Sociality of Robots: Do Robots Construct or Collapse Human Relations?

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ABSTRACT
With developments in robotics, robots "living" with people will become a part of daily life in the near future. However, there are many problems with social robots. In particular, the behavior of robots can influence human relations, and societies have not yet clarified this. In this paper, we report on an experiment we conducted to verify the influence of robot behavior on human relations using the "balance theory." The results show that robots can have both good and bad influence on human relations. One person's impression of another can undergo changes because of a robot. In other words, robots can construct or collapse human relations.

Categories and Participant Descriptors
J.4 [**SOCIAL AND BEHAVIORAL SCIENCES**]: Psychology.

General Terms
Design, Experimentation, Human Factors.

Keywords
Robotic Social Psychology.

I. INTRODUCTION
Over the past few years, many robots with human-like embodiment have been developed. Currently, robots that "live" with humans are only used as pets. However, we must consider that humanoid robots will enter our daily lives in the near future. When humanoid robots have abilities such as human-like behaviors and utterances, how will we be influenced by these robots? In particular, what effects will they have on emotional aspects of human relations and societies?

We consider that robots can collapse human relations using the balance theory [1]. Concretely, by controlling a robot's behavior and utterances, we can control a human's impression of another human in group communication involving robots.

In this paper, we performed an experiment to verify how social robots influence human relations. To determine this effect, we tried to confirm what occurs in the human-robot relationship. When robots take on sociality, these robots might easily construct or collapse human relations. We will examine these possibilities.

II. RELATED WORKS

We will use the balance theory to control a person's impressions of the robot and a third person in group communication. The balance theory was formulated by Heider. It assumes that when a system is put into a state of imbalance, forces arise to restore balance. For example, the attitude of a person, P, toward another person, O, is positive. And the attitude of another person, O, toward a third person, X, is positive. Then person P's attitude toward the third person, X, will be positive. If P's attitude toward X is negative, then the relationship among P, O and X is imbalance. In this case, one of the following cases will be occurred to balance the relationship. The person, P, changes his/her attitude toward X to positive. Either P's attitude toward O or O's attitude toward X will be changed to negative.

If we replace person P with the robot, we consider that we can control the attitudes of O and X toward each other by controlling the robot's behaviors. We consider that the robot can have a good or bad influence on the relationship between persons O and X.

We survey related works briefly. Nakanishi et al. conducted an experiment to verify the balance theory in agent-mediated communication [2]. One agent and two participants joined in this communication. In this experiment, they confirmed that the balance theory applied in cases in which participants could not talk to each other. However, they did not confirm that the theory did not apply in case in which participants could talk to each other.

III. PROPOSED METHOD

An experiment was conducted to verify the effects of the robot's sociality using the balance theory.

A robot talked to two participants simultaneously. In this situation, we tried to determine how the robot's behavior would influence the impressions of (A) one participant to the robot, (B) another participant to the robot and (C) one participant to the other participant.

Interactive Humanoid Robot "Robovie"

We used the interactive humanoid robot "Robovie," which is characterized by its human-like bodily expressions and various sensors [3]. The body consists of eyes, a head, and arms, which generate the complex bodily movements required for communication.

Conditions

This experiment has three conditions. One is an Agreement condition. This condition states that the robot agrees to each participant's opinions. Next is a Disagreement condition. The robot in this condition disagrees with each participant's opinions. In these two conditions, the robot agrees or disagrees with participant's opinion without distinction. On the other hand, the robot in an Unfairness condition agrees to only one participant's opinion. In this condition, the robot behaves unequally.

Participants

Forty-six university students participated in the experiment. They do not have contact with robots on a daily basis.

Procedure

Before starting the experiment, each participant answered questions about their likes and dislikes. These answers were used to control the behavior of the robot during the experiment. The robot acted to use the results of questions appropriately.

Two participants interacted with the robot at the same time. This interaction is exchanging questions and answers. After the experiment, each participant answered questionnaires. The experimenter asked them some questions, which participants answered concurrently to confirm their impressions of the robot and each other. Finally, participants answered questions about (a) their impressions of the robot, (b) the other participant's impressions of the robot, and (c) their impressions of the other participant. From analysis of the responses, we tried to confirm whether the balance theory applied to robot-mediated communication.

Evaluation

We evaluated this experiment with questionnaires containing 6 items. These items are rated on a 1-to-5 scale, where 5 is the most positive.

IV. RESULTS AND DISCUSSION

The results of the experiment were determined by analyzing the questionnaire responses. Figure 1 illustrates the result of the participants' impressions of the other participants in unfairness condition. We distributed three conditions to the plus and minus group based on the forecast of the balance theory. We consider that participants who were agreed with the robot on the opinion will have good impression to the robot. In the reverse case, they will have bad impression to the robot. In analogy with above two cases, the participants in clash of opinion will not have good impression to each other. From this forecast, the plus group consists of participants in the Agree and Disagree conditions. The robot in this condition agrees or disagrees with the participants

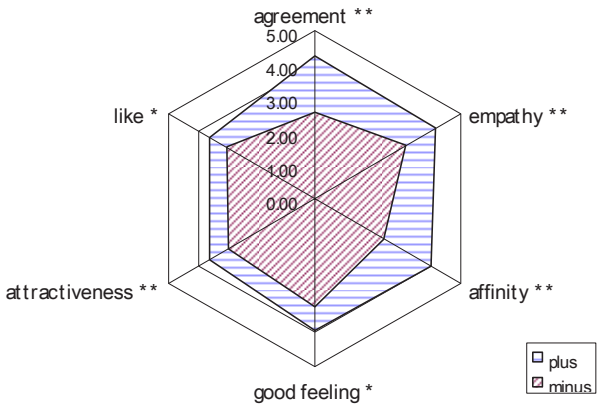

Figure 1: Questionnaire's result of Unfairness Condition

without distinction. And the minus group consists of participants in the Unfairness condition. The robot in this condition agrees with one participant. The ANOVA shows that there are significant differences in every question. This means that participants in the unfairness condition do not show goodwill toward each other. From these results, we confirmed the balance theory being applied in robot-mediated communication.

Our results show the possibility of the balance theory in group communication being applied by two humans and a humanoid robot. Previous research [2] confirmed that the balance theory applied by disallowing participants to talk each other. However, when participants were allowed to talk to each other, they did not confirm that the balance theory did not apply. In our experiment, we allowed participants to talk each other in the conversation with robot. In this situation, the balance theory was applied. We consider that the existence and the embodiment are important for the social conversation with robot.

V. CONCLUSION AND FUTURE WORK

In this paper, we conducted an experiment to verify whether the balance theory applied to robot-mediated communication. Our results show the balance theory being applied in robot-mediated communication. From these results, we confirmed that robots may have good or bad influence on human relations. In other words, robots can construct or collapse human relations.

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