The Impact of Robots Language Form on People's Perception of Robots

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Abstract. Robots in people's daily life have social relationships with human. This study investigated how the expression of social relationship in human communication is applied to human-robot relationship. We expressed two axes of social relationship through robots' verbal language. In a 2 (address: calling participants' name vs. not calling participants' name) x 2 (speech style: honorific vs. familiar) between-participants experiment (N=60), participants experienced one of four types of the robot and evaluate the robot's friendliness and dominance. Participants rated robots friendlier when it called their name than when it didn't call their name. In the case of robots' dominance, there was no significant difference in whether the robot called participants' name as well as the robot's forms of language. Based on the experiment results, we discussed the use of a social relationship concept for designing robots' dialogue.

Keywords: Human-Robot Interaction, Robot dialogue, Interpersonal traits, Social relationship.

1 Introduction

As robots appear and exist in daily life, it as social agents having their own identities rather than just autonomous products has a social relationship with human [1]. Social relationships are identified by each individual's social identity, status, mutual interpersonal closeness, etc. [2]. Among these factors, intimacy and status which represent horizontal and vertical axis of social relationship contribute to interpersonal attraction which is related to how much we like, love, dislike, or hate someone [3]. Therefore concepts of social relationships need to be applied and explored to the relationship between human and robot.

In this study, we set social relationships between human and robot by forms of robots' language and explored difference of people's perception of the robot through measuring robots' interpersonal traits (friendliness and dominance) perceived by people. According to Kiesler and Goetz (2002), dialogue affects people's perception more than the appearance of the robot [4]. As such, we used forms of language in dialogue because this is an effective way to represent social relationships between humans and robots.

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2 Related Works

In human-robot interaction research, researchers mainly consider three primary types of dialogue: low-level (pre-linguistic), non-verbal, and natural language [5]. Among these, it is expected that people will have natural language interactions with robots in the near-future [6]. Natural language interactions with robots will be needed for people to understand instructions given by the robots such as robot receptionists [7], serving robots [8], teaching assistant robots [9], museum guide robots [10], and so on. Natural language is also required for socially interactive robots, because it helps the robots be engaging with people [11]. Therefore, we applied forms of interaction in human communication on the interaction between human and socially interactive robots.

There are various factors of an interaction changed by social relationships between humans. In verbal communication, it can be addresses, speech styles, ways of speaking, etc., while nonverbal communication includes posture, eye contact, smiling and gestures [12]. Forms of language, including types of address, are one of the critical ways to represent social relationships between two people [13]. In this study, we explored the effects of calling name and selection of speech style on people's perception of robots.

2.1 Name and Social Relationships

Introducing, perceiving and calling someone's name occur when people make a relationship at the beginning of a meeting and keep other's attention to them. The meaning of calling name has been studied in a play to investigate the relationships between characters. Lee (2005) describes that an unnamed person is a stranger and nonexistence, that is to say one person of numerous nameless people [14]. Introduced and called someone's name indicates that existence of him/her is realized by others and he/she forms relationships with others.

2.2 Speech Styles and Social Relationships

In linguistics, an honorific speech grammatically encodes and represents the relative social status of the participants of the conversation [15]. Honorific speech style is the most common speech style and is commonly used between strangers or between superiors and subordinates, while familiar speech style is typically used when the addressee is below the speaker in age or social rank [16]. In addition, sentence-final speech styles of honorific and familiar forms are certainly divided in Korean language [17].

When one person calls another's name, the linguistic forms of address is governed by the relation between the speaker and his addressee [13]. If addressee is in an intimate distance from a speaker, such as close classmates, elder brothers, boy or girl friends, lovers, then a speaker calls addressee with first name, FN [4]. In contrast, a speaker uses title and last name, TLN, or don't call the name to addressee distantly related, such as teachers, strange fellow workers, neighbors, governors, strange waiters. The forms of address are reasonably well described by a single binary contrast in English as well as Korean language: FN (First Name) or TLN (Title + Last Name). FN is typically used when people talk to another with familiar speech style, while people who speak honorifically call another by TLN.

3 Method

We used a 2 (address: addressing participants' name vs. not addressing participants' name) x 2 (speech style: honorific vs. familiar) between-participants experiment design. All participants experienced one of four types of the robot.

We were interested in how people's perception of robots is different according to horizontal and vertical of social relationships between human and robots. Because Kim and her colleagues (2010) found that people allow the robot to come into their personal space more when the robot call names of people [18], we believed that participants would perceive interpersonal traits of the robot which calls their name more positively than the robot which don't call their name. The survey results also showed that people accept the robot which didn't call their name more than the robot which called their name when the robot used honorific speech style. As such, we anticipated that the effect of calling participants' name would vary by the speech styles.

This analysis led to the following research hypotheses:

H1. Friendliness of the robot's traits will vary with whether the robot calls participants' name.

H2. Dominance of the robot's traits will vary with whether the robot uses honorific or familiar speech style.

3.1 Participants

We recruited participants who are in their twenties (Male: 28, Female: 32). Korean students from an engineering college who is familiar with technology participated in the experiment. Because people might have poor mental representations of those with whom they have little experience [19], it may hard to make judgment confidently about robots.

3.2 Materials

We used the Nettoro robot which is a Mechanoid type rather than a Humanoid or Android type because most participants have never seen humanlike robot and should adapt to the robot easily to hold a natural conversation with it. The Nettoro robot is a cleaning and an information robot that can navigate the space autonomously. The robot's words were recorded in advance through text-to-speech (TTS) program with a mechanical voice. During the experiment, the robot's words for a conversation with participants were controlled using the Wizard of OZ technique (WOZ) [20].

3.3 Procedures

At the beginning of the experiment, participants were welcomed and asked to take a seat in front of the robot. An experimenter explained the experiment and notified that this robot can detect participants' voice and have a simple conversation with people, while complicated sentence is hard to recognize for it. After that, participant was asked to wait a minute and an experimenter went to the hidden area to operate the robot and the conversation, as shown in Fig. 1. After the conversation, the researcher asked participants to answer the questionnaire about the robot's interpersonal traits.

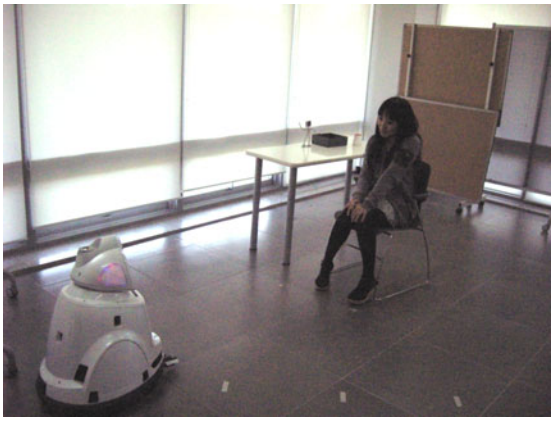

Fig. 1. One participant talking with a robot in testing room

3.4 Experimental Manipulations

One of the independent variables *Speech style* had two levels: honorific vs. familiar speech style. To make participants realize the speech style used by the robot, the robot said *"I'll use honorific (familiar) speech style because I'm a robot"* in the early part of the conversation.

In the case of another independent variable *whether the robot calls participants' name or not*, the robots ask three questions regarding participants' name such as *"What is your name?"*, *"What means your name?"*, and *"Who named you?"*, when it called participants' name. In addition, during the experiment, the robot called participants' name seven times to let participants know that it knows and calls their name.

The overall contents of the robot's words were neutral including instruction of the experiment to avoid an effect of it on participants' perception of the robot.

3.5 Measures

According to McCrae and Costa (1989), most critical traits to interpersonal relationships are dominance and friendliness based on Wiggin's circumplex [21]. For measuring interpersonal traits of the robot, revised interpersonal adjective scales (IAS-R) which includes 8 adjectives in each of the eight octant scales *PA: Assured-Dominant, BC: Arrogant-Calculating, DE: Cold-Hearted, FG: Aloof-Introverted, HI: Unassured-Submissive, JK: Unassuming-Ingenuous, LM: Warm-Agreeable,* and *NO: Gregarious-Extraverted* was used, as shown in Fig. 2. In this experiment, 64 Korean adjectives which are verified in psychology were used, because all participants were Korean [22]. Participants were presented with a list of single adjectives (e.g., "Extraverted") and asked to assess each adjective on a seven-point Likert scale ranging from "extremely inaccurate" to "extremely accurate".

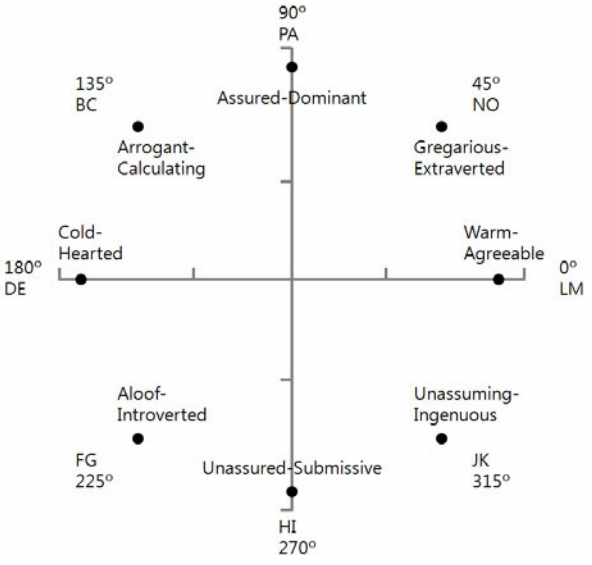

Fig. 2. Circumplex structure of Revised Interpersonal Adjective Scales (IAS-R; Wiggins, Trapnell, & Phillips, 1988)

For deriving aggregate measures of dominance and friendliness from the IAS-R, the following formulae [23] were used.

$$\text{Dominance} = \text{PA} - \text{HI} + .707(\text{NO} + \text{BC} - \text{FG} - \text{JK}) \quad (1)$$

$$\text{Friendliness} = \text{LM} - \text{DE} + .707(\text{NO} - \text{BC} - \text{FG} + \text{JK}) \quad (2)$$

(PA, BC, ..., and NO in these formulae are average scores of each of its items.)

4 Results

All statistical analyses were conducted using analysis of variance (ANOVA) with address (calling participants' name or not) and speech style (honorific or familiar speech style) as independent variables.

4.1 Friendliness

As predicted by H1, a significant effect of whether the robot called participants' name on friendliness of the robot was found, $F(1, 58) = 8.53$, $p < .01$, as described in Fig. 3. Participants feel the robot more friendly when it called their name, $M = 2.64$, $SD = 3.92$, than when it didn't call their name, $M = 0.02$, $SD = 2.96$. When the robot used honorific speech style, however, there was no significant difference of robots' friendliness rated by participants between whether participants were called by the robot or not, $F(1, 28) = 0.20$, $p = .66$. When participants had a conversation with the

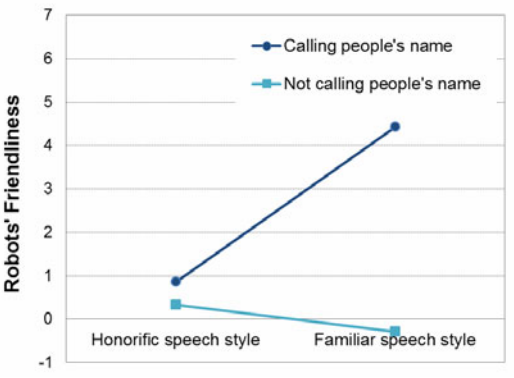

Fig. 3. Robots' friendliness perceived by participants according to whether the robot called participants' name and robot's speech style

robot which used familiar speech style, they felt the robot which called their name, M = 4.43, SD = 3.49, friendlier than the robot which did not, M = -0.28, SD = 3.11, $F(1, 28) = 15.24$, $p < .01$.

4.2 Dominance

In the case of dominance, there was no significant difference in whether the robot called participants' name, $F(1, 58) = 1.48$, $p = .23$, as well as robots' speech styles, $F(1, 58) = 1.21$, $p = .28$. Therefore, H2 was not supported.

5 Discussion

5.1 Summary and Interpretation of Results

Consistent with H1, people rated the robot as being friendlier when their name was called by the robot, while the robot which did not call was rated less friendly. During the experiment, the robot not only called participants' names but also asked their name, the meaning of it, and the person who named them which the participants revealed personally relevant information. It was the kind of self-disclosure which has traditionally been considered an important component and index of intimacy between people [24, 25, 26].

Regarding the friendliness, the results also showed that calling participants' name had no effect on robots' friendliness perceived by participants, when the robot used honorific speech style. Even if a robot called people by their names, the score of friendliness of the robot using honorific speech style was similar to that of the robot which did not address people by name. Because an honorific speech style is usually used by products, such as cash machines or automatic service machines, letting a robot know people's name might be just a way to check who will use the machine. On the other hand, if robots call people' name using a familiar speech style, it might be perceived not only as intelligent products but also as close objects which people can have social relationships with.

Related to the robots' dominance, no independent variables had an effect on it and all types of the robot were rated as being dominant.

5.2 Implications for HRI

From the results of this study, it may be argued that a robot's speech should be designed to be friendly and acceptable, because people perceive a robot communicating verbally as a dominant entity.

If a robot calls people by their name, it may be perceived as a social entity that can make close relationships with people rather than only a product. A robot would not be a social agent like a human with only verbal communication ability. Being a social agent may require having some factors which influence on forming social relationships, such as self-disclosure and being named. In the case of personal service robots which mostly interact with particular individuals, therefore, robot designers should make the robot call users' name to make users feel friendliness from the robot and make a social relationship with it. In particular, people's name should be naturally introduced by themselves as one of the self-disclosure process. In addition, if the robot talks to people with familiar speech style, people may accept the robot as if the robot is a close friend of them.

If a robot doesn't use or know people's names, it should use an honorific speech style because it would be just one of many products having no relationship with specific individuals as if two strangers newly meet. Therefore, a robot having a conversation using an honorific form of language would be more acceptable, if it is interacting with unspecified individuals in a public space, such as museum guide robots or information robots. In addition, results of this study suggest that inducing users' self-disclosure is not essential interaction factor to a robot in the public space, because asking and calling people by name have no serious effect on people's perception of robots.

5.3 Limitation

There are several limitations in this experiment. First, participants of this experiment were limited in their twenties. People's perception of addresses and speech style may be different in different ages. Children may be used to be called with familiar speech style than adults, while adults were usually called by others with honorific speech style. Therefore the results of this experiment are hard to be applied on all ages. Second, most contents of conversation in this experiment were consist of instructions for the experiment and then participants might perceive the robot dominant. Interactions with less dominant contents may produce different results. Third, the experiment was conducted in a short period of time. We expect that we can identify appropriate time to change robot's speech style from honorific to familiar one in a long term experiment, because as relationships between humans and robots are gradually developed. Further studies would handle this point of view.

6 Conclusion

Interacting with people is the most important ability for robots, as robots emerge in people's daily lives not only as assistant workers but as social partners. In particular, verbal communication has been regarded as the basic ability of robots. The objective

of this study is to examine the effect of representing ways of social relationships between human and robots on people's perception of robots through forms of robots' language. The results indicate that it is enough to make people perceive robots friendly with only by calling people's name. When robots use honorific speech style, however, whether robots call people's name have no effect on people's perception of robots. These findings suggest a way of enhancing positive human-robot interaction through designing a robot's dialogue.

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