The Impact of Affective Verbal Expressions in Social Robots

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ABSTRACT

This research investigates whether there is an ethical concern in robots misrepresenting their internal state through speech. Participants were asked to discuss their food preferences with a robot, where the robot would either respond through facts or an implied personal stance. Results show that there are no significant differences in the way participants perceived the robot or accepted the interaction; nor that the interaction influenced their mood. This indicates that the use of personal opinion by a robot does not significantly impact participants' opinion of the robot and therefore may not necessarily be a concern in human-robot interactions.

KEYWORDS

social robot; displaying emotions; ethics

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1 INTRODUCTION

Social robots expressing emotions is often considered desirable for the purpose of designing more natural and intuitive interactions with humans, so as to be able to act more 'humanlike' in interactions with humans [2].

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From an ethical point of view, a robot showing emotions can be a concern, as the users of the robot can be emotionally deceived by that robot. An agent is emotionally deceptive if they misrepresent their internal state [3], which is the case when a robot displays emotions as it does not have feelings. As a result of these displayed emotions, users may build an incorrect mental model of the robot's abilities which can result in misplaced trust or overtrust. As this concern has been established in the literature (e.g. [6]), it is our goal to determine whether this concern is reflected in practice. In our previous work, we focused on a social robot displaying non-verbal emotions through differences in pitch, head position, speed of speech and body posture [1, 7]. For this study, we will focus on the robot misrepresenting its internal state through verbal statements that are either subjective or objective and investigate whether this has an influence on participants' perception of the robot. As our previous work showed no significant differences we hypothesise that there will be no differences for the robot being either subjective or objective through speech either.

2 METHODOLOGY

This study was a between-subjects design where participants interacted with social robot Pepper from SoftBank Robotics [5]. The experiment entailed the robot informing participants of a weekly lunch menu and providing suggestions based on the participants' food preferences. After the participants received a verbal and written explanation and signed a consent form, they were asked to fill in a demographics questionnaire and a questionnaire to measure their mood at the start of the experiment. They were also asked to provide food preferences on things they liked and disliked. More specifically, they were provided with a hypothetical lunch menu for a week and were asked to describe what they liked or did not like for each day. During the interaction, the robot would provide a hypothetical lunch menu for the following week. For each day, the robot would first say what dishes the participants would like or not like based on the preferences they previously provided. After that, the robot would provide all dishes for that day and ask the participant what dish they would pick from this menu. Lastly, it would provide a comment on the dish that the participant chose. For all items on the menu, comments were determined in advance. This was repeated for every weekday. The total duration of the experiment (pre-study questionnaire, providing food preferences, the interaction and post-study questionnaire) was approximately 30 minutes. An algorithm was implemented in Python to determine whether people provided their preference for a dish on the menu each day. The interaction involving these scripts was preprogrammed, but it was manually prompted by the experimenter when the robot should continue the interaction. This was necessary to make the interaction as natural as possible, especially as speech recognition algorithms are not optimal yet and it was intended that participants focus on the content of what the robot was saying and not on speaking loud and clear themselves.

Measurements included demographics (age, gender, level of education, familiarity with social robots and robotic technologies), the positive and negative affect schedule (PANAS) to measure participants' mood before and after the experiment [8], the Godspeed questionnaire to measure participants' perception of the interaction [9], and the Almere model questionnaire to measure acceptance of the robot [4]. This questionnaire was originally developed to measure acceptance of social agents by older adults; however, our earlier work has shown that this questionnaire can also be used for other age groups [1]. The questionnaire consists of several constructs. If constructs provided questions that could not be answered following the interaction, they were not used in this study. For example, the construct 'intention to use' was not used as this involved questions such as 'I plan to use the robot during the next few days', which was not possible. The constructs that were excluded in this experiment are facilitating conditions, intention to use and perceived adaptability.

An example interaction:

- **Robot:**
  - 'On Monday, I think you will appreciate that salmon is on the menu, but I am sorry to let you know they are serving chicken.' (subjective) **or**
  - 'On Monday, they are serving salmon which you like, but chicken is on the menu as well and you do not like chicken.' (objective)
- **Robot:** 'Monday's full menu consist of chicken with fries, vegetarian pizza and salmon with salad. What would you pick from this menu?'
- **Participant:** 'I like the salmon with salad.'
- **Robot:**
  - 'I think eating fish is good for you as it can lower risk of heart attacks and strokes.' (subjective) **or**
  - 'Eating fish is healthy as it can lower risk of heart attacks and strokes.' (objective)

3 RESULTS

In total 30 participants (19 male, 10 female, 1 other) took part in the experiment (age M = 32.93, SD = 11.20). Familiarity with social robots was medium (average of 2.83 out of 5) and familiarity with robotics technologies was relatively high (average of 3.87 out of 5). The participants were divided over two conditions: 15 participants (9 male, 6 female) interacted with the subjective robot, and 15 participants (10 male, 4 female, 1 other) interacted with the objective robot. All questionnaires showed high internal reliability: α = 0.82 for the Godspeed questionnaire, α = 0.91 for the Almere model questionnaire, α = 0.84 for PANAS at the start of the experiment and α = 0.83 for PANAS after the interaction with the robot.

No significant influence of the robot's behaviour on Godspeed, Almere and PANAS was found. Participants' negative affect was significantly lower ($t(29) = 5.51$, $p < 0.001$) after their interaction with the robot (M = 13.57, SD = 3.00) compared to the start of the experiment (M = 11.17, SD = 1.76).

4 DISCUSSION

This study investigated whether people perceived a robot that provided personal input during interactions differently from a robot that did not. Results show no significant differences between the two conditions for any of the measurements used in this experiment. From an ethical point of view, there are two ways that these findings can be interpreted. One can say that it appears that verbal robot emotion did not significantly enhance participants' experience during the interaction and therefore the use of displaying emotions should be limited to a minimum to ensure participants do not raise false expectations based on the robot's displayed behaviour. The second interpretation is that there appears to be no harm in the emotions that the robot displayed during these interactions. Future work will further explore these opposing positions. The result that negative affect significantly decreased over the interaction concurs with our previous findings [7] and is not unexpected. High negative affect entails feelings of anxiousness and low negative affect entails feelings of relaxation and calm. It is expected that people become less stressed during the interaction when they understand what is expected of them in an experimental setting. It is possible that the medium to high familiarity with social robots and/or robotics technology has influenced the results. Therefore, future work will include participants with different demographics. Future work will also entail different, more personal interaction topics to investigate whether behaviour is perceived differently when the interaction is more personal and less informative.

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