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Investigating Politeness Strategies and Their Persuasiveness for a Robotic Elderly Assistant

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Abstract. This work is targeted towards the development of a Robotic Elderly Assistant (REA) system that provides assistance in the form of recommendations to support single-living elderly people in their domestic environment. To avoid potential face threats the REA should be as polite as possible whilst keeping a certain persuasiveness to promote its recommendations. This paper investigates different verbalizations of the REA's recommendations regarding their perceived politeness as well as their persuasiveness. We present the results of a laboratory study with younger adults and a user study with the inhabitants of a retirement home. Results suggest that the different politeness strategies reflected different levels of politeness in both studies, while their perceived persuasiveness needs further investigation in the domain of elderly care.

Keywords: Elderly people · Social robots · Recommendations · Politeness strategies · Persuasiveness

1 Motivation

The demographic change, especially in industrialized countries, results in important societal challenges to be dealt with. Since elderly people often suffer from physical and mental restrictions, they lose living independence. Especially single-living elderly often lack societal interactions and thus get isolated. Both problems get amplified if the elderly are inactive and lack self-initiative.

Studies have shown that regular physical and cognitive activities can help mitigate many age-related diseases [1,2]. For example, pain due to arthrosis could be alleviated by moving the affected joints on a regular basis, and activities, such as gardening or painting, can positively influence elderly people's well-being [3]. However, some seniors tend to not engage in these activities. Therefore, Seiderer et al. [4], for example, tried to promote a healthier lifestyle and to increase seniors' overall well-being by providing concrete recommendations. However, developing such systems for seniors should be done with care, as people of their generation may be less familiar with newer electronic devices and thus have a rather high barrier of use or, even worse, are afraid of using them [5,6].

Through their embodiment, among other features, social robots are very well suited to support socio-emotional factors. There is evidence that humans perceive them as social actors and are likely to respond to them in a similar way that people respond to each other [7]. Furthermore, through their ability to adapt to a large variety of users and remain attractive to users on a long-term basis, social agents are typically useful for intuitive and persuasive interaction [8]. Therefore, it seems to be promising to develop a Robotic Elderly Assistant (REA) that could contribute to the establishment of a positive emotional and social relationship between user and system.

A number of studies have been conducted that explore social robots, such as the iCat or Nao, in terms of their acceptance by older adults, e.g. [9,10]. In general, seniors seem to evaluate social robots mainly in terms of appearance, intellectuality, and friendliness [11]. Robots should appear less threatening, but kind-hearted [12,13] and more realistic faces are perceived as more trustworthy and sociable [11]. Elderly people prefer discrete and small robots with human or pet-like traits over large humanoid robots [12,14]. Furthermore, robots are more likely to be accepted if they move slowly, act less autonomously, have a female voice and a monochrome and serious appearance [12]. There is also evidence that elderly people respond positively to robotic companions if they emulate social behavior that matches the seriousness of a current task or situation [15]. However, if robots look too human-like, but do not match the high expectations in terms of behavior, people tend to get disappointed and distrustful of them [16].

Special attention should be paid to the fact that many elderly find themselves in a situation where they can no longer take full care of themselves and need the help of others to accomplish daily tasks. Consequently, the feeling of embarrassment or loss of control over their lives become important issues. Therefore, providing recommendations often comes along with a certain threat of the users' face. For example, the statement "Drink some water." could invoke the feeling of being patronized. In contrast, the question "How about drinking some water?" would keep the users in control whilst reminding them to drink enough water. Therefore, we think that verbal politeness strategies, as an aspect of social and respectful behavior, can further enhance the acceptance of a REA and can foster a good working relationship between the elderly user and the REA.

In the following we will introduce related work that investigated the role of politeness in verbal social interactions. Afterwards, our approach to a REA will be presented. The main part of the paper will explain details on two studies that were performed to investigate the perception of different politeness strategies and their persuasiveness. The second study was conducted in a local retirement home with our REA system and also investigated the elderly participants' reaction to the robot. The paper concludes with a discussion and some lessons learned from the observations made during our studies.

2 Politeness as a Social Factor

Sidner and Lee [17] designated politeness as an important factor when robots initiate engagement with people, and Nomura et al. [18] showed that even small

differences in a robot's non-verbal behavior, such as motions, could influence people's perception of it as well as their behavior towards it. In the domain of elderly care, politeness seems to be of special importance, as the perceived politeness of a system varies with the user's experience with technical systems [19].

We think that the way recommendations are verbalized by the robotic companion can help mitigating facial threats, e.g. by using suggestions, hints or proposals instead of commands. Brown and Levinson [20] describe politeness as a means to preserve the reputation of conversation partners even in critical situations. Their politeness theory builds on the fact that every interlocutor has two basic wants concerning their face or public self-image: (1) to be approved of by the conversation partner (positive face) and (2) to be unrestricted by the conversation partner (negative face). In order to avoid threads to their (positive or negative) face during a conversation, interlocutors tend to apply different types of politeness strategies: (1) to emphasize approval (positive politeness), (2) to emphasize the interlocutor's freedom of choice (negative politeness) and (3) indirect statements in case an action is necessary (off-record statements).

Johnson et al. [21] incorporated these politeness strategies in different verbalizations of an artificial tutor that used politeness for motivating a learner to accomplish different tasks. Eight categories of verbalizations were presented that relate to Brown and Levinson's notation of positive and negative face. These categories are: (A) direct commands, (B) indirect suggestions, (C) requests, (D) actions expressed as the tutor's goals, (E) actions as shared goals, (F) questions, (G) suggestions of student goals, and (H) Socratic hints.

Results of Johnson's experiment showed that participants rated positive and negative politeness with a high degree of consistency and that their ratings were consistent with Brown and Levinson's assessment of the strategies' politeness.

In the context of an elderly care assistant, it should be noted that depending on the importance of the given advice, more or less polite wordings might be required. Thus, the present contribution investigates all eight categories and rates them with regard to their perceived politeness as well as their perceived persuasiveness.

3 The REA System

Our overall goal is to develop a sensitive and personalized system to support elderly people who would generally be able to live independently, but lack a certain autonomy due to forgetting appointments, daily tasks or not showing the initiative for activities. Assistance is given in the form of situationally appropriate recommendations to encourage physical, mental, and social activities, all aimed at increasing the users' well-being. To ensure an interaction that is as natural and intuitive as possible, and to reduce barriers to entry, the system is impersonated by an expressive robot that acts like a social companion. The robot chosen for the REA system was a *Robopec Reeti*[1], see Fig. 1. It meets the

[1] http://www.reeti.fr.

most important criteria that were mentioned in Sect. 1. It is comparatively small (44 cm), plain white and, apart from the head, it does not have any movement capabilities that could be perceived as threatening. Its basic appearance is that of a cartoon-like extraterrestrial or fantasy creature. The facial expressions are human-like, which allows the user to relate to the robot more easily, yet stylized enough to reduce expectations about realistic behavior. For German speech synthesis, Reeti uses the Loquendo text-to-speech software by Nuance[2].

Fig. 1. Reeti, a social robot with an expressive head created by Robopec. It supports gaze behavior with three movement axes in the neck and two in each eye, as well as eight degrees of freedom for animating the mouth, eyelids and ears.

Based on Brown and Levinson's politeness strategies and Johnson et al.'s taxonomy of verbalizations (see Sect. 2), we prepared three recommendations

Table 1. Different wordings of the recommendation 'Drink some water'

Politeness strategy	Verbalization	Translation
Direct command	Trinken Sie etwas Wasser	Drink some water
Indirect suggestion	Ihr Ernährungsplan sieht vor, dass Sie etwas Wasser trinken	Your dietary plan suggests that you drink some water
Request	Ich hätte gern, dass Sie etwas Wasser trinken	I would like you to drink some water
Actions expressed as the system's goals	Ich würde etwas Wasser trinken	I would drink some water
Actions expressed as shared goals	Wir sollten etwas Wasser trinken	We should drink some water
Questions	Wie wäre es, wenn Sie etwas Wasser trinken würden?	How about drinking some water?
Suggestions of user goals	Sie möchten bestimmt etwas Wasser trinken	You would probably like to drink some water
Socratic hints	Haben Sie daran gedacht etwas Wasser zu trinken?	Did you think about drinking some water?

[2] http://www.nuance.com.

that would naturally fit in a scenario of a REA: 1) drink some water, 2) open the window, and 3) go for a walk. Examples of the different wordings can be seen in Table 1. The German version as used in our system is included, since an equally perceived degree of politeness of the translations cannot be guaranteed.

For presenting the recommendations, the *VisualSceneMaker* tool [22,23] was used to implement a semi-automatic dialog application. Via keyboard inputs the experimenter was able to move to the next phrase, to repeat the current phrase, or to stop the whole process.

4 Laboratory Study

To ensure that our experiment is not too subtle or too abstract to grasp for the inhabitants of an elderly home, we conducted a text-based study at our lab first to verify that the different verbalizations are perceived as expressing different levels of politeness and persuasiveness.

4.1 Participants and Procedure

The study was conducted with 5 female and 15 male native German speakers aged from 25 to 45, in a lab environment. After a short introduction, participants answered a few demographic questions. Then they were shown eight textual verbalizations for each of the implemented recommendations (1: drink some water, 2: open the window, and 3: go for a walk) in an incomplete counterbalanced order. For each verbalization, participants had to rate their perceived politeness as well as persuasiveness on a 7-point Likert-scale from 1 = "not polite/persuasive at all" to 7 = "very polite/persuasive".

4.2 Results

An analysis of the mean ratings, see Fig. 2, showed that *questions* were rated as most polite. Actions that were expressed as *shared goals* or *the system's goals*, and *requests* were perceived as polite, too. In contrast, *direct commands* were assessed as impolite. Interestingly, *direct commands* were perceived to have a similar degree of persuasion as *questions*. *Socratic hints* and *suggestions of user goals* were rated as least convincing. Strategies that were perceived as polite as well as persuasive were *actions expressed as shared goals* and *requests*.

A repeated-measures ANOVA analysis of the provided ratings for all recommendations showed significant differences for the perceived politeness ($F(7, 308) = 37.82, p < .001$) as well as the perceived persuasiveness ($F(5.25, 231.05) = 8.14, p < .001$). A subsequent Bonferroni post-hoc test, see Table 2, confirmed the impressions of the descriptive analysis. Amongst others, *questions* were perceived as significantly more polite than any other strategy, and *direct commands* scored significantly worse on politeness than the other strategies.

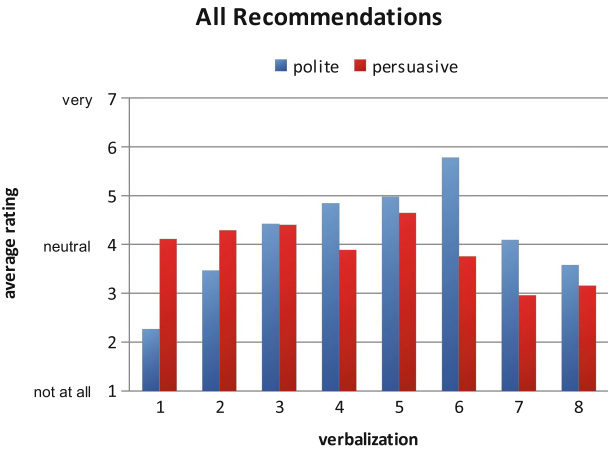

Fig. 2. Results of the laboratory study (Mean ratings for all recommendations). 1: direct command, 2: indirect suggestions, 3: requests, 4: actions as system goals, 5: actions as shared goals, 6: questions, 7: suggestions of user goals, 8: Socratic hints

Thus, the study showed that the investigated politeness strategies were perceived as significantly differently polite as well as persuasive. However, strategies that were perceived as polite were not necessarily perceived as persuasive or unpersuasive. Therefore, a good strategy for a REA might be to (1) choose verbalizations that are both, polite and persuasive, (2) neglect verbalizations that are neither polite nor persuasive, and (3) adapt verbalizations to the current situation to keep a certain variability in behavior, e.g., by choosing the verbalization depending on the importance of the given recommendation. For example, in cases where it is necessary to follow the advice of the robotic companion (such as remembering to take the prescribed medicine), a more convincing strategy

Table 2. Results of the laboratory study: M = Mean; SD = Standard Deviation; Sig = significantly better than

	Politeness			Persuasiveness		
	M	SD	Sig	M	SD	Sig
1. Direct command	2.27	1.03		4.11	1.76	
2. Indirect suggestion	3.47	1.41	1**	4.29	1.63	7**; 8*
3. Request	4.42	1.60	1***	4.40	1.48	7***;8**
4. Actions expressed as system goals	4.84	1.11	1,2,8***	3.89	1.45	7*
5. Actions expressed as shared goals	4.98	1.22	1,2,8***	4.64	1.45	7***; 8**
6. Questions	5.78	1.11	5*; 1,2,3,4,7,8***	3.76	1.32	7*
7. Suggestions of user goals	4.09	1.41	1***	2.96	1.38	
8. Socratic hint	3.58	1.20	1***	3.16	1.51	

*significant with p <.05; **significant with p <.01; ***significant with p <.001

could be chosen over a more polite but less persuasive version. In other cases, such as a suggestion to drink water regularly, the recommendation should focus more on politeness than on persuasiveness.

5 Study with Target User Group

After the politeness strategies were evaluated by younger adults in text form in a laboratory environment, a second study was conducted with the target user group, elderly inhabitants of a local retirement home who are needing assistance in certain daily situations, but do not suffer from serious mental diseases such as dementia. This time, the recommendations were presented by the REA described in Sect. 3. The aim was to investigate whether the elderly would distinguish between the perceived politeness and persuasiveness of the different verbalizations. Furthermore, we wanted to observe the seniors' acceptance of the presented REA system.

5.1 Participants and Procedure

In cooperation with the retirement home's head, we recruited 11 female and three male native German speakers aged between 50 and 100 that required care, but were still capable of accomplishing many of their daily tasks themselves. To facilitate the questionnaires' completion for the elderly, they were adapted to their requirements. Questions were formulated shortly and clearly, and whenever possible the Likert-Scales were reduced to five options. Each item of the questionnaire was printed on a separate page. Thus, at any time, participants only had to deal with the information that was necessary for rating the current verbalization.

Figure 3 shows the experimental setup. After a short introduction to the REA system, the robot introduced itself and allowed the participant to choose a comfortable volume and speed of its voice, to ensure that the recommendations were easy to understand. Then the robot explained the course of the study. In the next phase, the robot presented the eight different wordings for each of the three recommendations. To reduce the risk of order effects, the verbalizations were presented in an incomplete counterbalanced order. After each item the dialog paused while the participant answered the related questions. During the explanation and the waiting phases, the robot's head and face were subtly animated with idle movements such as blinking or moving its head to make it appear more alive and therefore more accessible. To avoid an influence on the ratings, the robot stopped moving and returned to a neutral position when presenting a recommendation. At the end, the robot thanked the participants for their help and said goodbye. This last phase could be triggered earlier in case a participant did not want to complete the entire study.

Fig. 3. Experimental setup: The study took place in a dining room at the retirement home. The REA was placed on a table in front of the participant. The application controlling the REA was running on a laptop which was positioned behind the robot and turned away to hide the screen and keyboard from the participant's view.

5.2 Results

Ten of the elderly people finished the study which took 45 to 60 min to complete. Unfortunately, four participants wanted to terminate their participation early because the procedure was too tiring for them.

In general, the participants provided relatively high ratings for the perceived politeness as well as the perceived persuasiveness for all verbalizations. The mean ratings of both criteria are graphically represented in Fig. 4. Similarly to the first study, *questions* were perceived as most polite. *Actions expressed as the system's goal* also received high ratings regarding the perceived politeness. However, *Socratic hints* were perceived as much more polite than in the first study. *Direct commands* also received much higher ratings, but were still perceived as least polite. Regarding the perceived persuasiveness, most of the verbalizations scored around 5.00. Only *suggestions of user goals* achieved a slightly lower mean rating of 4.73. Strategies that achieved high ratings concerning both criteria include indirect *suggestions*, *requests* and *Socratic hints*.

A repeated-measures ANOVA analysis showed significant differences between the different wordings for the perceived politeness ($F(7, 203) = 4.69, p < .0001$), but not for the perceived persuasiveness ($F(4.39, 127.38) = .53, p > .05$). A subsequent Bonferroni post-hoc test showed that *questions* and *actions expressed as the system's goals* were rated significantly more polite than *direct commands*, see Table 3. Nevertheless, the three strategies were rated as equally persuasive.

Observations of the seniors interacting with the REA indicated that none of them was afraid of the robot or rejected it, although most of them had never seen a system like REA before. After a few minutes of skepticism and doubts ("That's a machine. I can't talk to it.") almost all seniors did like the REA and talked to it as if it would understand them. They stated that the robot is "very friendly", "very nice", or even "really polite". Several participants complimented it directly and told stories about their families, their own childhood, adolescence, or current life. One woman even wanted to hug it. Furthermore, some of the elderly people tried to interpret the REA's random non-verbal behavior when it incidentally moved its head after they had talked to it.

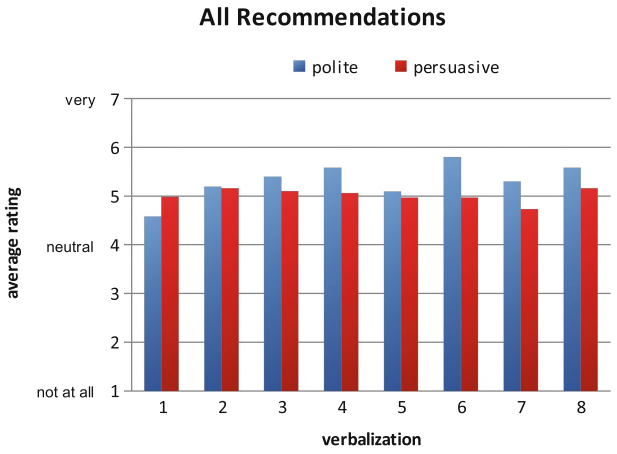

Fig. 4. Results of the field study (Mean ratings for all recommendations). 1: direct command, 2: indirect suggestions, 3: requests, 4: actions expressed as system goals, 5: actions as shared goals, 6: questions, 7: suggestions of user goals, 8: Socratic hints

Table 3. Results of the user study: M = Mean; SD = Standard Deviation; Sig = significantly better than

	Politeness			Persuasiveness		
	M	SD	Sig	M	SD	Sig
1. Direct command	4.58	1.37		4.98	1.39	
2. Indirect suggestion	5.19	1.04		5.16	1.13	
3. Request	5.40	1.28		5.10	1.21	
4. Actions expressed as system goals	5.58	.96	1**	5.06	1.18	
5. Actions expressed as shared goals	5.10	1.38		4.97	1.58	
6. Questions	5.80	.96	1**	4.97	1.38	
7. Suggestions of user goals	5.30	1.47		4.73	1.66	
8. Socratic hint	5.58	1.28		5.16	1.25	

*significant with $p < .05$; **significant with $p < .01$; ***significant with $p < .001$

5.3 Discussion

The studies' results showed that people do distinguish between the perceived politeness and persuasiveness of different politeness strategies. However, compared to the study with younger adults, with inhabitants of an retirement home we found smaller and fewer significant differences concerning the perceived politeness and no significant differences concerning the perceived persuasiveness.

One reason could be that the interrelation between politeness and persuasiveness was perceived differently by the seniors. There is evidence that, while several people found wording that they rated more polite also more persuasive, other people rated wording that they found more polite less persuasive.

Furthermore, the comparably small differences between ratings of verbalizations may be caused by some limitations of the elderly. For example, since two of the participants were no longer physically able to open a window, or go for a walk, it was difficult for them to compare the different wordings. In addition, some participants felt tired after a while, and people suffering from impaired hearing had problems to understand the robot at certain points.

Nevertheless, all ratings provided by the elderly were relatively high and all politeness strategies received higher ratings from the elderly than from the younger people in the first study. This is in line with the findings of Nomura et al. [24]. In a series of experiments they found that elderly people have more positive impressions of a robot than younger people. Some interactions such as telling private stories to the REA showed that, despite the short interaction time, the elderly people already established some trust in the robot, which is an important prerequisite to apply recommendations provided by a robotic system.

6 Conclusion

In the present contribution, we investigated linguistic variations to convey different levels of politeness in human-robot interaction. In the long run, a Robotic Elderly Assistant (REA) should provide assistance for elderly people in the form of recommendations to support them in their domestic environment. When robots provide recommendations to the user, they permanently risk threatening the user's face. For example, a recommendation such as "You should be more active." could be perceived as offensive and demotivate users. Politeness strategies may help mitigate face threats that might arise in such situations.

The results of a laboratory study with younger adults and a study with elderly people in a retirement home showed that different politeness strategies were perceived differently. In the laboratory study some wordings were perceived neither polite nor persuasive, e.g. *suggestions of user goals* and *Socratic hints*. Therefore, we think that these verbalizations should be ignored by a REA. In contrast, wordings such as *requests* and especially *actions formulated as shared goals* were perceived as polite and persuasive. They could be utilized as standard strategies whenever a recommendation should be applied. Other wordings that were not rated as very polite or very persuasive could nevertheless be applied by a REA, e.g., to maintain the seniors' interest in the REA by providing a wider variety of behavior that could be adapted on the current situation. For example, wordings that were perceived as being polite but not very persuasive, such as *questions* or *actions expressed as the system's goal*, could be utilized in uncritical situations, where the recommendation does not necessarily have to be applied. In this way, the relationship between the elderly person and the REA could be further established. Vice versa, in critical situations, the system could emphasize the need to apply a specific action by utilizing, for example, *direct commands* or *indirect suggestions* that were assessed rather impolite, but convincing.

While some of the findings from the laboratory study could be confirmed in the study with elderly users regarding the perceived politeness, the perceived persuasiveness of the recommendations needs further investigation. Hence, we will refine our studies to better match the requirements of our target user group. For example, some ratings seemed to be influenced by the fact that certain recommendations were not suitable for some of the participants due to physical impairments, e.g. not being able to go for a walk. In a follow-up study, more recommendations will be included that will be chosen based on the participant's preferences and abilities. Furthermore, it would be of interest to investigate which of the recommendations of the REA will be carried out. It seems likely that there is a gap between the abstract thinking of rating a recommendation as being convincing and the real drive to carry out an action.

Serendipitously, the elderly people's behavior during the user study showed that they were very open minded towards our REA system and acted very positively during the interaction. Therefore, we think that elderly people are generally willing to accept recommendations provided by our REA, and aim on contributing to the field of robotic elderly assistant systems by sharing our insights on the usage of different politeness strategies in this domain.

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