Let’s Talk About It!

Subjective and Objective Disclosures to Social Robots

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ABSTRACT

This study aims to test the viability of using social robots for eliciting rich disclosures from humans to identify their needs and emotional states. Self-disclosure has been studied in the psychological literature in many ways, addressing both peoples’ subjective perceptions of their disclosures, as well as objective disclosures evaluating these via direct observation and analysis of verbal and written output. Here we are interested in how people disclose (non-sensitive) personal information to robots, in an aim to further understand the differences between one’s subjective perceptions of disclosure compared to evidence of disclosure from the shared content. An experimental design is suggested for evaluating disclosure to social robots compared to humans and conversational agents. Initial results suggest that while people perceive they disclose more to humans than to humanoid social robots or conversational agents, no actual observed differences in the content of the disclosure emerges between the three agents.

CCS CONCEPTS

•Human-centered computing → Empirical studies in HCI;

KEYWORDS

Social Robots, Self-Disclosure, Text Analysis, Speech Analysis, Prosody, Human Robot Interaction

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1 Introduction

Self-disclosure is involved in many aspects of life, including developing and sustaining intimate relationships, coping with stress and traumatic events, and eliciting help and support [6][7][12]. However, when the procedure is involuntary or unnatural, it can be perceived as invasive or uncomfortable [1][4]. Moreover, when the level of disclosure does not correspond with expectations, it can damage a relationship [2][4].

Given the importance of self-disclosure for psychological health, here we are interested in assessing the viability of using social robots for eliciting rich disclosures to identify needs and emotional states. We expect that people will ascribe mental capacities to these (e.g., [14][15]) following the social robots’ human-like design and gestures [5]. Accordingly, we propose that disclosures to humanoid social robots are genuine and can overcome some of the natural limitations of self-disclosure [1][2][4].

Self-disclosure has been studied and conceptualized in the psychological literature in many ways, addressing both peoples’ subjective perceptions of their own disclosures, as well as evaluating disclosure objectively via direct observation and analysis of verbal output (see [13]). Accordingly, this study aims to further understand the differences between one’s own subjective perceptions of disclosure to robots compared to objective evidence of disclosure based on observed methods for evaluating disclosure from disclosed content and behavior. An experimental design is suggested for evaluating disclosure to social robots compared to humans and conversational agents.

2 Methods

2.1 Population

The study consisted of 26 university students between the ages of 17 to 42 years old ($M = 24.42$, $SD = 6.40$) including 61.5% females. Participants reported being from different national backgrounds, with fifty percent of the participants reported English to be their native language, and for most of the participants (88.5%) this was their first interaction with a robot. All participants provided written informed consent before taking part in any study procedures and participants were compensated for their time with either credits or with cash. All study procedures were approved by a research ethics committee of the University of Glasgow.

2.2 Design

A within-subjects experimental design was conducted with three treatments, applying a round-robin test. In a randomized order, all the participants interacted with the 3 elicitors: (1) a humanoid social robot (2) a human agent, or (3) a conversational agent.

2.3 Stimuli

The three agents communicated the same questions using different visual and verbal cues that corresponded appropriately to their embodiment.

2.3.1 Humanoid Social Robot. This treatment was manipulated using the robot NAO (Softbank Robotics), a human-like robot who can communicate with humans via speech but can also demonstrate several cognitive-like cues using motion, gaze, and body gestures. NAO communicated with participants in this study via the Wizard of Oz (WoZ) technique controlled by the experimenter.

2.3.2 Human Agent. This treatment consisted of the experimenter as an elicitor. This treatment was manipulated by the natural agent's looks, voice, and gestures (e.g., nodding).

2.3.3 Conversational Agent. This treatment was manipulated using the "Google home mini". A voice assistant is a software in a speaker, and as such it has a minimal physical presence. The voice assistant was also controlled by the experimenter via the WoZ technique.

2.4 Measurements

2.4.1 Perceived Self Disclosure. Participants were requested to report their level of perceived self-disclosure via the sub-scale of work and studies disclosure in Jourard's Self-Disclosure Questionnaire [10]. This questionnaire was adapted and adjusted for the context of the study, addressing the statements to university students. The measurement included ten self-reported items in which participants reported the extent to which they disclosed information to one of the agents on a scale of one to seven.

2.4.2 Length of the Disclosure. The volume of disclosure in terms of the number of words per disclosure.

2.2.3 Compound Sentiment. Using Vader for Python [8], the disclosures were measured to determine their overall sentiment in terms of positive, neutral, and negative sentiment. The compound sentiment evaluates a disclosure sentiment from negative (-1) to positive (+1), based on the calculated sentiment score (see [8]).

2.4.4 Sentimentality. The ratio of overall demonstrated sentiment in each disclosure. It was calculated based on the combined scores of Vader's [7] positive and negative sentiments.

2.4.5 Voice acoustics features. The features were extracted and processed using Parselmouth [9], a Python library for Praat [3]. The extracted features were mean pitch (in hertz), mean harmonicity (the degree of acoustic periodicity in decibels (dB)), mean intensity (the loudness of the sound wave in dB), energy (air pressure in voice, measured as the square of the amplitude multiplied by the duration of the sound), and duration of speech in seconds (see [3]).

2.5 Procedure

The experiment was conducted in a recording studio for 30 minutes per participant. The participants were asked three questions by the three different agents. The aim of this approach was for a short interaction to be elicited by each agent. Each interaction started with a short introduction followed by one question addressing one of three different aspects in the student experience: academic assessments, financial condition, and social life. Each topic had one pre-defined question that was asked randomly by one of the agents. After the participant answered, the agent demonstrated gestures of understanding and finished the interaction. Finally, the participants answered a short questionnaire subjectively reporting their own perceived self-disclosure for each of the agents and answering demographic questions. The interactions were recorded for content and voice analysis.

3 Preliminary Results

Doubly multivariate analysis of variance was conducted to determine whether a difference in disclosure emerged for different agents, measured in terms of perceived self – disclosure and observed disclosure (length of the disclosure, sentimentality, compound sentiment, pitch, harmonicity, intensity, energy, and duration of speech). The model was found to be statistically significant, Wilk's $\Lambda = .42$, $p = .002$, suggesting that a difference emerged across the three agents. Univariate tests reveal significant differences within the agents in terms of perceived self-disclosure ($SS = 11.17$, $F(1.37) = 6.34$, $p = .010$) and voice intensity ($SS = 23.03$, $F(1.94) = 4.63$, $p = .015$), but not in any of the other observed measurements of the disclosure. Post hoc analysis using Bonferroni correction entails that people perceive to disclose more to a human ($M = 3.76$, $SE = .31$]) than to a humanoid social robot ($M = 3.30$, $SE = .31$), $Mdif = .46$, $SE = .17$, $p = .042$, 95%CI[.01,.90], and to a disembodied voice conversational agent ($M = 2.84$, $SE = .27$), $Mdif = .93$, $SE = .33$, $p = 0.029$, 95%CI[.08,1.78]. Moreover, when disclosing to a humanoid social robot, voice intensity is higher ($M = 66.84$, $SE = .57$) than when disclosing to a human ($M = 65.64$, $SE = .42$), $Mdif = 1.20$, $SE = .40$, $p = 0.017$, 95%CI[.18,2.21].

4 Conclusions

While people perceive they disclose more to humans than to humanoid social robots or disembodied conversational agents, no actual observed differences in the content of the disclosure or in the participants' voice acoustics emerges between the three agents. There were differences in voice intensity between disclosures to the humanoid social robot and the human agent, but these can be caused by the location of the agent in the room. People might speak louder to a robot as it is harder to evaluate robot's comprehension compared to a human.

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