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Insights on Usability and User Feedback for an Assistive Robotic Health Companion with Adaptive Linguistic Style

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ABSTRACT

Socially assistive robots help the human in everyday tasks. In particular, they can also provide assistance with regard to health and wellbeing, which is an important opportunity to support the independence of the elderly. Since spoken language often carries the essential information, the robot's verbal communication style is of special interest. In order to explore individual user's preferences with regard to the robot's linguistic style we built an autonomous, assistive health companion. It is operated with a custom hardware control panel and offers games, jokes, health-related recommendations, applications for information retrieval and communication. This paper reports on insights from the in-situ user study with regard to the system's usability and participants' feedback.

CCS CONCEPTS

• **Computing methodologies** → **Intelligent agents**; *Reinforcement learning*; • **Human-centered computing** → Haptic devices;

KEYWORDS

social robots; assistive companions; linguistic style; adaptation

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1 INTRODUCTION

Robots will be part of our future to assist, facilitate and enrich our everyday lives. Entertainment, information retrieval and communication will be important tasks. Especially with regard to health and wellbeing, robots will also act as assistant and advisor. Even today, the commercial *Pillo* robot integrates such functionality: its main tasks are reminding family members of taking pills, as well as answering questions regarding the nutritional intake of food. Further examples of similar consumer products are *Jibo*, *Buddy*, *Mabu*, *ElliQ*, *Lynx* and *Moorebot*.

Figure 1: Female study participant and control panel with physical buttons to interact with the robotic companion.

In order to support the independence of the elderly population, robotic companions have long been subject of research. For example, Sidner et al. [8] developed a social companion agent for the elderly which offers various activities for entertainment, communication as well as exercises. Interaction with the robot is achieved primarily with a touch screen. Schroeter et al. [7] presented a socially assistive robot companion for older people suffering from mild cognitive impairment. It reminds of appointments and activities, makes video calls, includes a cognitive stimulation game and is linked to smart home technologies. Especially with regard to health and wellbeing attempts are made for example to support everyday life by providing information about the nutritional value of drinks based on the human's drink consumption [5]. The support of exercises is the main task in robot-assisted training [9] with the goal to increase enjoyment and intrinsic motivation. In this context, research also addresses the elderly population, such as with arm, finger or cognitive training [2].

2 AN ASSISTIVE ROBOTIC COMPANION

Inspired by [8] and [7] we built an assistive companion [6] with adaptive linguistic style in order to investigate the role and impact of the robot's communicative behavior. It is equipped with games, jokes, health-related recommendations, information retrieval for news, weather forecast, appointments and contacts as well as email and chat communication. Depending on the current task it explores different politeness strategies or types of expressed persona during runtime. It tailors its linguistic style to the individual user's preferences based on their explicit evaluative feedback.

The interaction with the robotic companion is realized completely with the help of a custom-built, 3D printed control panel (see Figure 1). It was implemented with physical buttons due to issues reported in the literature with respect to touch-based interaction in the context of the elderly domain. Ten physical buttons with integrated LED lights allow giving explicit positive or negative feedback for the linguistic adaptation process, to navigate through

Table 1: Questionnaire results.

Questionnaire		female subject		male subject	
TA-EG	Enthusiasm	3.8	of 5	3.2	of 5
	Competence	4.0	of 5	4.3	of 5
	Positive Effects	4.6	of 5	4.0	of 5
	Negative Effects	1.8	of 5	2.4	of 5
SUS		100	of 100	90	of 100
AttrakDiff	PQ	6.0	of 7	6.6	of 7
	HQ-I	6.1	of 7	5.7	of 7
	HQ-S	5.0	of 7	6.4	of 7
	ATT	6.6	of 7	6.3	of 7

the menu and choose selections, to start an application or confirm selections, to stop the robot's text output or quit an application, to repeat the robot's last utterance and to provide help.

3 USABILITY

At the time of this writing two test persons participated in the ongoing in-situ study. Both the female user (aged 64) and the male user (aged 61) were German native speakers. The autonomous robot was placed in their homes (see Figure 1) for one week, where they were free to interact with it as often as they wanted.

At the beginning of the study, the participants were asked to fill in the TA-EG questionnaire [4] about their attitude towards electronic devices. It measures four aspects: *Enthusiasm*, *Competence*, *Positive Effects of Technology* and *Negative Effects of Technology*. As shown in Table 1, both participants scored rather high on the aspects *competence* and *positive consequences*. On the *enthusiasm* aspect, the woman scored rather high whereas the man's attitude was closer to the neutral value of 3.0. As for the aspect *negative consequences*, both were below neutral. The results indicate a positive, optimistic opinion about electronic devices and confidence in the ability to handle them. This is not overly common among this demographic, so their affinity with modern technology was probably the reason why both test persons agreed to participate in the study.

To evaluate the custom-made control panel, we asked the participants to fill in the System Usability Scale [1] after the study. According to their answers, the interface achieved very high scores of 100 respectively 90 out of 100, so evidently both perceived it as straightforward to use and did not experience problems. This is in line with their perceived competence in handling electronic devices as previously measured by the TA-EG questionnaire.

4 PARTICIPANTS' FEEDBACK

After the study, we interviewed the participants to gain a deeper understanding of their experience with the system. To measure the overall perception of the system, we asked the participants to rate it on the AttrakDiff [3] questionnaire (see Table 1). The woman's opinion was positive with regard to *Attractivity* (ATT), *Pragmatic Quality* (PQ) and *Hedonic Quality - Identity* (HQ-I). On the *Hedonic Quality - Stimulation* (HQ-S) subscale, the system achieved a lower score, but still above the neutral value of 4.0. The man rated the system rather positive on all subscales, the lowest rating being on the *HQ-I* subscale (5.7 of 7). Overall, these results are in line with the TA-EG questionnaire which had revealed both users' high affinity with modern technology.

Both participants mentioned that they would also like to use spoken language to interact with the robot, e.g. to reply to received messages. The female person pointed out that this would be a privacy concern and that embedding cloud services would not be an option at all. She would not have participated if cloud-based speech recognition was embedded in the robot. Offline speech recognition would be essential which handles the user's data transparently. Furthermore, she pointed out that she would like to cancel long-winded speech output earlier. The male participant noted that the robot switched between the informal and formal pronouns ("Du" and "Sie" in German), which could occur due to the robot's different politeness strategies. This shows that in languages with these kinds of differences special care should be taken when a learning system explores different degrees of formality.

5 DISCUSSION

The robot was perceived as attractive and easy to use, which is in line with both users' preexisting affinity with technology. Both participants were able to interact with the system as intended and successfully used the control panel to give feedback to the adaptation process. Since participants' feedback shows that privacy is still a concern, autonomous technologies, such as assistive companions, should be built in a transparent and responsible manner. Moreover, the experiment indicates that evaluating a robot's language is hard due to fact that efficiency may be more important than politeness.

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