

The Influence of a Social Robot's Persona on How it is Perceived and Accepted by Elderly Users

Andrea Bartl, Stefanie Bosch, Michael Brandt, Monique Dittrich,
and Birgit Lugin^(✉)

Human Computer Interaction, University of Wuerzburg, Wuerzburg, Germany

{andrea.bartl, stefanie.bosch, michael.brandt,
monique.dittrich}@stud-mail.uni-wuerzburg.de,
birgit.lugin@uni-wuerzburg.de

Abstract. The demographic change causes an imbalance between the number of elderly in need of support and the number of caring staff. Therefore, it is important to help older adults keep their independence. Forgetting is a common obstacle people have to face when they become older which can be moderated by social robots by reminding on tasks. Since most elderly people are not used to robots a challenge in HRI is to identify aspects of a robot's design to promote its acceptance. We present two different personas (companion vs. assistant) for a robotic platform by manipulating verbal and nonverbal behavior. A study was conducted in assisted living accommodations with the robot reminding on appointments to review if the persona influences the robot's acceptance. Results indicate that the companion version of the robot was better accepted and perceived more likeable and intelligent compared to the assistant version.

1 Introduction

According to the United Nations Department of Economic and Social Affairs [1] 21 percent of the world's population will be older than 60 years in 2015. This causes an obsolescence of society and consequently personnel bottlenecks in elderly care. At this point robotic systems can help foster older adults' autonomy. Thereby, not only physical but also cognitive tasks are of interest for HRI [2]. One aspect that jeopardises independent living is being forgetful [3]. While conventional calendars miss an active reminder function, technical alternatives such as smartphones require technical skills and the handling of small touch displays which can be barriers for older people [4].

A potential solution lies in using social robots: while combining the functionality of a calendar with its humanlike interaction the robot can serve as a social reminder for medication, family meetings and other appointments [5]. Since older adults consider a "robot calendar" as a useful application [5] the objective of this contribution is to identify their preferences regarding characteristics which make

the robot more acceptable. We define acceptance as the preference for a specific way of interacting, not the acceptance of the technology itself. Therefore, two versions of a scenario were evolved in which the robot reminds older people of appointments. They differ in the robot's persona and therefore in its way of interacting: a prevalent friendly (companion) and a formal (assistant) persona.

2 Persona and Anthropomorphic Interfaces

Studies show that the implementation of single personality traits, e.g. introversion vs. extroversion [6], can have an impact on the acceptance of a robot. Thus, the question arises, if a robot's persona, meaning a fictional personality with varied and stable behavioral and personality patterns [7], has a similar effect. Derived from studies which focus on the simulation of a persona in the context of social robots and virtual agents [8], we differ between the companion and the assistant persona. The *assistant* distinguishes itself through its professional competence as well as its formal and authoritarian aura, whereas the main characteristics of the *companion* are its emitted likeability and kindred spirit [9–11]. In general, the companion is more emotional, enthusiastic and expressive and construed to establish emotional ties [9–11]. Another important attribute of the companion is the similarity to its human counterpart regarding qualities such as appearance, age or ethnicity [12]. Similar to the definition of companion and assistant, Goetz and Kiesler [11] differ between a robot's playful and serious personality. In a controlled laboratory experiment with younger adults, the playful robot was rated more positive and improved the mood of its interaction partners, while the serious robot elicited the most compliance. Following these findings we address the question whether robots representing different personas are perceived and accepted differently by elderly users.

3 Implementation

For the implementation of persona-specific behaviors we chose the humanoid robot Reeti¹. Advantages of this platform are its mimic expressivity and the integrated text-to-speech-synthesizer that allows to modify speech output with respect to gender, pitch, emphasis and speed. Reeti's cartoon-like appearance allows human-like facial and linguistic expressions without creating inappropriate expectations towards the realism of the robot's behavior. Moreover, the robot's neutral design (gender neutral, white body) benefits to exclude confounding variables. This, as well as the absence of limbs, the robot's height (40 cm) and its restricted movement capabilities give Reeti a non-threatening appearance suitable in the context of elderly care [13]. Since older adults prefer robots with female voices [2] the voice was set to female. To ensure that hearing impaired participants can follow the robot's voice, the speed was reduced.

¹ Robopec, www.reeti.fr.

The robot was connected to an electronic online calendar². The actor pattern was used to separate different aspects of the application such as the connection to the Robot Operating System, e.g. to activate speech output, or the connection to a server using the Google Calendar API to retrieve events and store them in a local database.

For our prototype, reminders were set manually. An interaction sequence for each condition (companion vs. assistant) was created in which the robot reminds of appointments using the calendar function. Both versions were equally designed as social actors and only differed concerning persona-specific behaviors, e.g. filler words for the companion version but not for the assistant version (see Table 1). Blinking and ear movements were added periodically and consistent over both conditions to create more authentic and lively expressions.

4 Study

To test the two versions of the robotic reminder a within-subject experiment was conducted with the following research questions (RQ):

- Does the presentation of the robot as a [companion/assistant] influence the likeability (RQ1a) and the perceived intelligence (RQ1b) of the robot?
- Does the presentation of the robot as a [companion/assistant] have an influence on the acceptance of the robot? (RQ2)
- Do elderly people consider a robot connected to a calendar useful? (RQ3)

4.1 Participants

The target group of the study was elderly people who are still able to handle their everyday lives rather autonomously. Therefore, the study was conducted in different assisted living accommodations for healthy and independent people in Wuerzburg (Germany) and at one participant's home. Four experiments had to be interrupted before completion because the participants either had problems understanding the robot acoustically or with answering the questions. After exclusion of the discontinued runs, the sample contained $N = 18$ participants aged between 71 and 91 years ($M = 81.83$, $SD = 5.56$), with 66.7 percent of the participants being female.

4.2 Procedure

Figure 1 (left) shows the experimental setup which was conducted as a Wizard of OZ (WOZ) study to reduce technical risks and ensure a fluent interaction. The experimenters were student researchers that were unknown to the participants before and followed a predefined study schedule. The procedure (see Fig. 1 (right)) lasted from 30 to 45 min and contained the following steps:

² Google Calendar, <https://developers.google.com/google-apps/calendar/>.

Table 1. Operationalization of the personas by specific verbal and nonverbal behavior.

Behavior	Companion	Assistant
Name	Anna (informal, surname only)	Kathrin Schmidt (formal, surname and lastname)
Fillers	Fillers “oh” and “ah” at semantically meaningful passages and emphasis of these words by widening the eyes [9]	No fillers
Status	Imitation of the participant’s age by the statement “I was built three years ago but I feel years older” [9]	Representation of <i>competence</i> by the statement “I was produced three years ago. Ever since I assist the personnel of retirement homes” [9]
Questions	Additional questions to increase affiliation [9]	No additional questions
Words of agreement	Words of agreement “okay”, “alright” and “good” to increase affiliation [14] and emphasis of these words by head nodding	No words of agreement
Pronouns	Pronoun “we” to increase affiliation [15]	No pronoun “we”
Directness/emotions	More emotional and informal language [9,16]	More direct and formal language [9,16]
Head tilt	Head tilts to pose warmth [17]	No head tilts
Smile	Friendly smile to increase affiliation and liking [18]	Less frequent smiles [18]

(a) After a short welcome, the experiment started with open questions. (b) To get the seniors acquainted with the robot, it introduced itself and its abilities. This sequence also contained speech volume regulation according to the participants’ preferences. (c) A short explanation of the calendar function was given and two exemplary appointments were stored in the calendar. The experimenter explained that the participant will interact with two different versions of the robot without naming their different characteristics. (d) The participant interacted with one of the two personas with the robot reminding them of the stored appointments. To avoid order and learning effects half of the participants started with the companion followed by the assistant whereas the other half interacted the other way round. (e) A questionnaire referring to the interaction was filled in addressing the seniors’ perception and acceptance of the persona

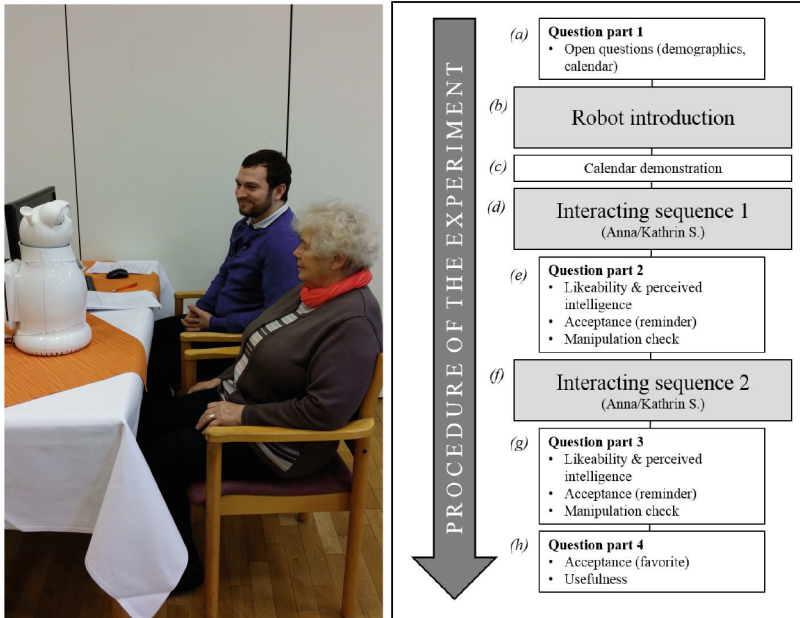


Fig. 1. Experimenter with a participant during the study. The wizard, who controls the robot, is not visible (left). Procedure of the study (right).

and the success of the manipulation. (f, g) The prior two steps were repeated for the remaining persona. (h) The experiment ended with the selection of the favorite version and the evaluation of the usefulness of the robot.

4.3 Questionnaire

To collect the relevant data, a survey was designed using both open and polar questions. The questions were aligned with the management of the assisted living accommodations to avoid misunderstandings and adapt them optimally to the target group.

Question part 1. Demographics on age and gender were collected followed by questions about calendar usage as a daily routine.

Question part 2 and 3. *Likeability and perceived intelligence:* The German version of the Godspeed Questionnaire Series [19] was taken as a basis to measure the perception of the persona (RQ1a and b). Its rating scale consists of adjectives building a semantic differential (e.g. unintelligent – intelligent). The subscales likeability (like, friendly, kind, pleasant, nice) and perceived intelligence (competent, knowledgeable, responsible, intelligent, sensible) were considered relevant for this study. *Acceptance (reminder):* To measure the acceptance (RQ2) of the persona, participants were asked whether they wanted appointment reminders

from the represented persona (c.f. [20]). *Manipulationcheck*: To find out if the manipulation of the independent variable (persona) was successful, participants rated to what extent they experienced the presented robot version as a companion and as an assistant.

Question part 4. Acceptance (favorite): As a second acceptance indication participants were asked to choose their favorite persona, by asking which robot version they would prefer. *Usefulness*: The perceived usefulness (RQ3) was measured by asking participants how useful they rate the robot as a calendar - detached from the persona.

The items regarding likeability, perceived intelligence, acceptance (reminder), the manipulationcheck, and usefulness were designed as 5-point Likert scales with labeled levels.

4.4 Results

Most participants ($n = 17$) use a calendar (e.g. a wall or pocket calendar) in their daily routine. Only $n = 2$ people use an additional electronic calendar. The descriptive statistics of the relevant items and indexes are shown in Table 2. The items analysed were converted to numeric values from -2 to $+2$.

Table 2. Descriptive statistics comparing Anna (companion) and Kathrin Schmidt (assistant), with $N=18$.

	Companion	Assistant
	$M (SD)$	$M (SD)$
Likeability	1.58 (.51)	1.31 (.70)
Perceived intelligence	1.33 (.64)	1.19 (.66)
Acceptance (reminder)	1.22 (1.00)	.89 (1.08)
Manipulationcheck: Companion	0.67 (1.33)	0.11 (1.41)
Manipulationcheck: Assistant	0.83 (1.04)	1.06 (.94)

Likeability and perceived intelligence: The valuations of the companion and the assistant version on likeability and perceived intelligence were compared. Two-tailed Wilcoxon Signed-Rank Tests showed that the companion was rated significantly higher than the assistant regarding both likeability ($N = 18, T = 10.50, p < .05$) and perceived intelligence ($N = 18, T = 3.50, p < .05$).³

Acceptance (reminder/favorite): The analysis of the acceptance (reminder) of the two robot personas along with their calendar function did not show significant results, meaning that the participants' ratings on whether they wanted to be

³ Analog t tests confirmed the results ($t_{likeability}(17) = 2.55, p < .05; t_{intelligence}(17) = 2.60, p < .05$).

reminded of their appointments by Anna or Kathrin Schmidt respectively did not differ ($T = 3, p = .19$)⁴. However, as shown in Fig. 2 the majority of the participants stated that they preferred Anna and that they would rather keep Anna than Kathrin Schmidt for their own use (acceptance favorite).

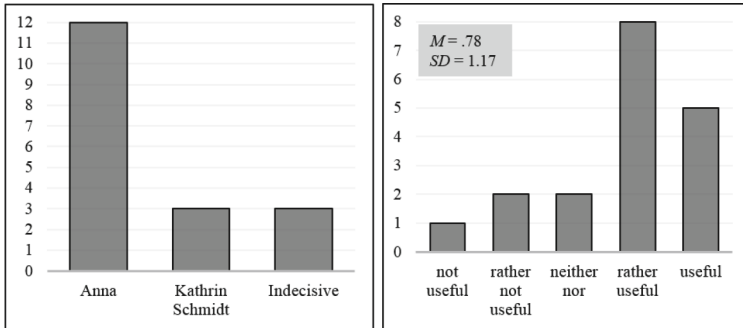


Fig. 2. Absolute frequencies of participants who chose Anna or Kathrin Schmidt as their favorite version (left), and distribution of the participants on the perceived usefulness of the robot with its calendar function (right).

Manipulationcheck: To verify to what extent participants experienced Anna and Kathrin Schmidt as a companion or as an assistant, two-tailed Wilcoxon Signed-Rank Tests were performed. The results are summarized in Fig. 3. No significant differences were observed between the perception of Kathrin Schmidt and Anna as assistant or companion respectively (horizontal arrows). Comparing both scores (assistant vs. companion) for Anna and Kathrin Schmidt separately (vertical arrows) a significant difference was found: people experienced Kathrin Schmidt significantly more as an assistant than as a companion⁵.

Usefulness: Participants rated the usefulness of the robot with its calendar function (detached from the persona) predominantly positive (see Fig. 2).

Further evaluation of the data indicated that age and gender of the participants also influenced the results. Two-tailed Mann-Whitney-U-tests showed that female participants rated Anna higher on the sympathy-dimension than male participants ($M_{female} = 1.73, SD = .46, M_{male} = 1.27, SD = .48, U = -2.19, p < .05$). Significant correlations occurred between the age of the participants and the ratings on the perception of the personas as well as the usefulness of the robot in general (see Table 3).

⁴ Analog t test accounted for the same result ($t(17) = 1.68, p = .11$).

⁵ Analog t tests showed the same results ($t_{Assistant}(17) = -1.07, p = .30; t_{Companion}(17) = -2.05, p = .06; t_{KathrinS}(17) = 2.65, p < .05; t_{Anna}(17) = .40, p = .70$).

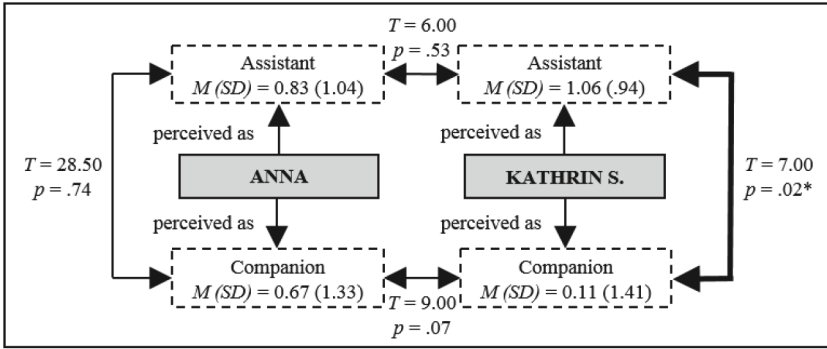


Fig. 3. Results of the manipulationcheck: perception of Anna and Kathrin Schmidt as companion or assistant.

Table 3. Significant correlations (Kendall-Tau-b) between the age of the participants and the perception of the personas as well as the usefulness of the robot.

	Age
Likeability Companion	-.42 ^a
Likeability Assistant	-.43 ^a
Perceived Intelligence Companion	-.45 ^a
Perceived Intelligence Assistant	-.43 ^a
Acceptance (reminder) Companion	-.63 ^b
Usefulness	-.50 ^b
Manipulationcheck: Assistant Anna	-.42 ^a

a. significant correlation on a significance-level of .05 (two-tailed).

b. significant correlation on a significance-level of .01 (two-tailed).

4.5 Discussion

The companion version was rated significantly more likeable and intelligent compared to the assistant version of the robot. This result is somewhat surprising, considering the fact that the companion was designed to be friendly but not necessarily more competent. A reason could be the Halo-Effect [21] which states that the assignment of certain properties to a person influences the perception of other properties. Transferred to this experiment the positive assessment regarding the likeability could have exuded on perceived intelligence.

The preference for the companion version was also reflected by the fact that the majority of participants chose the companion persona as their favorite, although there was no difference in the participants' preference to get reminded by the companion or the assistant. Interestingly only two of the participants

could name reasons for their decision by stating that they found the companion to be nicer.

Results also indicate that the participants were only limitedly able to classify Anna and Kathrin Schmidt correctly as companion or assistant. It is possible that the assistive role with a reminder function of both versions has been influencing the participants' judgments.

Regardless of the persona participants considered the robot with its calendar function as rather useful. This is in line with findings of Schroeter et al. [22] who conducted an evaluation of an assistive social robot for elderly people.

Further results suggest that the age of the participants played a role in the evaluation of the robot: the older a person, the more negative was the general attitude towards the robot. Similar effects were observed in [23] where the attitude of 75 year olds towards service robots was more skeptical compared to seniors that are younger than 65. This raises hope that the future generation of seniors will be more open towards robotic companions in the domain of elderly care. Our future studies will therefore focus on younger seniors.

Participants' statements indicated that the voice of the robot seemed unnatural and 'non-human' making it difficult to understand the robot. Even the deliberate reduction of the speech rate and adjustment of the volume to each participant's individual preference did not help overcome these difficulties. Therefore in future studies other solutions for the speech should be considered.

5 Contribution and Future Work

We believe that social robots bear great potential to help older people to stay autonomously. In this contribution, two different personas (companion vs. assistant) for a social robot with an integrated calendar function have been investigated and tested in assisted living accommodations. Our preliminary study suggests that the companion persona has a positive impact on the likeability and perceived intelligence and is preferred when compared to the assistant persona. Therefore, we aim on contributing to the field, by recommending companion-like personas over assistants and by providing guidance on implementation of their prototypical behavior. However, these findings should be taken with care due to the small sample size as well as potential drawbacks of the study, e.g. regarding the target age group and speech output. In future work, more interactions with the robot over a longer period of time in an assisted living accommodation need to be researched. On the one hand this would shed light on the actual effectiveness and use of a robotic calendar for elderly people, and on the other hand it could help cancel out the Halo Effect [21] that might have been taken place due to the novelty effect of the robot and the special attention of the student experimenters. For such an experiment, however, a more mature prototype needs to be implemented containing features such as speech recognition, more sophisticated techniques for reminding at appropriate times, and additional functionalities such as recommending to drink water regularly. We hope that the presented implications for further research advance the introduction of social robots to actively support seniors in their everyday life soon.

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