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Conference Paper · May 2019

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Persuasive Social Robots using Social Power Dynamics

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ABSTRACT

Social Power, the potential for social influence, is a pervasive social process in human interactions. On the other hand, recent advances on Social Robotics raise the question whether a social robot can be used as a persuasive agent. To date, different attempts have been performed using several approaches to tackle this research question. However, few studies looked at the concept of social power in Human-Robot Interaction (HRI) and how it can be beneficial to the development of persuasion skills. This is the precisely the goal of the work that is described here. In this text, we briefly report the results of our recent advancements for this objective and draw suggestion for speculating on future directions.

KEYWORDS

Social Power, Persuasion, Trust, Social Robot, Human-Robot Interaction, HRI

1 INTRODUCTION

Social power, a pervasive aspect of our daily life, has been proved to have a significant impact on social interaction [1]. Recent evidence suggests that power influences affect, cognition, and behavior [13]. Also, previous research has established that power affects specific classes of behaviors, such as self-perception, attributions, the decoding of nonverbal behavior, stereotyping [5], etc. More specifically, earlier work by historians has established that powerful and less-powerful individuals perceive and act differently within the social environment [15]. Besides, recent evidence suggests that representing social behavior leads to more believable synthetic agents [8]. Hence, such agents are required to have the capability of processing social power dynamics, to be perceived more believable.

On the other hand, with the current advancement of technology, the future will bring robots (as a specific instance of synthetic agents) into many aspects of our personal and work lives. Thereby, the increasing interest towards the presence of robots in our lives has led to the field of Social Robotics. The general aim of this field is developing robots capable of communicating and interacting with human users in a socio-emotional way [4]. With this objective, a number of researchers have addressed different factors regarding social robots (such as social processes), to make short/long-term interaction with them more friendly, pleasant, believable, etc.

More interestingly, the existing body of research on Human-Robot/-Computer Interaction (HCI/HRI) acknowledged that individuals' interactions with machines are fundamentally social [18]. This finding has motivated lots of researchers to investigate a vast varieties of social factors in HRI. However, despite the acknowledged role of Social Power in our social processes, few studies have addressed this important factor in HRI. "Social Power" is defined as one's ability to influence another to do something which s/he would not do without the presence of such power [7]. A number of factors contribute in effectiveness or level of social power, such as the level of trust [7, 10]. Recently, in [11], the author has addressed a number of controversies on why robots are supposed to be powerful. Despite some doubts about having robots in power, preferable roles for having a high power robots is discussed.

One potential application of social power in HRI is the advancement of persuasive robots, which are suitable for different applications such as storytelling to children, therapy, sustainability, etc. In general, persuasion is defined as an attempt to change/shape a target's belief or behavior about a subject, an issue or an object [23]. In HRI field, recent research has identified a number of factors that contribute in persuasiveness of social robots, such as personality, gesture, gaze, trust, etc. So far, however, very little attention has been paid to the role of social power on persuasiveness of social robots.

The aforementioned factors motivated us to close the research gap between Social Power and Social Robots with a focus on persuasion. With this aim, in our recent literature, we have been investigating the trust factor in HRI - as an important factor contributing to the persuasion skills of social robots. More specifically, we have investigated the role of embodiment [20], facial expression and small talk in trust towards robots [21]. Also, we have proposed a conceptualization of Social Power within Social Agents [10]. And currently, we are employing the result of these studies in our current step aiming at designing more persuasive robots.

2 BACKGROUND

Research on Social Power has a long history and to date, different definitions of Social Power have been defined in the field of psychology (for a short overview of the existing theories see [6]). For instance, in [7] social power is considered to have 5 different bases: reward, coercion, legitimate, expert and referent. As for the concept of Social Power in HRI, potential implication of power dynamics in Human-Robot Interaction is discussed in [12]. Furthermore, other studies have indirectly addressed this concept. For instance, in [14], the effect of social (power) distance in HRI was investigated. Or, in [16] the authors concluded that people prefer robots when robots are less dominant than human beings.

Similarly, research on Persuasion has a long history in the field of social psychology (for a review look at [2]). Recent studies in field of HRI have explored the persuasiveness of social robots, focusing on different factors such as gender and social cues [9], or vocal and bodily cues [3]. Also, to date, persuasive robots have been used in applications such as energy saving advisers [17], storytellers [19], etc.

Proc. of the 18th International Conference on Autonomous Agents and Multiagent Systems (AAMAS 2019), N. Agmon, M. E. Taylor, E. Elkind, M. Veloso (eds.), May 2019, Montreal, Canada

https://doi.org/doi

As discussed earlier, we aim to design persuasive social robots as an application of social power. A first and foremost step in designing robots capable of processing social power dynamics is conceptualizing social power. Next, after identifying important factors specifying power level, we can investigate such factors and their implication for developing persuasive social robots. These steps are briefly explained in the remaining parts of this paper.

3 MODELING SOCIAL POWER

As discussed earlier, power is central to interaction and shapes behavior. Thus, to have a more believable and hence intelligence interaction, the agents are supposed to perceive power and represent behaviors in correspondence of power. On the other hand, the capability of maintaining a Social Interaction has an acknowledged role in Believability of autonomous agents. We argue that an ability of reasoning and planning in the presence of Social Power enhances Social Believability of agents (either robotic or virtual), leading to more rational interactions. With this aim, we have investigated the theoretical issues of agent modeling aiming at increasing intelligence and therefore believability of agents. Thereby in [10], we proposed a model of social power inspired by a recently proposed model, SAPIENT, based on a well-known theory of Social Power proposed by French and Raven [10]. To be more specific, we have modeled the five bases of social power computationally. One important factor in this model, which is common in all 5 bases, is trust, i.e. to what extent the target believes in the power holder. However, in HRI a number of factors might contribute in shaping trust in the interaction further discusses in the next section.

4 TRUST

Human beings live in a society with a complex system of socio-emotional relations. Apart from its important role in persuasion, trust is one key concept in this complex system. *Trust* can help reducing the social complexity, mainly in those cases where it is necessary to cooperate. Thus, the area of social robotics has been studying trust with different goals, to gain higher persuadability, to perform cooperative tasks between humans and robots, etc. 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. We used two different metrics, a trust questionnaire and the amount of donation the participants would make after the interaction with the robot. The results showed that people tend to trust significantly differently on Emys depending on its facial expression and making or not making ST. In the same sense, people tend to donate a different amount to Nao when it is performing different emotional gestures and making or not making ST. Furthermore, the trust levels were significantly different when comparing the experiment using Emys and the one using Nao, 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.

5 PERSUASION

Having identified the factors effective in trust and hence social power, we turn to designing persuadable robots. Recent advances on Social Robotics raise the question whether a social robot can be used as a persuasive agent. To date, a body of literature has been performed using various approaches to answer this research question, ranging from the use of non-verbal behavior to the exploration of different embodiment characteristics. With this aim, we investigate the role of social power for making social robots more persuasive. Different theories classify alternative ways to achieve social power, such as providing a reward, using coercion, or acting as an expert. Recently, 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 try to persuade the user on a concrete choice. The results show that even though each of the strategies caused the robots to be perceived differently in terms of their competence and warmth, both were similarly persuasive. However, we could not draw a conclusion which robot is more persuasive and why. Thus, future work will focus on addressing potential limitation of this study to draw conclusive results.

6 CONCLUSION

We have briefly reported our steps toward persuasive social robots with a focus on social power. Nevertheless, there are a number of avenues through which we can continue this work. We intend to explore the effect of different bases of social power (by raven and French [22]) in persuasiveness of social robots. We aim to explore these effects in different studies and test the generalization of the theory experimentally. The next step we would like to undertake is improving the design of our last study.

One important challenges in this direction is including a control group to the scenario. The first solution would be using a robot without any source of power; However, such a robot might cause negative bias in the results due to being inactive. Another challenge might be implementing other bases, such as coercive, legitimate. Regarding the latter, defining a situation in which the robot has an authority over the people within a lab experiment does not seem to be believable. Also, the former might raise the question why a robot might have the right to punish humans. And more importantly, is it ethical? Future work will investigate a compromise to cope with these challenges.

ACKNOWLEDGMENTS

This work was funded by the EC H2020 project RAGE (Realising an Applied Gaming Eco-System); http://www.rageproject.eu/; Grant agreement No 644187, the AMIGOS project (PTDC/EEISII/7174/2014), and was supported by national funds through Fundação para a Ciência e a Tecnologia (FCT) with reference UID/CEC/50021/2019.

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