Robot-Human Interaction -- How Robot Approach Behaviors Affect Human Perception of a Robot's Character and Role

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Introduction

When building computational artifacts that are capable of social relationships with human, it is desirable for these artifacts to possess a human form like those of humanoids, bipedal robots and anthropomorphic agents. If these artifacts appear human-like, they can display nonverbal social interaction cues. In particular, physically embodied artifacts such as bipedal robots can use the nonverbal, spatial channels that are studied in the field of *proxemics*.

In the case of human-human communication, behavior that decreases spatial distance is a crucial factor in increasing immediacy, which is strongly related to affection, attachment, and intimacy (e.g. Mehrabian, 1969). Therefore, a robot's spatial approach towards a user may improve the user's impression of the robot, and may change their expectation of the robot. This study explores how the way a robot approaches a person influences that person's perception of the robot's character and their expectations of the robot's role such as a work partner, an assistant, a pet or a toy.

Experimental Method

Thirty-six undergraduate students from the Osaka Electro-Communication Univ. (31 males and 5 females) between the ages of 20-24 years participated in the experiment.

The experiment was conducted in a 6 m by 8 m room (Figure 1). For the purpose of the experiment, the zone where participants could move was indicated on the floor with vinyl tape using nine markers in three different shapes (□,△, and ×) and three colors (either blue, red, or yellow). The participants' behavior was monitored at remote place where the robot operators were stationed using a video camera.

Three bipedal robots (Kondo Kagaku: KHR-1) were used as stimuli. Each robot was painted in blue, red, or yellow, and had a small dummy video camera and LCD on its head. The robots were controlled in one of three ways: (1) manual operation, where the operator repeatedly chose among the actions go straight, turn right, or turn left, making the robot pursue the participant; (2) half-automatic operation, where half the time the robot was manually operated and half the time a computer randomly chose from among the programmed actions go straight, turn right, or turn left; and (3) automatic operation; the computer repeatedly and randomly chose from among the actions. The colors (red, blue and yellow) and the stimuli were counterbalanced.

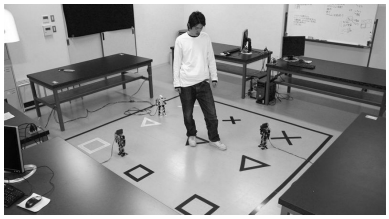
Figure 1: Translocation task.

Participants performed a translocation task for 10 min that required them to move toward the instructed markers on the floor every 15 sec. The marker order was random. Before the task, each participant was given a false explanation that the purpose of the experiment was to investigate human walking behavior among the robots and that each robot worked according to a different algorithm. Both before and after the task, participants rated on bipolar 5-point scales their affective responses towards the robots (likeability, fear), their evaluations of the robots' character (intimacy, intelligence, social extroversion, ascendancy and agreeableness), and their role expectation (partner, assistant, pet and toy).

Results and Discussion

In order to examine the effect of robot approach patterns in terms of the difference between pre- and post-evaluations, we conducted a two-way repeated measures analysis of variance (ANOVA) test. There were significant interactions between the approach patterns and the pre/post evaluations in terms of intimacy, intelligence, social extraversion, ascendance and expectation as a partner and as an assistant ($p<.05$), but not among the others. The results indicate that an increase in immediacy caused by the robots' approach behaviors affected the participants' evaluations of the robots' characteristics, and also increased the users' expectations that the robots could function as partners or assistants.

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References

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