Development of Human-agent Attachment by Form of Address *

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Having an attachment is important to promote the utilization of electronic devices. To induce an emotional bond between people and voice interface, several companies have often named the voice interface. The present study examined whether a form of address (i.e., a way of calling a name of a voice agent or consumer) would modulate creating an attachment. Results showed that consumers reported a stronger attachment with voice agents that fit with the master-servant relationship based on the way of calling the name. Interestingly, this tendency was confirmed only for the behavioral index, but not for the subjective reports, suggesting that the form of address would implicitly affect the selection of behavior. Also, our findings indicate that increasing the emotional bond between consumers and voice agents could be modulated by the perception of the power balance during a human-agent interaction.

Key words :
Human agent interaction, Attachment, Address form

1. INTRODUCTION

Recently, many electronic devices are planned to have a voice agent interface. Therefore, we can speak with them directly and they support us to use the devices. Although a voice agent is a part of the device, sometimes people view the voice agent as an anthropomorphized agent because he or she can speak just like a person. Having an attachment with the agent is important for the promotion of the utilization of the device. To create such an emotional bond between people and voice interfaces, several companies provide a specific name for the voice interface (e.g., "Siri"). However, it is unclear whether naming voice agents and calling their name would affect the development of human-agent attachment. In the present study, we examined whether the form of address would modulate the attachment with voice agents by changing how to call the name.

A voice agent is a product contained within the device. Product attachment is defined as the strength of the emotional bond experienced with a product [1,2]. It implies that when people become attached to a particular product, they are more likely to handle

the product with care, repair it when it is broken, and hesitate to throw it away [2)3)]. Research have investigated what kind of factors are important for the product attachment and found that there are many determinants modulating the degree of product attachment, such as memories, pleasantness, usability and reliability of the products [4)5)]. However, these previous studies only focused on the objects (e.g., watch or bag), not for the products with a virtual agent. Recently, various interactive agents (e.g., robotic agent and embedded conversational agent) have been developed. To elicit positive affect toward the products, consumer acceptance and long-term relationships between consumers and agents, we need to consider interpersonal and social factors between the human and virtual agent inspired by human-human communication.

A voice agent is an interactive agent and they sound like a person that has specific personality traits. At the beginning of human conversation, we usually call a person by his or her name and say hello. Several companies have often named the voice interface (e.g., Siri) and consumers have to, or can, call the name in order to start conversation. This process may be able to facilitate to create such an emotional bond between the voice agent and consumers. In human communication, although there are cultural differences, we usually change the form of address (the way of calling a name) depending on the kind of interpersonal relationships between us [6)7)]. For example, in a close relationship, we call each other by the first name or nickname. But for the initial encounter, it is usually a social norm to use the surname or the titled name. Thus, how to call a name is an index of the interpersonal relationship and enables us to make an adequate relationship among people. Even in the communication between the voice agent and consumers, the form of address might also have an important role for their relationship. The present study examined how the address form of voice agent called by the consumer affects the relationships between them.

Not only consumers call the name of a voice agent, but also the voice agent calls the consumer's name. In the field of medical service (e.g., hospital), it has been shown that patients preferred to be called by their first name than by their title or surname by hospital staffs in Western culture [8)9)]. The usage of a formal name seems to be interpreted as a lack of personal interest in patients and creates an atmosphere of disconnect [10)]. The calling of a name is just one single word, but it could make an atmosphere either bad or good. In the present study, we also manipulated the address form of the consumer as well as the voice agent and examined how they interact with each other during human-agent interaction.

As an index of attachment between human and voice agent, we used not only for subjective impressions for voice agents, but also a behavioral measure by examining how a person would reluctant to throwing away the product with a certain agent. Previous research on product attachment suggested that indispensability and irreplaceability for the product are important psychological factors for an emotional bond between people and product [4)11)]. People do not want to leave the product and exchange them for a new one when they have an emotional bond with the product. Based on this notion, in the current study, we conducted the throwing-away task and measured the subjective distress associated with the behavior.

2. EXPERIMENT

2.1 Method

2.1.1 Participants. Forty people (20 females) participated (mean age = 38.93, standard deviation = 6.27). They were all healthy and had normal hearing. Since the voice agent in this experiment was introduced as a car driving agent, we recruited the

participants who were familiar with driving a car.

2.1.2 Stimulus and Designs. We prepared two types of agent systems with a female voice: Amy and Mary. They were introduced as the driving agent to support a driver and to read the scenarios related to car driving (Fig. 1). There were three types of scenarios. Along with the scenarios, participants and voice agents conversed. In these scenarios, the voice agent and participants called each other either by their first name ("XX") or their first name with a title ("XX san" in Japanese, which means "Mr./Ms. XX" in English) five times. Participants were divided into two groups: half of them called the agent with their first name, while the other half called the agent with the first name with a title throughout the experiment (between-participant factor). Yet, the address form of the participant's name by the voice agent was a within-participant factor. If the participant was called by their first name by Amy, Mary called him/her by his/her titled name, and vice versa. The form of address by the voice agent was counter balanced among the participants (Table 1).

Table 1   Matrix of the name address conditions

		Name called by agents	
	Name called by participants	*Amy*	*Mary*
Half of participants	First Name	First Name	Title Name
	Title Name		
Other half of pariticipants	First Name	Title Name	First Name
	Title Name		

2.1.3 Procedure. The participants sat in a chair in front of a table. On the table, there was a sound speaker labeled either Amy or Mary. Through this speaker, participants spoke with Amy or Mary (Fig. 2). Before the experiment, participants received the scenarios to read with Amy or Mary, and were given the explanation about the task by the instructor. After the instruction, they started having a conversation with Amy or Mary. In all scenarios, at the beginning, the participants had to call the name of the voice agent to start the conversation. During the conversation, participants called the agent's name six times. The voice agent also called the participant's first name or titled name five times. After the conversation, participants answered the questionnaire about the social impressions for the voice agent on a 10-point scale. Based on the previous study on the affective impressions for virtual agents [12], 4 rating scales (*likeability, approachability, reliability, and friendliness*) were prepared. After a short break, they had another conversation with another voice agent and answered the questionnaire again. Participants were then asked to choose which voice agent they preferred to continue to have a conversation with in the subsequent session. After the selection, they were also asked to throw the voice agent in the trash of the experimental room. Half of them threw away the voice agent that they chose, while the other half threw away the agent that they did not choose (between-participant factor). After the throwing away, participants rated their emotional distress about the throwing away on by a 10-point scale with *10* being most pain.

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U : Amy (Ms. Amy).
A : Nice to meet you. I am a driving agent and my name is Amy.
U : Amy (Ms. Amy), What is the driving agent？
A : My role is to improve safety and comfort in driving. For
example, I will inform you traffic jam information and parking
availability. In addition, I can detect your sleepiness and support
your safety driving.
U : I see. Nice to meet you, too.
A : Pleased to meet you.
A: May I have your name, please?
U: Amy (Ms. Amy), I am XX.
A: XX(Mr./Ms. XX), Where did you go by car, recently?
U : Amy (Ms. Amy), (Free Conversation e.g., Last Sunday, I went
skiing to Yamanashi.)
A : I see. XX (Mr./Ms. XX), how often do you drive per month?
U : Amy (Ms. Amy), (Free Conversation e.g., twice a month...on
weekend..)
A : I see. I will do my best so that I can support XX's (Mr./Ms. XX 's)
comfortable driving.
A : So...XX (Mr./Ms. XX), shall we go driving? A sea lion show will
be held at the Hakeijima Sea paradise (an aquarium) today.
U: Amy (Ms. Amy), sounds good. Let's go there, then.
A: XX(Mr./Ms. XX), let's go.
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Fig. 1   Example of the scenarios used in the present study. U or A signifies user's (participant) or agent's part of the scenarios, respectively. The name of voice agent in this scenario is Amy

Fig. 2   Photograph of a scene of the experiment

2.2 Results

2.2.1 The number of selections. After the conversation with Amy and Mary, all participants were asked to choose the voice agent they preferred to continue to have a conversation with in the subsequent session. The total number of this selection was first counted when the address form was a first name or a first name with a title (Fig. 3). If the address form could be related to the selection of the voice agent, the number of this selection would be changed depending on the address forms called by the voice agents.

Since each participant called the voice agent by either first name or first name with a title, we divided the participants into two groups (the first name and the first name with a title), and conducted the chi-square test for each group. Results showed that there was a significant difference of the selection number (x^2(1)=4.35, *p*=.03 (one tail)) between the first name and the first name with a title when the participants called the voice agent with just their name. The voice agent that called their titled name was more selected by the participants than the agent that simply called their name. On the other hand, we found no significant differences when the participants called the voice agent name with a title (x^2(1)=0.45, *p*=.50 (one tail)). These results suggested that the participants

wanted to continue conversations with the voice agent in the next task, when they just called the voice agent with the first name (Mary or Amy) and they were called with their titled name (Mr./Ms. XX).
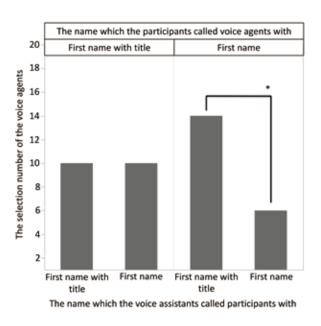

Fig. 3   The selection number of the voice agents

2.2.2 Impressions of voice agent. Averaged rating scores of the four impressions (*likeability, approachability, reliability,* and *friendliness*) for the voice agents are shown in Fig. 4. To assess the statistical significance, two-way analyses of variance were conducted for those scores by the address form of voice agent called by participant (First name and First name with a title) as a between-participants factor and the address form of participant called by voice agent as a within-participant factor (First name and First name with a title). None of the main effects and interactions were significant for all the impressions (all *F*s (1,38) < 4). These results are partially inconsistent with the results of the selection behaviors. It might mean that the selection behavior is more sensitive than the subjective rating of voice agents and that the selection and subjective rating are not related.

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2.2.3 Emotional distress of throwing away a voice agent.
After the selection of a voice agent, the participants were also asked to throw the voice agent in the trash. Half of them threw away the voice agent that they chose, while the other half threw away the agent that they did not choose. The participants then rated their emotional distress on a 10-point scale with *10* being the most painful. The mean rating score of all participants was 6.25 (SD = 2.80) suggesting that the participants were stressed to some extent about throwing the speaker in the trash. If the participant had an emotional bond with the voice agent that they selected rather than the non-selected one, emotional distress scores of throwing away the selected agent would be larger than that of the others. However, t-test analysis did not show significant differences between the selected and non-selected voice agents for the emotional distress scores ($t(38)$=0.67, p=.50, d=0.21).

In addition, to assess the effects of the address form, these scores were also posted via the two-way analysis of variance with the address form of voice agent called by participant (First name and First name with a title) as between-participant factor and the address form of participant called by voice agent as within-participant factor (First name and First name with a title). Neither main effect nor interaction was significant (all Fs (1,38) < 1).
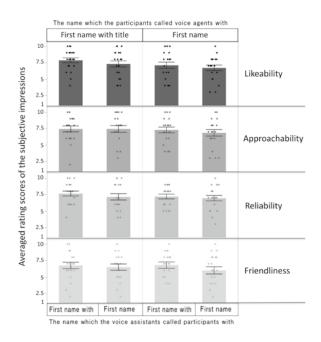

Fig. 4 Averaged rating scores of the subjective impressions (likeability, approachability, reliability, and friendliness) of the voice agents. Each error bar indicates a standard error.

3. DISCUSSION

This study examined whether the forms of address are related to making an attachment to a voice agent. Our results suggest that when there was the superiority over the voice agents by the address forms, participants wanted to keep the relationship with the voice agents. However, this tendency was not confirmed with the interpersonal impressions for the voice agents. It means the interpersonal ranking implied by the address form could affect the selection behaviors, but could not manifest in subjective rating of impression toward the agents (or speakers).

The superiority on the form of address could depend on a power perception between the voice agents and consumers. Previous studies reported that the perception of power modulates our social activities. For example, the perception of some types of power of supervisors was negatively related to the behavioral outcomes or motivations of employees [13)14)]. During

a conversation with a voice agent, participants would have an expectation that a voice agent act as a servant and participants implicitly act as a master. If the voice agent responded to the consumer's expectations, consumers would feel satisfaction with their communication and might want to keep their relationship. However, the present study did not measure subjective satisfaction or power perception during the conversation. Future research needs to examine these determinants and reveal the process resulting in the development of product attachment and selection behavior.

Participants in our experiment only interacted with the voice agents for a short duration, and it was the first encounter. Therefore, it might be expected that after further interactions their attachment to the agent might change. Although previous research on user's evaluation for virtual agents for long duration is spars, few works reported that subjective impressions for robots or virtual agents were modulated by the experience of interactions with them [12)15)]. In human communication, the form of address tends to change over time; for example, as we got to know each other better, we may call them by nickname. Future research has to show, how long-term human-agent interactions affect the preference for the form of address and modulate their relationship.

In the present study, the preference for the master-servant relationship between the consumers and voice agents was only found in the selection behavior, rather than in the subjective impressions. It has been known that social belief or attitude (such as stereotype or prejudice), is often hidden due to the lack of awareness or social-desirability bias. To assess these hidden psychological phenomena, psychologists often use implicit measures, such as an automatic behavior (e.g., Implicit Association Test [16)]). Our results could reflect a similar process of these social biases. For future, artificial agents including a voice agent are

becoming widely used to support, accompany and nurse humans, and it would be important to make a good relationship with them. Future research needs to examine how we measure psychological attitudes for artificial agents, and construct an adequate relationship in the human-agent interaction.

Another possibility of our results might be due to cultural differences. As we mentioned in the introduction, for the English-speaking world, being addressed by one's first name is a sign of friendship or an attachment, while employing a title with last name shows distance. On the other hand, in Asian culture, people usually prefer to be called by their name with a title at the first encounter [6)17)-20)]. Although how to express the emotional bond would be different between Eastern and Western cultures, there still remains the possibility that this kind of muster-servant relationship would be important for the first encounter with the virtual agent in both Eastern and Western cultures. Future research should examine how cultural characteristics concerning the preference of the form of address modulate the relationships between human-agent interaction.

4. CONCLUSIONS

Our data provide novel evidence for the idea that the way of name-calling modulates the way of making an attachment with voice agents. Results suggest that during a conversation with a voice agent, participants could have an expectation that a voice agent act as a servant and participants implicitly act as a master, and showed a stronger attachment with a voice agent that fit with the master-servant relationship caused by the form of address. Perception of power could be one of the determinants of increasing an attachment between human-agent interaction.

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