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Perception of Social Robots as Communication Partners in Healthcare for Older Adults

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***Abstract*—Addressing the global caregiver shortage through socially assistive robots necessitates a deep understanding of their psychological and physiological impacts on older adults. This study addresses whether social robots can serve as effective interaction partners compared to humans, and if "positive prompts" can similarly enhance these interactions. We conducted a comparative study with 35 participants (aged 70+) to evaluate responses during both human-human and human-robot encounters, including an assessment of "positive prompts" for cognitive reappraisal. Our multi-modal analysis, integrating facial expression data, heart rate variability, and subjective questionnaires, revealed no significant differences in overall stress levels between human and robot interactions. Facial expression analysis confirmed that the robot was accepted as a valid interaction partner, while physiological data showed slightly lower heart rates during robot interactions, suggesting a more relaxed state compared to human-led sessions. These findings indicate that social robots can engage older adults without inducing psychological strain and are capable of alleviating caregiver burden by performing structured tasks, such as health-sensing surveys. Future work should address the identified "appearance-content mismatch" in robot design to facilitate even more natural and effective interactions.**

***Index Terms*—Social HRI, Robot Companions, Acceptability and Trust**

I. Introduction

The rapid aging of the global population has created a critical labor shortage in the healthcare sector. This labor shortage imposes severe physical and mental strain on existing caregivers, who must manage both strenuous physical tasks and psychological monitoring of care recipients. To mitigate this crisis and maintain the quality of care, the integration of social service robots into healthcare settings has emerged as a promising solution. However, while various robots have been developed for physical assistance or simple tactile therapy, HRI studies focusing specifically on proactive verbal interaction for older adults remain limited. In HRI, proactive verbal engagement serves as a vital mechanism for maintaining and repairing trust [1]. This research gap is critical because verbal communication is the primary interface for building trust and social presence.

To evaluate the practical potential of such engagement in healthcare, this study addresses the overarching question.

- Can social robots be effective interaction partners compared to humans?
- Does a "positive prompt" [2] enhance these interactions similarly for both?

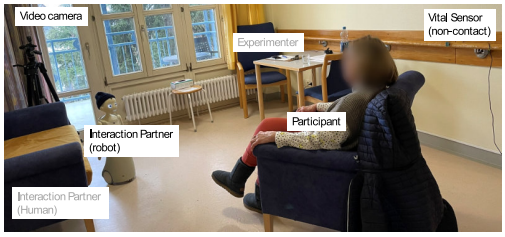


Fig. 1. Experimental setup. The participant is monitored via a camera and mmWave sensor. The robot is operated by an experimenter in a separate room under prescription.

To address these two questions, we analyze the following sub research questions: first, we investigate the impact of interaction conditions and positive prompts on emotional responses through facial expressions (RQ1). Second, we examine how these encounters are reflected in the mean and standard deviation of heart rate (RQ2). Finally, we investigate the participants' general perceptions of the robot as an interaction partner (RQ3).

II. Method

The study employed a 2×2 mixed design to evaluate the impact of interaction partners and positive prompt. All participants interacted with both robot and human partners in a randomized order, and were randomly assigned to either a "no prompt" or "with prompt" condition.

To implement this design, the humanoid robot "Navel" (Navel Robotics GmbH) was used as the robot partner, using its movable head and eyes to maintain eye contact during the conversation. Consistent experimental procedure was ensured via a Wizard-of-Oz (WoZ) approach. We recruited 35 healthy older adults (MMSE $\geq$ 24; average age 77.9, 27 women) for the study. All interactions took place in a room with equipment for data collection shown in Fig. 1.

The experiment lasted approximately 60 minutes and consisted of five phases:

- (a) Before Interaction 1: Assessment of Baseline.
- (b) Interaction 1: Interaction with the first partner.
- (c) Between 2 Interactions: Assessments of interaction.
- (d) Interaction 2: Interaction with the second partner.
- (e) After Interaction 2: Assessments of interaction and a survey about robot perception.

Data collection and analysis were conducted based on the principle of triangulation to ensure a robust assessment. For facial expressions (RQ1), emotions were estimated by

image recognition system during the two interactions. A YuNet-based CNN model was used to assess immediate psychological reactions. Heart rate (RQ2) was monitored during the whole experiment. 60GHz mmWave radar sensor for non-contact heart rate measurement (mean and SD) was used. Finally, general perception (RQ3) was measured after the interaction. The questionnaire was set with a 5-point Likert scale, including friendliness. Statistical significance ($p < .05$) was tested using Chi-square or Fisher's exact tests for facial expressions, and one-way ANOVA for heart rate and Likert-scale ratings.

III. Result and Discussion

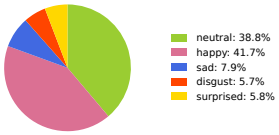
Fig. 2 shows that the ratios of facial expressions (RQ1) are comparable between the robot and human partners. The analysis revealed no significant differences in the occurrence of happiness at the initial time point ($p = .806$) and during the entire experiment ($p = .470$), regardless of the positive prompts ($p = .0734$). This smiling toward the robot suggests the robot was accepted as a valid partner with affiliative intent [3]. Negative affect ("Sad" and "Disgust") remained below 25% for most participants ($p = .607$). Video review suggested these detections primarily reflected cognitive effort and concentration during dialogue rather than aversion [4].

Heart rate (RQ2) analysis showed no significant difference between interaction partners ($p = .975$) or prompt conditions ($p > .64$). Despite the lack of statistical significance, participants exhibited lower mean heart rates and smaller standard deviations when interacting with the robot compared to the human partner ($p = .121$ and $p = .193$ for the during interaction phase (b) and (d)) as shown in Fig. 3. This suggests that interactions with the robot were less tense than interactions with a human, allowing participants to converse in a relaxed state. This interpretation is consistent with well-established findings that reduced heart rate and diminished short-term variability are markers of decreased sympathetic arousal and greater calmness [6].

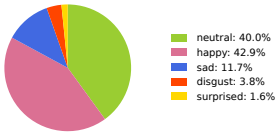
General perception survey about the robot (RQ3) confirmed high robot acceptance, with 33/35 participants rating the robot as "friendly". On the other hand, participants noted that the robot's childlike look appeared inconsistent with the conversation content, leading to perceptions of the robot as "machine-like" or "unnatural" in specific contexts. This suggests that while a childlike appearance reduces social pressure and may also limit engagement depth if the persona is not carefully aligned with its conversational role [5]. These results emphasize the need for "persona alignment," ensuring that a robot's visual and behavioral impression is consistent with its specific task to maintain naturalness and trust.

IV. Conclusion and Perspective

This study confirms that social robots can potentially be interaction partners for older adults without adding psychological burden. Robot interaction elicited facial expressions comparable to human partners, while heart rates were slightly lower and more stable. The enhancement from positive prompts was minimal, as the redundant nature of the dialogue

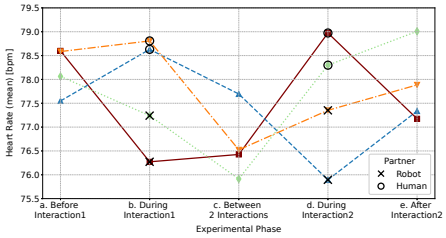


(a) Interaction with Human

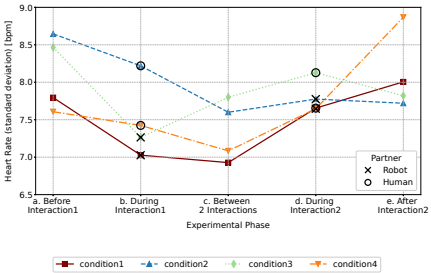


(b) Interaction with Robot

Fig. 2. Facial expression results of all participant. Emotional responses toward the robot and human partners are comparable.



(a) Mean heart rate for each condition



(b) SD of heart rate for each condition

Fig. 3. Heart rate results for each condition. The robot interaction phases (marked with crosses) show lower and more stable.

led to participant fatigue. While 33/35 participants found the robot friendly, a mismatch between the robot's childlike appearance and adult-oriented conversational content hindered acceptance. These results emphasize the need to align a robot's persona with its specific conversational role.

Future research will focus on enhancing AI-driven persona alignment to ensure that the robot's appearance and non-verbal cues more effectively simulate holistic human care. Additionally, optimizing interaction content is essential to maximize engagement while minimizing redundancy.

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