Can I Get Close to You?: The Impact of Communicator Types on People's Acceptance toward a Communicator

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Abstract

Background Since a robot has characteristics of both humanness and productness, we investigated the dominant characteristic of a robot by comparing a robot with a human and a product.

Methods we conducted a 3 (communicator types: a human vs. a robot vs. a product) within-participants experiment (N=30) to explore the impact of the communicator types on people's perception of a robot and social distance to figure out which robot's characteristic is dominant between humanness and productness.

Result People perceived the robot to have better social presence, anthropomorphism, animacy, and likeability than the product while less than the human. On the other hand, participants had the longest duration of physical contact with the robot, followed by the product and the human.

Conclusion In order to investigate the dominant characteristic of a robot between humanness and productness, we compared a robot with a human and a product, and explored the impact of communicator types on people's acceptance of a robot. People positioned the robot inbetween the human and the product. In the case of duration of physical contact in intimate space, people had the shortest physical contact with the human while they had the longest physical contact with the robot. The result indicates that between two characteristics of a robot, productness is perceived more dominantly than humanness.

Keywords Communicator Types; Humanness; Productness; Perceptions of a Robot; Social Distance

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1. Introduction

Robots are becoming social agents which can interact and communicate with people in our daily lives. Accordingly, the neccessity of emotional communication between people and robots has come to the fore in the field of Human-Robot Interaction (HRI). Even though many studies have been done on developing robotic interface which recognizes people's emotions and reacts toward robots (Breazeal et al., 2003)(Fong et al., 2003), many studies demonstrated that there are limitations in emotional interactions between a human and a robot due to the limitation in today's robotic technology.

This could be interpreted based on Kashibuchi et al.'s study (2003). According to Kashibuchi et al.'s study (2003), robots are positioned inbetween people and inanimate objects. This showed that a robot had both characteristics of living creatures and artificial objects. Moreover, Disalvo et al. (2002) suggested that robots have the characteristics of humanness, productness, and robotness. As a robot have both characteristics of humanness and productness, it needs to be investigated which characteristic is more dominant.

Social distance is described as the distance that exists between two or more social groups (Bogardus et al., 1933). Social distance can be revealed by one's perceptions of other social being and their collective co-presence. As a robot has a both characteristics of humanness and productness, we focus on investigating whether social distance can be revealed between a human and a robot. If a robot has characteristic of humanness dominantly, people would perceive strong social presence of a robot, and it would make people feel uncomfortableness to have physical contact in intimate space. However, if a robot has characteristic of productness dominantly, people would perceive week social presence of a robot, and it would not make people feel uncomfortableness to have physical contact in intimate space. Thus, in this study, we compared communicator types, a human, a robot, and a product and examined its impact on people's perception of a robot and social distance between a human and a robot.

2. Related Works

2. 1. Ontology of a Robot

There are two contrasting claims with ontological approach about a robot: strong ontology and weak ontology (Searle et al., 2001). The strong ontological claim is that a robot could replace a human being with advanced technology, whereas the weak ontological claim is that a robot could not replace a human being but remained as an artifact being. If the strong ontology is taken, people could have substantive emotional engagement toward a robot. On the other hand, if the weak ontology is taken, people could not. There are several studies showed limitations of emotional communication between a human and a robot, supporting weak ontology.

Moravec (2003) demonstrated that artificial emotions by robots have been frustratingly out of reach in emotional communication between a person and a robot. Pepe et al. (2008) suggested that people were more engaged to the animals than pet robots at a deeper level of emotional interactions. Moreover, according to Friedman et al.'s study (2003), even if a pet robot evoked some of the feelings that people attribute to human-animal relationship, there were limitations in the human-robot relationship, such as in moral relationship.

Based on weak ontology, people could perceive robots as having both characteristics of living creatures and artificial objects. According to Kashibuchi et al. (2003), people divided 10 stimuli (human, animal, machine, inanimate object, humanoids and animalike robots) into three groups, by positioning robot group inbetween human-animal group and machine-inanimate object group. Moreover, Disalvo et al. (2002) described the characteristics of robots as humanness, productness, and robotness.

Thus, we expected that people would perceive a robot differently when comparing with a human and a product.
This analysis led to the following hypotheses:
H1. The perceived social presence will be different by communicator types.
H2. The perceived anthropomorphism will be different by communicator types.
H3. The perceived animacy will be different by communicator types.
H4. The perceived likeablity will be different by communicator types.

2. 2. Social Distance

Bichi (2008) proposed three modalities of social distance: perceived social distance, which is perceived by a person who faces the counterpart; an expressed social distance, purposely made by an action of distancing oneself; and undergone social distance, the result of the distancing action. The undergone social distance could be also explained by Hall's proxemics (1986). Proxemics is the study of human’s use of space in interpersonal situation. He suggested four categories of spacial distance: public space for public speaking; social space for interactions between aquaintances; personal space for interactions between friends or family; intimate space for interaction with close friends or family members (see Fig 1).

Among them, intimate space is for physical contact, which is reserved for lovers, children, family members, friends, and pet animals. Short et al. (1976) insisted that people would feel higher social prsence of others when they get closer to each other. As social distance plays a significant role in people's social interaction, various studies have explored the social distance between a human and a robot.

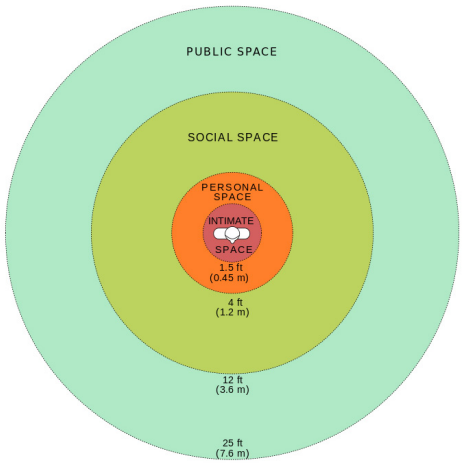

Figure 1 Four Categories of Spacial Distance (Hall, 1986)

For example, Walter et al. (2008) examined the effect of a robot's appearence on social distance. Kim et al. (2012), demonstrated the effect of a robot's language forms on people's social distance from robots. Even though several studies have been done on investigating social distance as a way to evaluate the people's acceptance of a robot, the study exploring social distance as a way to find out the dominant characteristic of a robot between humanness and productness is limited.

In this study, as intimate space is acceptable between people in close relationship, the duration of physical contact in intimate space would be affected by the dominant characteristic of a robot. If humanness is dominant, physical contact between a human and a robot would be limited or rejected as people would perceive a robot closer to a human in intimate space. On the other hand, if productness is dominant, physical contact between a human and a robot would be acceptable as people would perceive a robot closer to a product in the intimate space.

This analysis leds to the following hypothesis:
H5. The duration of physical contact will be different by communicator types.

3. Study Design

In order to figure out which robot's characteristic is more dominant between humanness and productness, we conducted a 3 (communicator types: a human vs. a robot vs. a product) within-participants experiment.

3. 1. Participants

Thirty female university students participated in the experiment. We recruited the same sex group of the participants with the communicators since sex difference could yield negative emotion in accidental interpersonal touch (Stier et al., 1984).

3. 2. Stimuli

In the human condition, participants made physical contact with a woman. In the robot and the product condition, participants made physical contact with the MyKeepon (2015) (see Fig. 2). It has an array of invisible sensors underneath its skin and makes motion feedback depending on the types of external touch. In the robot condition, MyKeepon was turned on and introduced as a robot. In the product condition, MyKeepon was turned off and introduced as a doll.

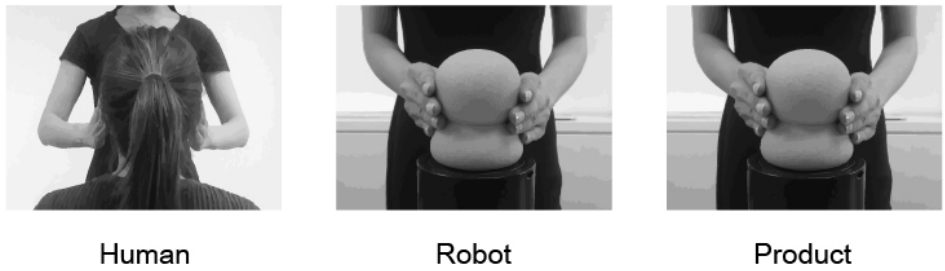

Figure 2 Stimuli

3. 3. Procedure

Participants were welcomed to the lab and the explanation about the experiment was introduced. Then, they were had physical contact with three communicators in random order. In each condition, participants were asked to put their both hands on each communicator's cheeks (see Fig. 3). We explained if participants felt awkwardness of uncomfortableness while they had physical contact, they could hands off from the material. After the participants experienced each condition, a questionnaire regarding each stimulus was administered.

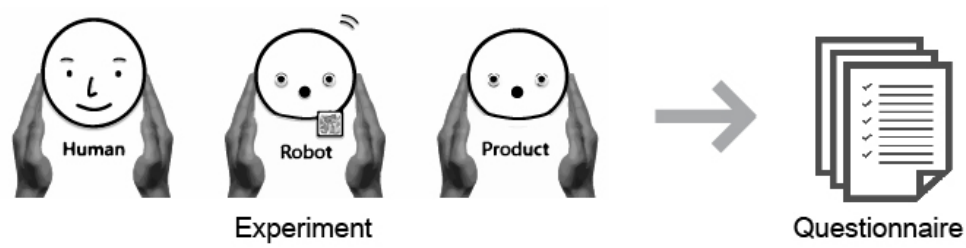

Figure 3 Procedures

3. 4. Measures

The post-experimental survey was composed of 21 Likert-type items, which were combined into four scales. The four scales was social presence, anthropomorphism, animacy and likeablity. In addition, the duration of physical contact with the communicator was recorded. *Social presence* was index of five items, which were drawn from Heerink et al.'s research (2008). The five items were "When interacting with the counterpart, I felt like talking to a real person," "It sometimes felt as if the counterpart was really looking at me," "I can imagine the counterpart to be a living creature," "I often think the counterpart is not a real person," and "Sometimes the counterpart seems to have real feelings." Participants indicated their answers on 7-point Likert scales ranging from "totally agree" to "totally do not agree." The index was very reliable (α=.93).

Anthropomorphism was an index of five items, which were drawn from Bartneck et al.'s research (2010). The five items were "natural, humanlike, conscious, lifelike, and moving elegantly." The index was very reliable (α=.96).
Animacy was an index of six items, which were drawn from Bartneck et al.'s research (2010). The six items were "alive, lively, organic, lifelike, interactive and reponsive." The index was very reliable (α=.96).
Likeablity was an index of five items, which were drawn from Bartneck et al.'s research (2010). The five items were "like, friendly, kind, pleasant, and nice." The index was very reliable (α=.95).

4. Results

We investigated the impact of communicator types on social presence, anthropomorphism, animacy, likeablity and duration of physical contact. Statistical analyses were conducted using the one-way analysis of variance (ANOVA) test.

4. 1. Social Presence

H1 was supported by the data. Social presence was significantly different depending on the communicator types ($F_{(2,58)}$=63.29, p<0.0005). Participants perceived more social presence to a human (M=6.41, SD=0.89) compared to a robot (M=4.31, SD=1.20) and a product (M=2.83, SD=1.44) (see Fig. 4).

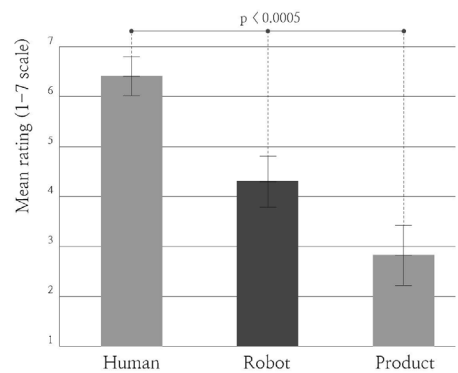

Figure 4 The Impact of the Communicator types on Perceived Social Presence

4. 2. Anthropomorphism

H2 was supported by the data. Anthropomorphism was significantly different depending on the communicator types ($F_{(2,58)}$=85.34, p<0.0005). Participants perceived more anthropomorphism to a human (M=6.57, SD=0.82) compared to a robot (M=4.31, SD=1.12) and a product (M=2.55, SD=1.34) (see Fig. 5).

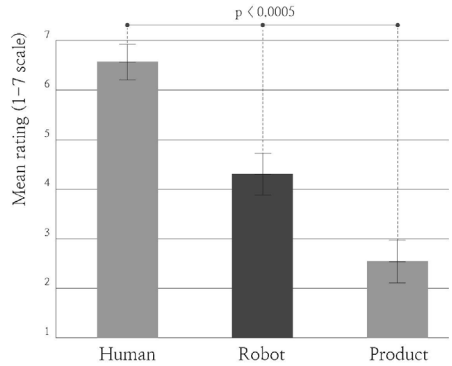

Figure 5 The Impact of the Communicator types on Perceived Anthropomorphism

4. 3. Animacy

H3 was supported by the data. Animacy was significantly different depending on the communicator types ($F_{(2,58)}$=73.41, p<0.0005). Participants perceived more animacy to a human (M=6.45, SD=0.93) compared to a robot (M=4.84, SD=1.22) and a product (M=2.54, SD=1.44) (see Fig. 6).

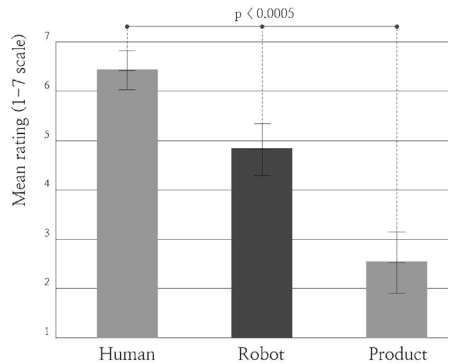

Figure 6 The Impact of the Communicator types on Perceived Animacy

4. 4. Likeability

H4 was supported by the data. Likeablity was significantly different depending on the communicator types ($F_{(2,58)}$=36.11, p<0.0005). Participants perceived more likeablity to a human (M=6.13, SD=0.87) compared to a robot (M=5.46, SD=1.18) and a product (M=4.08, SD=1.22) (see Fig. 7).

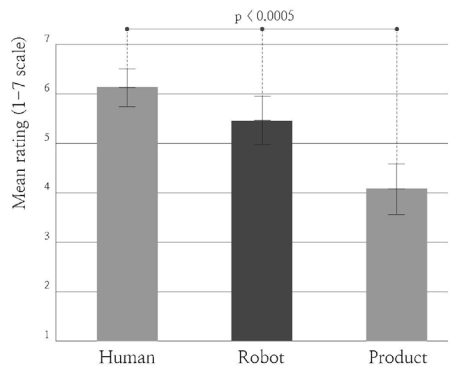

Figure 7 The Impact of the Communicator types on Perceived Likeability

4. 5. Social Distance

H5 was supported by the data. The duration of physical contact was significantly different depending on the communicator types ($F_{(2,58)}$=13.19, p<0.005). The duration of physical contact with a robot was the longest (M=45.24sec., SD=49.55), and that of a human communicator type was the shortest (M=11.16sec., SD=13.55). The duration of physical contact with a product was in the middle (M=33.87sec., SD=39.88) (see Fig. 8).

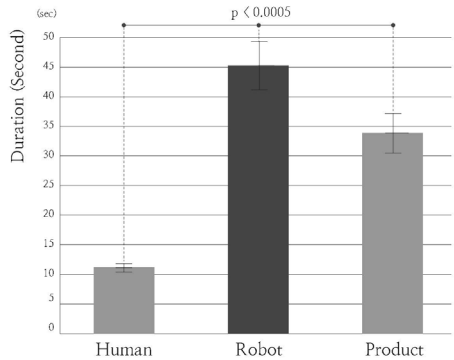

Figure 8 The Impact of Communicator Types on Duration of Physical Contact

5. Discussions

5. 1. Summary and Interpretations of Results

All five hypotheses were supported by the data. As predicted by H1, H2, H3, and H4, people perceived the robot to have better social presence, anthropomorphism, animacy, and likeability than the product while less than the human. This indicates that people positioned the robot inbetween the human and the product, which is consistent with Kashibuchi et al.'s study (2003).

In addition, H5 was supported by the data. People had physical contact with the robot longer than the product, and the human. The shortest duration of physical contact with a person indicates that people felt uncomfortableness to have the physical contact with the unfamiliar person in intimate space. On the other hand, the longest duration of physical contact with a robot indicates that people did not feel uncomfortableness to have the physical contact with the unfamiliar robot in intimate space. This implies that people perceived a robot as a product more dominantly than as a human. Moreover, people had longer duration of physical contact with the robot than with the product. By interview, participants answered that there was no reason to communicate continuously with the product since it doesn't have any interactivity. It is inferred that the interactivity of a robot leads to the longer interaction with a robot over a product.

5. 2. Limitations

There are several limitations in this study. First, our participant pool was limited to female university students. Replicating this study with people of different gender, ages, and cultures is an important next step.

Second, we examined interactions between humans and robots in an experimental room with short-term study. As interactions in more natural settings may produce different results, future studies should examine long-term experience in natural settings.

6. Conclusions

The objective of this study was to investigate the impact of communicator types on people's acceptance of a robot. People perceived the robot inbetween the human and the product. In the case of duration of physical contact in intimate space, people had the shortest physical contact with the human while they had the longest physical contact with the robot. This result indicates that between two characteristics of robots, productness is perceived as more dominantly than humanness.

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