ナッジ技術による人間のロボットへの向社会性の促進

Facilitating humans' prosociality to robots with nudge technology

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Abstract: The nudge, which is an effective tactic for encouraging prosocial behaviors in human-human interaction. However, there is still a lack of research in the field of social robotics to confirm the impact of nudging on prosocial behavior. In this paper we use two nudge methods: peak end and multiple viewpoints and apply them into a video stimulus performed by social robots. The findings demonstrate that viewers who watched only one point of view exhibited more prosocial behavior. For extension of multiple viewpoints, we also conducted an experiment to see whether taking the perspective of different robots in a same robot-altruistic task would influence the prosocial behaviors of participants. These two studies provide an experimental basis for the development of socially conscious robots and serve as a direction for future study on the social interaction between robots and people.

1. Introduction

Nowadays, robots have become more and more integrated into our lives. The use of robots is no longer just about repetitive or boring tasks [1, 2, 3], which need robots to adapt to human rhythms and habits [4], but more towards the direction of "robots having the ability to influence our thoughts and behaviors" [5]. This concept serves as the foundation for our work. We are thinking about the possibility that robots can influence our prosociality, even to promote or reduce our socialization.

Prosocial behavior is a multidimensional concept that is broadly defined as voluntary behavior to benefit the other [6],such as altruism, solidarity, sharing, care-giving, and comforting [7].

Previous studies have found that nudging, that is, changing people's behavior without forbidding them from pursuing other options or by significantly changing their economic incentives[8], is a potential and effective mechanism for promoting pro-social behavior in human and human interactions, even altruistic behavior [9, 10].

In the field of HRI and HAI, although Paiva et al.[11] mentioned the future use of nudges in autonomous agents for cooperation and prosociality in a hybrid society involving humans and machines, there is still no application of nudges in the robots or agents existing around us, which are expected to increasingly enter everyday environments [12].

In Study 1, we picked up two mechanisms, peak-end effect and multiple viewpoints, from 23 mechanisms defined by Ana et al.[13]. Peak-end rule, suggesting that our memory of past experiences is shaped by two moments: their most intense (i.e., peak) and the last episode (i.e., end) [14]. Providing multiple viewpoints, which means collecting different points of view (two or more than two views) for an object or event and offering an unbiased clustered overview. It also shows good performance at avoiding confirmation bias [15].

The result shows that multiple view has a main effect, it raises the question of whether experiencing different roles in an event can influence human prosocial behavior if the event is the same and the solution is the same.

In Study 2 of this paper, we based on the idea of perspective taking and the storyline of altruistic behavior in Study 1, to allow participants experience the different perspectives of the robots being helped (the help-receiver) and the robots giving help (the help-provider) in the event. Perspective taking, which allows people to imagine another's thinking and goals[16], is also be called empathy nudge[17].

Through these two experiments we can see the effect of the robots' behavior towards each other on people's prosociality towards the robots. This provides a reference for future exploration of the social relationship between robots and humans and provides an experimental basis for designing socially oriented robots.

2. Study 1

2.1. Method

2.1.1. Video stimulus

Based on factorial design, we designed our video scenarios.

For the factor of multiple viewpoints, there are two kinds of viewpoints of battery sharing event, the one view point (only the altruistic part) and the two viewpoints (both altruistic part and selfish part). The common structure of event was as follow. There are two robots work in the task of organizing the same range of the tables and chairs in the meeting room separately. When halfway through the arrangement, one of the robots stops moving as it runs out of the battery.

In the altruistic scenario, the robot which on behalf of the help-provider shares its battery with the help-receiver robot. Here, we use speech bubbles [18] to visualize the help-provider robot finding the help-receiver robot are running out of the battery and also express gratitude from help-receiver robot after being charged. In the selfish scenario, although the help-provider robot figures out that help-receiver robot runs out of battery, it continues its work till the end (see Fig.2. (c)).

In order to represent peak-end effect, despite the altruistic and selfish behavior, the video stimulus also contains the trivial parts, two robots type or organize information.

2.1.2. Participants

We performed a power analysis to identify the ideal sample size before to gathering the data for the experiment. An initial sample size of N = 128 was recommended by G*Power 3.1.9.7 analysis [19] (effect size f = 0.25, α= 0.05, and $1 - \beta = 0.80$). Through an online crowd sourcing service offered by

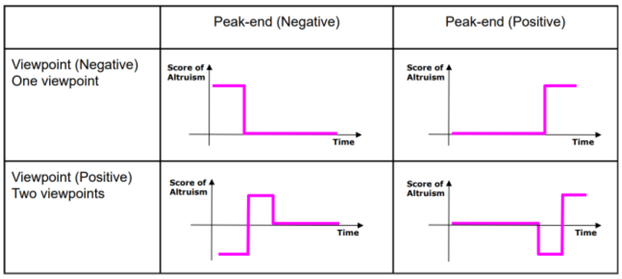

Fig.1. Scenario type of Study 1

Yahoo! Japan, 159 participants (96 male, 63 female), ranging in age from 17 to 70, participated in the study.

Fifteen participants were disqualified for failing to complete comprehension questions on video stimulus. The final sample was made up of 128 participants (75 male, 53 female, M = 44.30, SD = 11.34), based on the computation of G*Power 3.1.9.7 analysis [19].

2.1.3 Procedure

We first ask participants to read the introduction of the experiment and answer the demographic questions. Then basing on the factor design four video stimulus were shown in different groups. After that participants were asked to finish the post questionnaire which contains willingness of help, the original dictator game, the battery version of dictator game. For each question, we also asked participants to show the reason why they make the decision. Next, for ensuring the participants completely watching the video, we also asked them to finish the comprehension question. After that questionnaire for acceptance to social robots which include trust, attitude and perceived adaptability were asked. At the end of the experiment, the free-description question was asked.

2.1.4 Measurement

For willingness of help, we consult the questionnaire from Avelino et al.[20], based on the scenario of video stimulus we asked participants will they help other robot if that robot was out of the battery. For the original dictator game[21], we change "the other participant" in the dictator game to "the robot", we asked that "Now you are given 1,000 yen (about US$8.70). The money needs to be shared with the other robot. How much money would you give to the other robot?". As there is no common value between robot and human, we also set the battery version of dictator game, "Now you are given 100% battery. The battery needs to be shared with the other robot. How much battery would you give to the other robot?". For the comprehension question, we asked participants that “What did the robots do in the video?” and “What happened to one of the robots?” for each question we asked participant to picked correct answer among four selections. For the questionnaire included trust, attitude and perceived adaptability, we picked up seven questions that were included in questionnaire of measuring acceptance of an assistive social robots [22].

As all the participants were recruited from the Japanese crowd sourcing platform, all the questionnaires were translated into Japanese.

2.1.5 Result

The study 1 followed a 2 × 2 between-participants factorial design: peak-end effect (positive vs. negative) × viewpoint (one viewpoint vs. two viewpoints) and for each questionnaire we use ANOVA to do the analyze.

For willingness of help, the interaction between the peak-end rule and providing multiple viewpoints was not significant. The main effects of peak-end rule were not significant. The main effects of providing multiple viewpoints was significant ($F(1,124) = 6.364$, $p = 0.013$, $\eta^2p = 0.049$).

For original dictator game, the interaction between the peak-end rule and providing multiple viewpoints was not significant. The main effects of peak-end rule were not significant. The main effects of providing multiple viewpoints was not significant.

For battery version of dictator game, the interaction between the peak-end rule and providing multiple viewpoints was not significant. The main effects of peak-end rule were not significant. The main effects of providing multiple viewpoints was not significant.

2.1.6 Discussion

The results showed that although peak-end rule and providing multiple viewpoints did not show its interaction and main effect on of the original dictator game, the battery version of dictator game and acceptance to social robots. However, for the willingness of help, providing multiple viewpoints show its main effect. The participants those who watched video contains one viewpoint performed more altruistic than those who watched video two viewpoints. The result is quite different from the previous work by Hang et al.[23]. The previous work did not use speech bubbles to express the inside change of robots. This may show somehow the unstable tendency of using nudge technology.

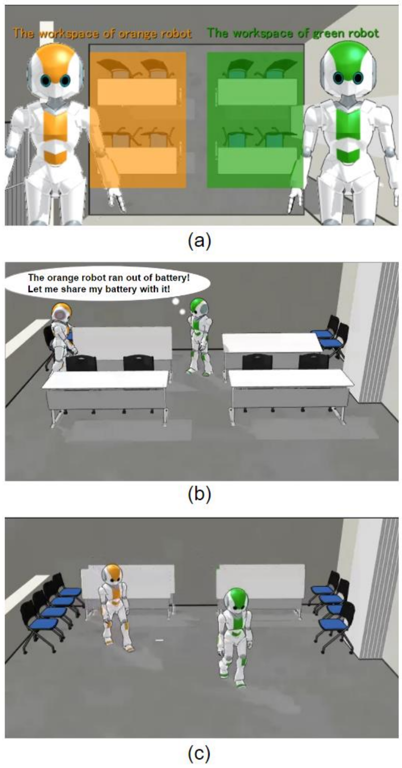

Fig.2. Altruistic scenario

By introducing battery measurement, instead of money in the original dictator, we make the attempt to define the common value between human and robots, but through the reason that participants gave following these two questions, we know that participants still have doubt why they need to share money or battery with the robot. For the results of acceptance to social robots, we consider that as there is no direct interaction between participants and robots. In addition, there are several robots in the video so participants may give a clustered attitude to robots.

3. Study 2

3.1.1. Video stimulus

In the study 2, we use the scenario of altruistic part, we set two robots organize the same range of the tables and chairs in the meeting room. We want to know whether different views of robots in same task will have different result on people's altruistic behavior (see Fig.3.).

As the video was made by MikuMikuDance, we set the video's camera from the position of each robot's head to simulate the first-person viewpoint.

3.1.2. Participants

We performed a power analysis to identify the ideal sample size before to gathering the data for the experiment. An initial sample size of N = 128 was recommended by G*Power 3.1.9.7 analysis [19] (effect size f = 0.25, α = 0.05, and 1 - β = 0.80). Through an online crowd sourcing service offered by Yahoo! Japan, 176 participants (116 male, 60 female), ranging in age from 16 to 87, participated in the study.

Thirty-three participants were disqualified for failing to complete comprehension questions on video stimulus. The final sample was made up of 128 participants (84 male, 44 female, $M = 45.70$, $SD = 12.59$), based on the computation of G*Power 3.1.9.7 analysis [19].

3.1.3 Procedure

We first ask participants to read the introduction of the experiment and answer the demographic questions. Then basing on the factor design two video stimulus were shown in different groups. Then participants were asked to finish the post questionnaire which contains the original dictator game and comprehension question for ensuring participants finished the video. At the end of the experiment, the free-description question was asked.

3.1.4 Result

This study followed a one factorial two level design: view of point (help-receiver vs. help-provider). An independent sample t-test was used for the result of dictator game. The results revealed a significant difference between the two groups (t (126) =2.20, p=0.029)(see Fig.4.). Particularly, those who observed the help-receiver view tended to give more money to the robot.

Participants who watched the help-receiver video referenced the words “cooperation" and "altruism" more frequently than those who watched the help-provider video. Comparing with that, the participants who watched help-provider video mentioned more about discomposure about job losing because of the replacement by robots.

3.1.5 Discussion

Study 2 was conducted to investigate whether experiencing two different points of view from virtual robots in the same altruistic task could promote human altruistic behavior. The results showed that participants who watched the help-receiver-view video gave more money to the robot than those who watched the help-provider-view video. However, without the explanations provided in the instruction, we are unable to determine whether the participants believe they have transformed into robots, or the robots are being controlled remotely, even though the video stimulus is depicted from the perspective of a human who has become a robot.

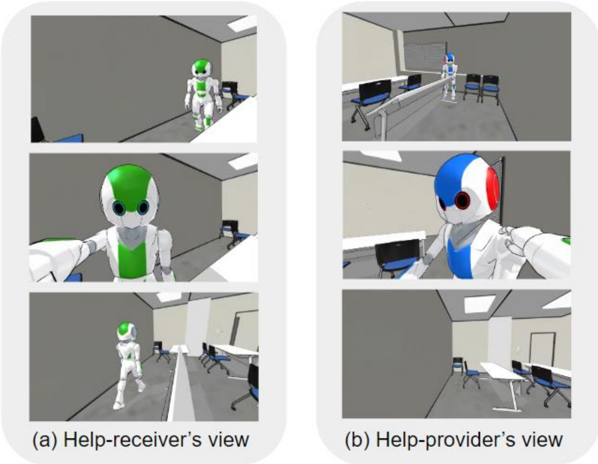

Fig.3. Perspective-taking scenarios

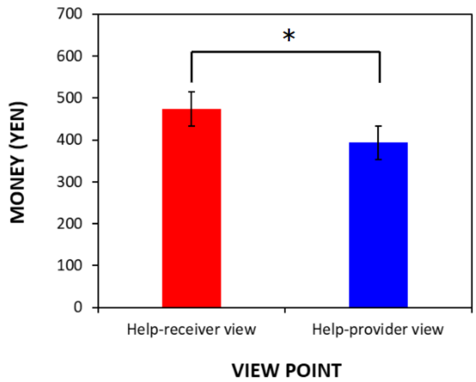

Fig.4. Results of different views in perspective taking

In addition, the findings of our study show that perspective-taking has a favorable impact on altruistic behavior in a cooperative task. However, some participants of the help-provider-view video mentioned in the free-description section that they felt a sense of crisis about maybe losing their jobs in the future after seeing robots could perform numerous duties so effectively. Pierce et al.[24] have demonstrated that adopting the perspective of a competitor may result in more unethical acts in human-human interaction tasks. The influence of taking a different robot’s perspective in a more competitive robot task would be an interesting avenue for future.

4. General discussion

In this paper, we apply peak-end rule, providing multiple viewpoints and perspective-taking to video stimulus performed by virtual agents.

For the general discussion, first, we considered the task and robot appearance we use in this paper. Previous works have shown that interacting with human-like agents actually enhances the prosocial behavior of participants [25]. Based on our current setting, it is hard for us to compare the effect between human-appearance agent and robot-appearance agent. Because it is impossible that human will run out of the battery. Second, the application to different forms of media (e.g., text, video, virtual reality, acted demo) also be expected [26]. Third, previous works showed that there are some differences between human robot/agent interaction in real life, virtual reality, 3D and 2D [27], the application and comparison to various mode of presentation also be expected. Fourth, the measurement of prosocial behavior is considered. Initially the players of dictator game are humans, but in this experiment, we are asking not only for humans but also for robots. This can confuse some participants as to what the money allocated to the robots in dictator game means, or who exactly is the beneficiary. With these considerations in mind, constructing a suitable questionnaire to test the altruism to robots and even can test both altruism to humans and robots are something that should be explored in the future. Although we design the battery version of dictator game in study 1, through the comments from participants, it still seems not the proper questionnaire for measuring people's altruism to robots.

5. Conclusion

In this paper we applied three nudge technologies to either third-person point of view or first-person point of view. The result shows that the providing multiple viewpoints and perspective-taking of robots can influence people’s prosociality towards robots. In the future, we will apply our study approach in 3D, virtual reality and real life.

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