
There may be differences between this version and the published version. You are advised to consult the publisher’s version if you wish to cite from it.

© The Authors 2022. This is the author's version of the work. It is posted here for your personal use. Not for redistribution. The definitive Version of Record was published in the Proceedings of the 10th International Conference on Human-Agent Interaction (HAI '22), Christchurch, New Zealand, 05-08 Dec 2022, pp. 287-289. ISBN 9781450393232. https://doi.org/10.1145/3527188.3563927.

https://eprints.gla.ac.uk/288226/

Deposited on: 21 December 2022
User experience of human-robot long-term interactions

Guy Laban
Guy.Laban@Glasgow.ac.uk
Institute of Neuroscience and Psychology, University of Glasgow
Glasgow, United Kingdom

Arvid Kappas
a.kappas@jacobs-university.de
Department of Psychology and Methods, Jacobs University
Bremen, Germany

Val Morrison
v.morrison@bangor.ac.uk
School of Human and Behavioural Sciences, Bangor University
Bangor, United Kingdom

Emily S. Cross
emily.cross@mq.edu.au
Institute of Neuroscience and Psychology, University of Glasgow
Glasgow, United Kingdom
Department of Cognitive Science, Macquarie University
Sydney, New South Wales, Australia

ABSTRACT
Since interactions with social robots are novel and exciting for many people, one particular concern in this specific area of human-robot interaction (HRI) is the extent to which human users will experience the interactions positively over time, when the robot’s novelty is particularly salient. In the current paper, we investigated users’ experience in long-term HRIs; how users perceive the ongoing interactions and the robot’s ability to sustain it over time. Therefore, here we examine the effect of the repeated measures (10 testing sessions) and the discussion theme (Covid-19 related vs general) on the way participants experienced the interaction quality with a social robot and perceived the robot’s communication competency over time. We found that despite individual differences between the participants, over time participants found the interactions with Pepper to be of higher quality and that Pepper’s communication skills got better. Nevertheless, our results also stressed that the discussion theme has no meaningful nor significant effect on the way people perceive Pepper and the interaction.

KEYWORDS
Human-Robot Interaction, HRI, Social Robot, Self-Disclosure, User Experience, Interaction Quality, Communication Competency, Communication, Long-term Interactions

ACM Reference Format:

1 INTRODUCTION
Social robots can elicit socially meaningful behaviours and emotions from humans across several experimental and real-world contexts [5, 6, 9]. Nevertheless, one of the challenges to human-robot interaction (HRI) research is replicating and extending lab-based findings to better understand how short, constrained laboratory manipulations might translate to real-world scenarios. Since interactions with social robots are novel and exciting for many people, one particular concern in this specific area of HRI is the extent to which human users will experience the interactions positively over time, when its novelty is particularly salient [12]. In the current paper, we were particularly interested in users’ experience in long-term HRIs; how users perceive the interaction and the robot’s ability to sustain it over time. Therefore, here we examine the effect of the repeated measures (10 testing sessions) and the discussion theme (Covid-19 related vs general) on the way participants experienced the interaction with a social robot and perceived the social robot Pepper (SoftBank Robotics). To evaluate the way participants perceived and experienced the interaction and the robot we are using measurements of interaction quality and communication competency.

2 METHODS
The study methodology followed an experimental design protocol for mediated online experimental design with a social robot [10]. For a detailed description of the experimental design, stimuli, task, procedure and measurements, please see the experimental design
which was found to be reliable (Cronbach’s α = .96). Accordingly, a mean scale was constructed (M = 5.45, SD = 1.58) which was found to be reliable (Cronbach’s α = .96).

2.1.2 Communication competence. This scale was aimed at capturing how participants experienced and evaluated Pepper’s communication competency using an adapted and adjusted version by [3] for a scale by [4]. The scale included three items that were evaluated on a seven-point scale ranging from 1 (not at all) to 7 (extremely). Accordingly, a mean scale was constructed (M = 5.76, SD = 1.18) which was found to be reliable (Cronbach’s α = .93).

3 RESULTS

3.0.1 Interaction quality. We used and lme4 [1] for R to perform a linear mixed effects analysis of the effect of session number, discussion theme and their interaction term on participants’ perception of Pepper’s communication competence. As fixed effects, we entered the session order, the discussion theme and their interaction term into the model. To control for the part of the overall variance that can be attributed to the participant themselves (rather than the previous exposure and topic) we included a random effect intercept for the participants; which will not be further analysed but increases the power of the analysis. Significance was calculated using the lmerTest package [7], which applies Satterthwaite’s method to estimate degrees of freedom and generate p-values for mixed models. The model explains 70% (Pseudo R² = .697) of the variance in participants’ perceptions of Pepper’s communication competence, whereas the fixed effects in the model explain 4% (Pseudo R² = .039) of the variance in participants’ perceptions of the interaction quality. The results stress that despite the variance between the participants (SD = 1.26), the session number has a significant positive fixed effect on participants’ perceptions of the interaction quality (β = .03, SE = .02, p < .001). Nevertheless, there were no significant fixed effects in terms of the discussion theme (β = -.16, SE = .45, p = .730), and the interaction term of the session number and discussion theme (β = .03, SE = .03, p = .394).

Figure 1: Mean scores of participants’ perceptions of the interaction quality by the fixed effect of session number. Error bars: 95% CI.

3.0.2 Communication competence. We used and lme4 [1] for R to perform a linear mixed effects analysis of the effect of session number, discussion theme and their interaction term on participants’ perception of Pepper’s communication competence. As fixed effects, we entered the session order, the discussion theme and their interaction term into the model. To control for the part of the overall variance that can be accounted by the participant themselves (rather than the previous exposure and topic) we included a random effect intercept for the participants; which will not be further analysed but increases the power of the analysis. Significance was calculated using the lmerTest package [7], which applies Satterthwaite’s method to estimate degrees of freedom and generate p-values for mixed models. The model explains 70% (Pseudo R² = .697) of the variance in participants’ perceptions of Pepper’s communication competence, whereas the fixed effects in the model explain 4% (Pseudo R² = .039) of the variance in participants’ perceptions of the interaction quality. The results stress that despite the variance between the participants (SD = 1.26), the session number has a significant positive fixed effect on participants’ perceptions of the interaction quality (β = .03, SE = .02, p < .001). Nevertheless, there were no significant fixed effects in terms of the discussion theme (β = -.16, SE = .45, p = .730), and the interaction term of the session number and discussion theme (β = .03, SE = .03, p = .394).

4 CONCLUSIONS

Here we evaluated users’ experience of long-term human-robot interaction via mediated zoom online chats. We assessed participants’
perceptions of the robot’s communication competency and interaction quality. We found that, despite individual differences between the participants, over time participants found the interactions with Pepper to be of higher quality and that Pepper’s communication skills were better. These results are in line with some of our previous studies’ results (see [11]). Nevertheless, our results also stress that the discussion theme has no meaningful nor significant effect on the way people perceive Pepper and the interaction. These preliminary results provide important evidence concerning the potential of introducing social robots in real-life applications for long-term use and establishing meaningful relationships with these agents over time (see [8]).

ACKNOWLEDGMENTS

The authors gratefully acknowledge funding from the European Union’s Horizon 2020 Research and Innovation Programme under the Marie Skłodowska-Curie to ENTWINE, the European Training Network on Informal Care (Grant agreement no. 814072), the European Research Council (ERC) under the European Union’s Horizon 2020 Research and Innovation Programme (Grant agreement no. 677270 to EC), and the Leverhulme Trust (PLP-2018-152 to EC).

REFERENCES