The application of Social Power in Persuasive Social Robots

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ABSTRACT

The technology of the future will bring an increasing number of robots into our daily life. This has motivated a number of researchers to explore diverse factors to promote social interaction with robots. This PhD project aims at investigating social power dynamics in Human-Robot Interaction. Social power is defined as one's ability to influence others to do something which they would not do otherwise. Different theories classify alternative ways to achieve social power, such as providing rewards, using coercion, or acting as an expert. After conceptualizing social power to allow implementation in social agents, we studied how those power strategies affect persuasion when using robots. Specifically, we attempted to design persuasive robots by creating persuasive strategies inspired from social power.

KEYWORDS

Social Power, Persuasion, Human-Robot Interaction, HRI

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1 INTRODUCTION

Social power is defined as the ability to influence other's attitudes, behavior and beliefs that may not happen in the absence of it [1]. Previous research has established that social power is present in every relationship [2] and hence the rules of social dynamics can only be stated in terms of power [3]. On the other hand, recent evidence suggests that individuals treat computers as social actors and their response to technology is social [4]. This has motivated a number of researchers to examine different social theories in Human-Robot Interaction (HRI), however, little is known about the dynamics of social power in HRI.

In this direction, implications of power dynamics on HRI, and moral and philosophical implication of robots in power has been discussed in [5] and [6]. Specifically, in [5], the author states that the dynamics of structure, class, and power affect people's expectations from machines. There are certain situations in which robots in power perform better than human leaders, such as emergency cases [6]. Hence, despite the negative attitudes towards computers in power, researchers argue that high-power computers are beneficial to society, especially, due to the limitation of human cognitive ability. Furthermore, the increasing interest in grouping humans and robots, calls for the attention of researchers to investigate group dynamics in mixed human-robot teams. As collaborations might deal with a different power levels of sides, it is not unlikely to arise conflicts. Hence, it is important to understand the dynamics of power in HRI. So far, however, little discussion is made about how power functions in groups of humans and robots.

On the other hand, recent advances on Social Robotics raise the question whether social robots can be used as a persuasive agent. To date, recent studies have used various approaches to answer this question, ranging from the use of non-verbal behavior to the exploration of different embodiment characteristics [7–10]. Central to persuasion is trust, i.e. how reliable is a robotic agent when it argues with human users within interactions [11]. Awareness of trust in HRI is not recent and is investigated over the past decades [12–14].

In this research, we investigate social power dynamics in Human-Robot Interaction. Specifically, we aim to address the following research questions: How can robots process social power and make decisions? How powerful are social robots are perceived? Do power resources make social robots more persuasive? How participants behave when they have higher power than a social robot?

2 WHAT IS DONE SO FAR

We approached the preceding research questions in three different attempts. Initially, considering the significant impact of social power on *social interaction*, and its acknowledged role in *believability* of social agents (e.x. social robots), we proposed a conceptualization of social power for decision making of agents [15]. In this conceptualization, we argued that the ability of reasoning and planning in the presence of social power enhances *social believability* of social agents, leading to more rational interactions. With this aim,

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we proposed a computational model of social power inspired by a well-known theory [1], which identifies five bases of social power (reward, coercion, expert, referent, legitimate). Our proposed model leads the agents to process and generate behavior facing these five bases and make rational decisions. Robots designed based on this model could be beneficial in a vast variety of social interactions (e.x. personal companion), by exhibiting social behaviors under different power-related circumstances. However, further investigation is required to test the model in the application within a user-study to further examine its expressiveness.

The conceptualization revealed a factor common in most of the five power bases: trust. Hence, in another attempt, we investigated different factors influencing the trust that human users put in social robots. *Trust* can help to reduce the social complexity, mainly in those cases where it is necessary to cooperate. With this aim, we examined the influence of a set of factors (gender, emotional representation, making small talk (ST), and embodiment) that may affect the trustworthiness of a robot. To do so, we designed a set of user-studies in which a robot asked human subjects to make donations to fix a malfunctioning part of his body. We used two different metrics, a trust questionnaire and the amount of donations. The results show significant differences in trust depending on its facial expression and making or not making ST. In the same sense, people tend to donate significantly different amount when the robot performed different emotional gestures and making or not making ST. Furthermore, the trust levels were significantly different when comparing the experiment using NAO (with full embodiment) and the one using Emys (a robotic head), which proves that the embodiment is another factor that influences trust. A final result showed also that the gender of the participants leads to significant differences in the trust levels regarding the embodiment [16].

In the third attempt, to investigate how individuals perceive robots in power, we designed two user-studies with powerful robots. That is, we equipped robots with power resources. Since social power endows individuals the ability to influence, we designed scenarios in which the robot attempted to persuade the users. The link between power and persuasion has been investigated for a long time in social psychology [17]. Different theories exist regarding this link, for instance, recent evidence suggests that a higher level of power leads to higher persuasion [18]. Although other approaches are viable to make robots persuasive (as done before in other studies), we used social power strategies that have been neglected in this field. Initially, we selected reward, coercion and expert strategies due to their applicability in making more believable scenarios and we aim to investigate the other two power bases in the future.

In the first study [19], we investigated the role of social power in persuasive social robots. In this work, we explored two types of persuasive strategies that are based on social power (specifically reward and expertise) and created two social robots that would employ such strategies. To examine the effectiveness of these strategies we performed a user-study with 51 participants using two social robots in an adversarial setting in which both robots tried to persuade the user on a concrete choice (3 coffee capsules hidden in 3 boxes). In our design, one robot attempted to persuade the users to select his coffee by giving them information about the good quality of his capsule, while the other robot tried to influence the users by giving them a reward. Also, we put the third coffee, as the control condition, which was not promoted by any of the two robots We considered five dependent variables, the selected coffee, the preferred robot, robots persuasiveness, robot perception, and how likely they are to comply with each robot in the future. The independent variable was the power strategy used by the robots. The results showed that although each of the strategies caused the robots to be perceived differently in terms of their competence and warmth, both were similarly persuasive.

Similarly, the second study [20] was designed to investigate the persuasiveness of social robots using two persuasive strategies inspired from social power. In this design, we used a single robot in two different conditions, plus a control condition. In this design, we used two coffee capsules with different rankings. In the first condition (reward power strategy), the robot tried to persuade the users to opt for the lower-ranked coffee by giving them a reward (a pen). In the second condition (coercive power strategy), the robot first gave a pen to the users as a reward for participating in the experiment, but later required the pen as payment for the high ranked coffee (punishment for not complying). In the control condition, the robot did not use any persuasive strategy and the users were free to select any of the two capsules. We measured the personality of the users, the robot perception, and the social power of the robots (using the Social Power Scale). The results indicated that, in the two conditions, the robot succeeded to persuade the users to select a less desirable choice compared to a better one. However, no difference was found in the perception of the robot comparing the two strategies, neither the social power level. The results suggested that social robots are capable of persuading users, especially the ones who are new to social robots. However, the collected data did not represent any significant difference regarding the other measured variables, and we aim to investigate them in a future study.

3 FUTURE WORK

In the two user studies, it is not clear how the participants perceived the social power of the robots. Although the results showed that the robots were successful in persuading people, little is known about their perception of social power. One potential reason might be the way we measured social power. The standard questionnaire we used, was very general. In the future, we would like to measure perceived social power more profoundly by using other questionnaires more in line with our research. Also, the last design provides an opportunity to investigate the "endowment effect" and "loss aversion" theory in a future study. And last but not least, we intend to investigate the ethical quandary of persuasive robots. Persuasive and powerful robots could foster the human user's interests (e.g., in therapy sessions or suicide prevention) but could also deceive and manipulate the user (e.g., in sales and political propaganda).

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