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The influence of social cues in persuasive social robots on psychological reactance and compliance

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ABSTRACT

People can react negatively to persuasive attempts experiencing reactance, which gives rise to negative feelings and thoughts and may reduce compliance. This research examines social responses towards persuasive social agents. We present a laboratory experiment which assessed reactance and compliance to persuasive attempts delivered by an artificial (non-robotic) social agent, a social robot with minimal social cues (human-like face with speech output and blinking eyes), and a social robot with enhanced social cues (human-like face with head movement, facial expression, affective intonation of speech output). Our results suggest that a social robot presenting more social cues will cause higher reactance and this effect is stronger when the user feels involved in the task at hand.

1. Introduction

The use of robots as a technology to support attitudes and behavior changes is attracting a lot of interest from researchers (Agrawal & Williams, 2017; Lopez, Ccasane, Paredes, & Cuellar, 2017). In enhancing the persuasiveness of such artificial social robots and the emerging human-robot interaction experiences, it is essential to understand how people perceive diverse attitudes and social behaviors of robots. Ham, Cuijpers, and Cabibihan (2015) claimed that the persuasiveness of a storytelling robot could be increased by adding social cues like gazing and gestures. Social cues such as movement of robot's head to track human's motions and maintaining eye contact throughout a conversation have been shown to increase feelings of immersion in a task (Bailenson, Blascovich, Beall, & Loomis, 2006; Li, 2013). The earlier research studied to what extent social robots should portray social characteristics to elicit perceived social agency to be able to make use of user's social psychological responses towards the robot (Chetouani, Boucenna, Chaby, Plaza, & Cohen, 2017; Choi, Kornfield, Takayama, & Mutlu, 2017; Thimmesch-Gill, Harder, & Koutstaal, 2017). Some theories like the media equation hypothesis (Martin, 1997) suppose that basic social characteristics suffice to elicit social responses, and earlier research confirms this notion (Chidambaram, Chiang, & Mutlu, 2012; Roubroeks, Midden, & Ham, 2009). Relatedly, the social-cues hypothesis (Louwerse, Graesser, Lu, & Mitchell, 2005) explained that adding

human features as social cues on the robot like facial expression, voice, and physical presentation could enhance the chance for a human to perceive the technology more positively. This hypothesis was also supported by findings in several studies (Andrist, Spannan, & Mutlu, 2013; Cooney, Dignam, & Brady, 2015; Eyssel & Hegel, 2012).

However, when people are subjected to strong persuasive attempts, they may respond negatively towards the attempt, with a behavior that is known as psychological reactance. Psychological reactance is defined as an action or act of the doer that is different from their original intention because of persuasion activities that can provoke feelings of anger and negative cognitions (Dillard & Shen, 2005). It is a motivational response to the loss of freedom or threatened with reduction of alternatives (Brehm & Brehm, 2013; Brehm, 1972). Psychological reactance can lead to irregular behaviors in restoring the freedom in making a decision. People may not comply and even will do something that is opposite than what they are asked to do. Earlier research (Dillard & Shen, 2005; Lee, Lee, & Hwang, 2014; Rains & Turner, 2007) has shown that psychological reactance can be measured using questionnaires. Experimental studies have attempted to identify the cause of reactance and how human behave to portray their reaction towards the reactance. For example, earlier researcher has shown that forceful language in persuasive communications in a health campaign can be a source of reactance (Quick & Considine, 2008). An experimental study (Roubroeks, Ham, & Midden, 2011) found that people experience

higher psychological reactance when persuasive text messages are accompanied by a still picture of the persuasive agent, or a short film-clip showing the persuader deliver this message, concluding that stronger social agency of the persuasive source can lead to higher psychological reactance. As the interest in applications of artificial agents and especially social robots in care scenarios, it is important to understand how to design these agents to be more effective in their persuasive communication and to avoid that they evoke negative feelings to users. Specifically, it is important to understand the impact of social cues that can be implemented in such artificial agents upon reactance.

In this research, we aim to evaluate the effect of social cues of an agent upon reactance and compliance as well as the level of involvement of a person with the issue at hand. It can be expected that when an agent limits a person's freedom about an issue they are not involved in, reactance may be lower or not occur, but when a person's freedom is limited about an issue in which that person is strongly involved, they may experience stronger reactance. Several studies have investigated the effects of involvement towards human's psychophysiological responses in an interactive game (Lim & Reeves, 2009) like engagement level between gameplays with avatars or computer agents (Lim & Reeves, 2010) and persuasion (Johnson & Eagly, 1989; Oreg & Sverdlik, 2014). From those studies, it can be concluded that in high-involvement situations, the chances for successful persuasion activities are low, and that in such situations people may easily experience reactance. In contrast, in low-involvement situations, chances for successful persuasion might be higher, but in such situations reactance is not very likely to occur. Nevertheless, earlier research has not yet examined the effect of involvement upon of reactance.

In line with social agency theory (Atkinson, Mayer, & Merrill, 2005), people will be more socially responsive to the agent that has more social cues. Unintuitive and in contrast to earlier reactance studies (e.g. Roubroeks et al., 2009), a recent experiment reported by Ghazali, Ham, Barakova, and Markopoulos (2017) found that robotic agents evoked less reactant responses when using unpleasant language in persuasive messages. That is, the reactance towards a robotic agent that used forceful language to persuade people was lower when the robotic agent displayed some social cues. Thus, this earlier study did not show that people respond in more social ways (i.e., show more reactance) when a social robot displays more social cues in delivering the forceful persuasive message. Nevertheless, the external validity of that experiment can be criticized as the decision that experimental participants had to make pertained to an artificial task with little at stake for them. Specifically, the experimental task was to decide upon the constitution of a drink for an imaginary alien, a choice behavior for which the participants did not care about. The authors claimed that it was done to avoid confounding effects of psychological involvement with the task at hand. However, it leaves the question open whether the results can be replicated in case the participants have higher involvement with the given tasks.

Thus, this paper builds on and extends the study of Ghazali et al. (2017) which compared social agents that were endowed with three different levels of social cues. It aims to address the limitations of that study discussed above and to consolidate current understanding of the effects of social cues on social responses as suggested by social agency theory (Atkinson et al., 2005). We report an experiment that compared the situations of high and low psychological involvements in persuasion activity in different social agency conditions. The following sections motivate the method and describe the results of our study. We conclude with a discussion regarding the implications of our findings for the field of persuasion in human-robot interaction applications and research on psychological reactance.

1.1. The current study

The experimental set up involved a human-agent interaction in which the participants were asked to make decisions in a fantasy game

environment, similar to that of Ghazali et al. (2017). Participants were required to make an initial selection of a drink, after which an artificial agent would attempt to convince them to modify their choice. High controlling language was used by the social agent in conveying the advice throughout the study. This was done to obtain higher chances of compliance in persuasive attempts as reported in previous research (Ghazali et al., 2017). The experiment aimed to test the following two hypotheses:

H1. Participants in the high psychological involvement game will experience higher psychological reactance than those who receive the same advice in a low psychological involvement game, especially when the advisor had higher social agency.

H2. Participants in the low psychological involvement game will be more compliant to change their final decisions when being advised by an agent with a high social agency compared to the participants with high psychological involvement receiving feedback by the same agent.

2. Materials and methods

This study was carried out in accordance with the recommendations of Code of Ethics of the NIP (Nederlands Instituut Voor Psychologen – Dutch Institute for Psychologists) and the research group on Human-Technology Interaction at Eindhoven University of Technology. All subjects gave written informed consent in accordance with the Declaration of Helsinki. This study was reviewed and approved by the Human-Technology Interaction ethics board at Eindhoven University of Technology.

2.1. Participants and design

Sixty participants were recruited as volunteers from a local participant database with ages ranging from 18 to 37 years old (41 males and 19 females; age $M = 23.98$, $SD = 3.71$). A between-subjects experimental design was used in this study to avoid the carry-over effects as found in within-subjects design study (Yang et al., 2017). The participants were divided into six groups randomly assigned to a particular level of social agency (low vs. medium vs. high) and psychological involvement (low vs. high). Each participant received a €10 voucher as a token of appreciation at the end of the session which lasted 40 min on average.

2.2. Manipulations

2.2.1. Manipulation of social agency

The manipulation of social agency of the advisor in this experiment was based on the number of social cues portrayed as (1) low social agency: absence of a robot - the advice was displayed on a screen as an advisory-text (2) medium social agency: a robot with a human-like face that spoke with monotone voice and showing minimal nonverbal cues (blinking eyes) (3) high social agency: the robot gave advice using several verbal and nonverbal social cues including head movements (e.g., nodding the head), eye expressions (e.g., looking away indicates the robot was thinking) and emotional intonation in the voice. As in Ghazali et al. (2017), a Socibot robot was used in medium and high social agency conditions. SociBot is a desktop robot that displays an animated face through back projection and offering some built -in functionalities such as move its head, track a user movements etc. The robot is also equipped with lip-synced speech output and can give the impression of maintaining eye contact with the participants throughout the experimental session. It was given the facial image of a man with light brown skin color tone and hazel eyes. Various facial expressions were displayed by the robot in the high social agency condition only. An overview of the social agency manipulation is shown in Fig. 1.

The robot was operated by the experimenter using Wizard of Oz