the robot used for the "Similarity to human beings" feature.

this technology to solve real needs. Scenarios were arranged in order to have evaluations of the robot in different typologies of interactive situations: we propose a main distinction between "On-demand" and "Proactive" scenarios:

On-Demand scenarios imply an explicit request for the robot's activity by the final user;

Proactive scenarios depict situations in which the robot autonomously intervenes in the domestic environment, either for an emergency or for a simple suggestion.

The comparison between On-demand and Proactive situations is aimed to offer a suggestion as regards the preferred level of autonomy of the assistive device.

Second, we focus on the respondents assessment of our robotic mediator. The analysis focuses on aspects related to the physical aspect of the robot, its interaction capabilities, and in general its suitability in the domestic context (e.g., size, mobility, integration with the environment).

Third, we observe user preferences with respect to robot's features evoking a human being. Although our robot is not anthropomorphic, it is possible to deploy it in two slightly different versions: one in which the robot has a 3D facial representation and one without a facial representation. These variants were used to toggle the variable "Similarity to human beings", which emerged as a key component in elderly people's representation of domestic robots (Scopelliti, Giuliani, and Fornara 2005). The two versions are shown in Figure 1.

Material. Eight short movies (ranging from about 30 seconds to little more than one minute) were developed showing potential interaction scenarios between an elderly person and the robotic agent in a real domestic environment (see three scenes in figure 2). The features of the robotic agent were manipulated according to two different experimental conditions: in the first condition ("Face") a robot showing a human speaking face on a notebook monitor; in the second ("No-face"), a robot with no reference to human features (see Figure 1). The eight scenarios presented everyday life situations in which the robot provides cognitive support to the elderly person, and referred to critical areas, as highlighted by previous research, including (a) management of personal/environmental safety, (b) health care, (c) reminding events/deadlines, (d) support to activity planning, (e) suggestions.

The eight scenarios pertain to the categorization put forth earlier on the modality of interaction with the human user. More specifically, *On-demand* scenarios included:

Finding objects. This is an example of on-demand interaction where the assisted person relies on the robot's help to find objects within the environment.

Activity planning. In this scenario, the system supports the activity planning of the assisted person.

Reminding medication. This scenario describes an on-demand interaction in which the assisted person does not remember whether or not he/she took his/her medicine after lunch, and asks the robot.

Proactive scenarios, on the other hand, portray the robot proactively seeking interaction with the user as a consequence of his/her actions and environmental situation. The *safety-related proactive tasks* were:

Environmental safety. The robot warns the assisted person of a potentially dangerous situation within the domestic environment (e.g., the kettle was forgotten on the stove.)

Personal safety. This scenario depicts a medical emergency for the assisted person. The system detects the dangerous situation and issues an alarm to the assisted person's family.

Finally, also scenarios *not related to safety but nevertheless depicting a proactive robot* were shown. These were:

Reminding analyses. In this scenario the robotic assistant reminds the user of a medical appointment he/she had forgotten.

Suggestions. This scenario depicts an example of system's initiative in making suggestions to the user regarding non-critical situations, proposing to go for a walk as the user has been watching television all day.

Reminding events. This is an example of cognitive support provided by the system in case of events not related to the assisted person's medical care. In this specific case, the event is the birthday of the user's acquaintance.

For a more detailed description of the eight scenarios, please refer to (Cesta et al. 2007a).

Questionnaires. A questionnaire was developed for data collection. It consisted of three sections, plus a final part for socio-demographics. The sections were arranged as follows:
Section 1. Eight fill-in papers, each of them referring to one of the eight scenarios, were presented. For each scenario, questions about the likelihood of the situation for the elderly person, the utility and acceptability of the robot were asked.
Section 2. An attitude scale, consisting of 45 Likert-type items, referring to the physical aspect of the robot, its behavior and communication modalities; the level of integration with the domestic environment; the degree of perceived intrusion/disturbance of the robot in everyday life and routines; the personal advantages and disadvantages of having such a device at home.
Section 3. An emotional scale, consisting of sixteen adjectives through which respondents evaluated the possible presence of the robot in their home. In the Likert-type items, the respondents had to express their level of agreement/disagreement on a scale ranging from 0 ("I totally disagree") to 4 ("I completely agree").

Cross-Cultural Implementation

In order to obtain a comparable analysis, the Italian and Swedish studies were maintained as consistent as possible. This entailed preserving the demographics of the user groups, the material that was used, and the manner in which the survey was executed and analyzed.

Demographics. In Italy, forty elderly people were recruited for the study. Their age varied from 56 to 88 years, with a mean age of 70.3. Participants were 13 males and 27 females; as for their educational level, 17.9% ceased their studies after primary school, 43.6% after middle school, 25.6% after high school, 12.9% have a degree. Most of them (82.5%) are retired. Before retirement, 22.5% were teachers, 15% were office workers.

In an attempt to replicate the same conditions in Sweden, we established contacts with the National Organization for Pensioneers (PRO). This gave us access to a user group of 43 respondents, aged between 58 and 87, with an average age of 69.9. The education level of the two user groups, although difficult to compare given the difference in system, is similar in that both groups have at least six to twelve years of education. Specifically, in Sweden 9.3% of respondents had ceased their studies after primary school, 20.9% after middle school and 60.5% after high school or further. All of the respondents are retired. Prior to retirement, the majority of users were office workers or laborers (27.9% and 34.9% respectively).

Material. The material employed for the Swedish survey consisted in Swedish versions of the videos and surveys. Specifically, the questionnaires were translated and the order of questions preserved.

A short pre-evaluation on one elderly user was performed to ascertain whether subtitling or dubbing would be a preferred method for conveying the spoken language in the videos. As dubbing is virtually absent in Sweden, the user reported that reading subtitles seemed positively more natural than watching a dubbed scene, thus subtitling was chosen as the method of translation for the videos.

Procedure. In Italy, subjects were randomly assigned to one of the two experimental conditions (Face/No-face). The movies were either projected on a notebook monitor, in a face-to-face session, or on a larger screen, in a small-group session. Two different sequences of presentation were used, in order to avoid the potential influence of an order effect of episodes on results. After the vision of each scenario, participants were asked to fill the paper referring to it (Section 1 of the questionnaire). At the end of the eight viewings, subjects were asked to give general evaluations of the robot (Sections 2-3 of the questionnaire).

In Sweden group viewings were primarily used, in which up to eight persons were present. The variance of the order of presentation was maintained, and the manner in which the questionnaires were presented, filled and collected was consistent with the Italian group. Also, a brief description of what the interviewees were about to see was provided at the beginning of the sessions in both the Italian and the Swedish cases.

Results

The analyses we performed allowed us to get both an overall evaluation of the robotic mediator, its interaction with the elderly users and integration with the domestic environment, and a comparison of some cultural peculiarities in the two Countries we considered in our study.

Scenario analysis. On the whole, scenarios emerged as meaningful and common situation in everyday life of elderly people, even though Proactive situations involving emergency and health care (Mean = 3.05, s.d. = .76) and On-demand situations (Mean = 3.00, s.d. = .75) were considered as significantly more frequent than Proactive situations implying a suggestion (Mean = 2.57, s.d. = 1.04) ($F(2, 162) = 22.64$, $p<.001$); the perceived utility of the robot was higher in Proactive situations involving emergency and health care (Mean = 3.04, s.d. = .73) than in On-demand situations

(a) (b) (c)

Figure 2: Three scenes from the videos: (a) Alessandra (Eva in Swedish) is solving a crossword, suddenly faints and the robot calls for help (*proactive emergency*); (b) Paolo/Johan is preparing breakfast when the robot reminds him that he should not eat before his blood test (*proactive suggestion*); (c) Alessandra/Eva uses the robot as a diary while booking an appointment with her doctor (*on-demand*).

(Mean = 2.70, s.d. = .96) and in Proactive situations implying a suggestion (Mean = 2.24, s.d. = 1.04) (F(2, 162) = 52.35, p<.001); finally, also the personal acceptability of the robot was higher in Proactive situations involving emergency and health care (Mean = 2.69, s.d. = .93) than in On-demand situations (Mean = 2.32, s.d. = 1.09) and in Proactive situations implying a suggestion (Mean = 1.90, s.d. = 1.22) (F(2, 162) = 52.35, p<.001).

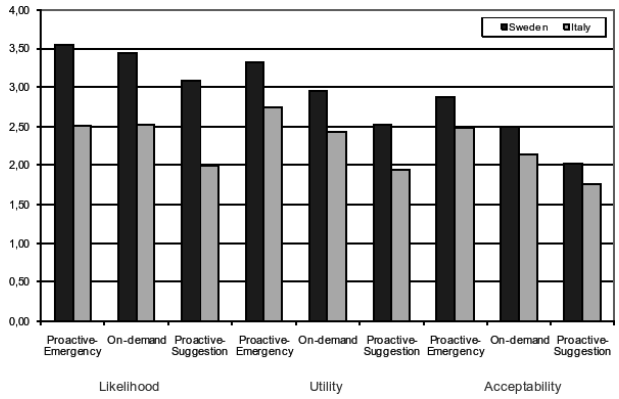

Figure 3: Overall comparison of Italian and Swedish response to the scenarios.

As shown in Figure 3, the Swedish elderly showed an higher evaluation of the likelihood of Proactive situations involving emergency and health care (F(1, 81) = 75.35, p<.001), On-demand situations (F(1, 81) = 48.52, p<.001) and Proactive situations implying a suggestion (F(1, 81) = 33.78, p<.001) than the Italian elderly. In addition, they considered the utility of the robot higher in Proactive situations involving emergency and health care (F(1, 81) = 15.42, p<.001), in On-demand situations (F(1, 81) = 6.23, p<.01) and in Proactive situations implying a suggestion (F(1, 81) = 7.02, p<.01) than the Italian elderly. No significant difference emerged between the Swedish and the Italian groups with reference to personal acceptability of the robot in Proactive situations involving emergency and health care (F(1, 81) = 4.20, n.s.), On-demand situations (F(1, 81) = 2.43, n.s.) and Proactive situations implying a suggestion (F(1, 81) = .94, n.s.)

Both in the Swedish and in the Italian group the trend of evaluations of the eight scenarios, with reference to meaningfulness/likelihood, utility and acceptability was similar, ranging from personal and environmental safety (scoring higher), to finding object and reminding events (scoring in between) , and suggestions (scoring lower).

Evaluation of the Robot. The general evaluation of the robot and its capabilities to support the elderly in the domestic environment was positive. In particular, the possibility for the robot to move in the home environment without crashing objects, the help for elderly people living alone to feel safer and to reduce impairments related to ageing as well as the ability in direct speech, were strongly appreciated both by the Italian and by the Sweden group (see Table 1, which shows the overall evaluation).

Table 1: General evaluation of the robot (score 0–4)

Positive Aspects	*Mean*	*St. dev.*
Obstacle avoidance ability	3.54	.74
People feel safer	3.27	.93
Reduction of age-related impairments	3.15	1.01
Direct speech ability	3.13	.85

The comparison between Countries showed that the Italian elderly would like the robot to be pre-programmed (F(1, 81) = 17.87, p<.001), and would be afraid of how to repair it (F(1, 81) = 17.40, p<.001) and how much they have to pay to buy the device (F(1, 81) = 11.23, p<.001) significantly more than the Swedish elderly. Conversely, the Swedish elderly seemed to feel more uncomfortable for a potential intrusion in the privacy of their domestic life (F(1, 81) = 10.03, p<.01), and for the idea of becoming too much dependent on the robot (F(1, 81) = 14.19, p<.001) and not being able to remind things by themselves (F(1, 81) = 11.38, p<.001) than the Italian elderly.

Finally, the emotional reaction of elderly people to the robot was very good, scoring high on the positive adjectives *useful*, *interesting*, *amusing* and *relaxing*, and scoring very low on the negative adjectives *scary*, *overwhelming*, *gloomy*,

dangerous, *out of control* (see Fig. 4).

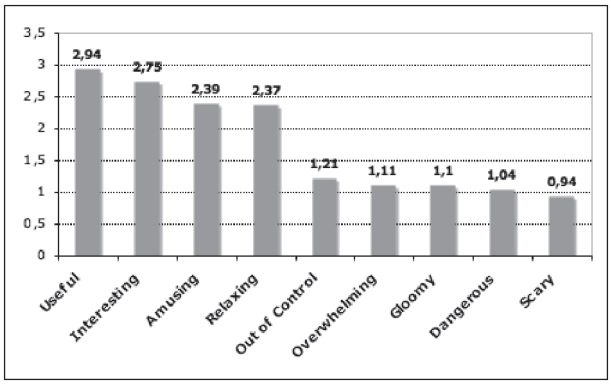

Figure 4: Emotional reaction of elder people to the robot (Means).

The Swedish and the Italian elderly affectively responded to the robot in a very similar way, being the only significant difference referring to the idea of the robot as a lively device, as it was perceived by the Italian more than by the Swedish ($F(1, 75) = 12.44$, $p<.001$).

Reference to human beings. As to this issue, our experimental conditions emerged to be effective. Interestingly, when comparing the two versions of the robot, the majority of respondents indicated the Face version as the preferred one, both in Sweden and in Italy; but when asked to evaluate the specific features of the device, the No-face version constantly emerged as the more appreciated. The No-face version was evaluated as less impersonal ($F(1, 81) = 8.87$, $p<.01$), easier to be integrated in the domestic environment ($F(1, 80) = 15.93$, $p<.001$), less scary for the pets ($F(1, 81) = 14.79$, $p<.001$), more reassuring when speaking ($F(1, 81) = 7013$, $p<.01$), and less irritating when taking decisions ($F(1, 81) = 6.81$, $p<.01$), independently of the country of respondents. In addition, in the Swedish group the No-face version was perceived as more suitable to simplify everyday life for the elderly than the Face version ($F(1, 40) = 7.82$, $p<.01$); in the Italian group the No-face version was perceived as easier to be used than the Face version ($F(1, 36) = 9.38$, $p<.01$).

With respect to the emotional response, the No-face version was evaluated as more amusing ($F(1, 78) = 7.46$, $p<.01$) and less gloomy ($F(1, 78) = 7.46$, $p<.01$).

Family status and perceived health conditions. An analysis of the evaluation of the robot was performed with reference to the living situation of the elderly, in particular comparing people living alone and with ones partner. As to scenario evaluation, elderly people living with their partner considered the presence of the robot as more acceptable in the management of personal safety ($F(1, 81) = 9.24$, $p<.01$), and in reminding activities related to health care ($F(1, 81) = 8.70$, $p<.01$). Conversely, no significant difference emerged when considering the likelihood of scenarios and the utility of the robot in each situation.

As to the general evaluation of the robot, no main effect of the living situation emerged. An interaction effect of the living situation and the Country was outlined. In Italy, elderly people living with their partner considered the presence of the robot as amusing ($F(1, 38) = 9.13$, $p<.01$) and useful to make the elderly living alone feel safer ($F(1, 38) = 17.86$, $p<.001$) and to simplify everyday activities ($F(1, 38) = 7.91$, $p<.01$) more than people living alone. On the contrary, elderly people living alone think that the robot might cause some problems in the domestic environment ($F(1, 38) = 7.22$, $p<.01$), could hardly be integrated at home ($F(1, 38) = 8.33$, $p<.01$) and might frighten the pets ($F(1, 38) = 8.3179$, $p<.01$), more than people living with their partner. In Sweden, elderly people living alone would like the robot to move only when requested significantly more than elderly people living with their partner ($F(1, 41) = 8.50$, $p<.01$).

Finally, no main effect of the perceived health conditions on the evaluation of the robot was shown. An interaction effect of perceived health conditions and the Country was outlined with reference to some interaction modalities. In Italy, the elderly in worse health conditions would like the robot not to approach people too much ($F(1, 37) = 7.89$, $p<.01$) and would not like to teach the robot what to do personally ($F(1, 37) = 5.38$, $p<.01$) significantly more than people in better health conditions.

Gender issues. Some differences emerged with reference to gender. Independently of the Country, women showed a stronger apprehension than men for the possibility that the robot would cause problems in the domestic environment ($F(1, 81) = 9.72$, $p<.01$), and a preference for a higher distance from the robot in personal interaction ($F(1, 81) = 8.32$, $p<.01$); conversely, men think that having a robot going around at home would be amusing significantly more than women ($F(1, 81) = 14.04$, $p<.001$). In the Italian group, the majority of women think that it would be a little strange to speak to a non-human device significantly more than men ($F(1, 38) = 7.45$, $p<.01$), while men would appreciate eye-contact when speaking ($F(1, 38) = 7.34$, $p<.01$) and the possibility for the robot to take decisions autonomously ($F(1, 38) = 9.14$, $p<.01$) significantly more than women. For the Swedish group, women showed a stronger hesitation than men about the cost of the robot, which is expected to be too expensive ($F(1, 39) = 10.18$, $p<.01$).

Discussion, Shortcomings and Future Work

The driving ambition of this work is to highlight the variety in level of appreciation of the domestic robots for elderly care as it relates to a number of aspects of culture which are not necessarily trivial to identify. For instance, the user's acquaintance with ICT can play a significant role in his or her confidence in handling new technology. Our results show that the Swedish user group, whom likely has more exposure to ICT, is less challenged by the prospect of having to program or repair the device.

Another determining factor are the social policies in the respective countries regarding elderly care and family culture. In Sweden, where elderly people are more incline to

living on their own in later life (due either to social policy or simply tradition), users may feel threatened by the introduction of a robot in their private sphere. The impact on privacy in Italy, on the other hand, was evaluated as less important. However, the Swedish user group recognizes a greater utility in the proposed scenarios: while emergency situations are equally appreciated by both samples, the Italian group tended to loose interest when the situation becomes less critical. An interesting example is the scenario in which the robot suggests the user to engage in more physical activity, a scenario generally not appreciated by the Italian user group and more tolerated by the Swedish sample.

Interestingly, the difference between user perception in acceptability and utility outlined is not reflected in the physical aspect of the robot. Both the Swedish and the Italian groups preferred the robot with less human-like attributes. Indeed, this can be explained by the implicit relationship between the preferred appearance of an assistive relational agent and the specific task it is designed to perform (Catrambone, Stasko, and Xiao 2002). The functional nature of the proposed scenarios may indeed not require strong human-like features to be present on the robot. The system was perceived as mostly useful for emergency-related tasks, thus its "social" skills are seen as less critical. This may explain why the version without a face is more appropriate for a domestic robot working within this context, as opposed to relational (and often web-based) agents providing "help center" like assistance. It is indeed reasonable to assume that the user interface appearance and interaction modalities tend to become more homogeneous across cultures in safety-critical applications, although the Authors are not aware of specific work on this issue which can be directly applied to the domain of embodied assistive agents for elder care. In addition it is possible to hypothesize that the appearance of the face version of the robot may have created an effect similar to the "Uncanny Valley" effect (Mori 1970) . Indeed the current version of the face is not very realistic and for this reason it can generate a repulsive response since its appearance is "barely-human".

Our results also show that Swedish users tend to see the system as a threat to their ability to remember things on their own, and are more worried of becoming dependent on the robot. Regarding how the issue of independence is perceived in Sweden, it is stated in (Dunér and Nordström 2005) that "Desire for independence was general, overshadowing other desires and directing actions" (p. 440). The article describes elderly people's various efforts to remain independent as long as possible, or to at least uphold a feeling of independence once they actually become dependent by trying to maintain control. By applying social action theories, the subjects' intentions and strategies to maintain independence were investigated, revealing that "being free, having control over one's situation, participating, and peace and quiet ..." was a strong priority, and that the strategies for maintaining such levels of independence were "...continuing to struggle and keep busy, adapting to circumstances, getting help from several sources, receiving services and giving services in return ...." (p. 440). It is in our opinion important at this point to investigate if there is a connection between the elderly person's desire for maintaining independence and control to their worries about developing a strong dependence on the robot. Specifically, one issue that cannot be answered by our survey, but which will be interesting to investigate in future work, is to assess which intentions as stated above are being violated or challenged by the robot and in particular how the functionality of a domestic robot can instead promote feeling of independence and preserve autonomy of the elderly.

In this and previous papers specific to the Italian user group we have focused on the manipulation of the Face/No-face parameter. However, our material also includes scenarios in which the user is shown to interact with an environment in which no robot is present. As the robot does not possess manipulatory capabilities, the system is portrayed as functionally identical to the scenarios in which an embodied interface is present. The aim of this further evaluation is to ascertain the added value of the robotic mediator as the primary user interface. Although we are currently still gathering and analyzing the data, preliminary results on Italian user groups show that the presence of the robot is indeed perceived as an added value, even though its presence adds nothing to the functionality of the system. It is possible that, as the general appearance of the robot was perceived similarly across the Swedish and Italian users, also the role of embodiment represents a cultural invariant.

Finally, as a last remark, gender related issues towards the user perceptions of domestic robotic technology of elderly people will also be a point of interest for future work. As gender has a significant impact on perception of technology ((Lohan and Faulkner 2004; Mellström 2004; Wajcman 1991; Cockburn 1985)) as well as perception of the home environment (West and Zimmerman 1987; Fenstermaker and West 2002), this issue is an important aspect for creating general solutions for domestic robotics for elderly care.

Towards a an open benchmark for evaluation. This paper is part of a larger project which seeks to create the foundation for a network of excellence in technology for elder care. Specifically, the cross-cultural experience described herein is a first step towards establishing an open benchmark for evaluation. The overall intent is a shared resource for the scientific community of which the present videos are a first contribution. Our long term goal is to create a common agora to facilitate a systematic analysis of the effectiveness of video based evaluation of elder care technology. This portal could be used to engage the community in comparing other forms of evaluation. Specifically, the Wizard of Oz (WoOz) methodology is one such technique against which we would like to compare our video-based results. The WoOz is an experimental condition in which subjects interact with a system that is perceived as autonomous, but which is actually being operated or partially operated by an unseen human being. An interesting question is to understand if and how live evaluation methods differ from video-based evaluation.

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