Social influence of overheard communication by life-like agents to a user

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Abstract

It is important to investigate influence of novel information technology, such as life-like agents, toward receivers of the information since some studies reveal that such novel technology can "persuade" people, in other words, they have strong power to change people's attitude and behavior. In this study, considering social influence of life-like agents' embodied expression, to a user, the influence of overheard communication (OC) by life-like agents toward online shopping Web site users was examined, since the OC by people often changes attitude of receivers. An experiment to compare the effect of OC by two life-like agents (a persuader agent and a persuadee agent) with regular communication (RC) by one persuader agent were conducted. The result of this experiment implied that even the OC by life-like agents could promote Web site users' online shopping purchase likelihood more than the RC by them. Moreover, attractiveness toward a persuader agent evaluated by participants was positively correlated with their purchase likelihood. This result suggests a new direction of studies of social influence from life-like agents, especially from a viewpoint of embodied expression of life-like agents, such as presence, gaze, appearance, and so on.

Keywords Life-like agents, embodied expression, overheard communication, social response to communication technologies, social influence

1 Introduction

Recently, there is much argument regarding influence of social interaction between users and communication technology as the communication technology prevails into our everyday life. Among such technology, a life-like agent (embodied conversational agent) has a possibility to interact with a user using embodied expression, and appeared in application softwares for presentation, Web navigation, and so on [4]. In particular, a life-like agent has potential to change a user's attitude. A life-like agent technology can be one of "interactive computing systems designed to change people's attitudes and behaviors" [5] with its many modalities. In this study, we approach life-like agent technology from the framework of life-like agents as social actors [6] applying the theories established in persuasion studies [10].

In this article, first we review the studies of social response toward life-like agents, and clarify the problem in the studies of inter-agent interaction. Second, the behavior rule called overheard communication is introduced and applied to inter-agent interaction. Then, through results of a psychological experiment, the influence and potential of overheard communication by life-like agents is discussed.

2 Related Works

2.1 Persuasion by Life-like Agents

Some studies of life-like agents as "social persuaders" already exist, however, there is still no study which focuses on the social influence of existence of inter-agent interaction. For example, André et al. [1] claimed the effect of inter-agent interaction in implementation of online car dealer agent system, but they did not argue how effective inter-agent interaction was. Moreover, Takeuchi and Katagiri [7] insisted that authorizing a life-like agent by other agent could grab a user's attention stronger than non-authorizing situation. Their study compared two inter-agent interaction styles, not existence of inter-agent interaction and absence of inter-agent interaction, and they did not mention the social influence by inter-agent interaction. Therefore, the influence of existence of inter-agent interaction toward a user's attitude change was investigated in this study.

2.2 Influence of Gaze by a Life-like Agent

Among embodied expression by a life-like agent, where the agent gaze plays a very important role in human-agent

interaction. As people pay attention to someone's eyes when interacting with him/her [2], the agent's "eyes" imply social meanings toward the user [6]. Although Reeves and Nass [6] claimed that the agent should gaze the user in front of a display since it would be the "etiquette" which the agent should obey, especially if there is inter-agent interaction, it is natural that two or more agents talk with gazing at each other. For these reasons, the influence of the agent's direction of gaze to distinguish to whom the agent talk was considered.

3 Overheard Communication by Life-like Agents

Suppose you hear the reputation of a movie in which you are not so much interesting in these two situations:

1. Your friend directly told to you that the movie was very interesting and you *must* watch it.
2. You overheard that someone told to another one that the movie was very interesting and he/she *must* watch it.

In some cases, the message from your friend may seem intrusive since your friend *directly* told you such an imposing message in situation 1. On the contrary, in situation 2, you may have interests in the movie because you did not receive someone's message directly and the message did not seem so intrusive. The persuasion style shown in situation 2, that a persuader tell another one the message, without telling the "true" persuadee, is known as *overheard communication* (OC) in persuasion studies [9, 10]. In this study, the persuasion style that a persuader directly tell the persuadee the message, represented in situation 1, is called *regular communication* (RC). Moreover, a life-like agent which behaves as a persuader is called a *persuader agent*, and a *persuadee agent* represents a life-like agent persuaded by a persuader agent in the situation of OC by life-like agents.

Considering the influence of human-agent interaction and inter-agent interaction, and the effect of OC-style persuasive communication, we implemented OC by life-like agents in the following manner:

- Let both the persuader agent and the persuadee agent appear on the screen, because users will perceive that two distinguishable social actors exist and each of them behave at their own thought.
- The persuader agent always tell the persuadee agent a message, because users will perceive the message of the persuader agent with distinguishing whom the persuader agent tell the message by where the persuader agent gazes.

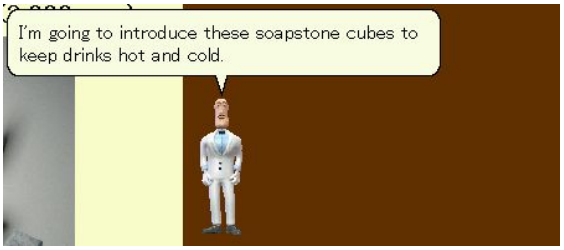

Figure 1: Explanation of characteristics of an item in RC condition

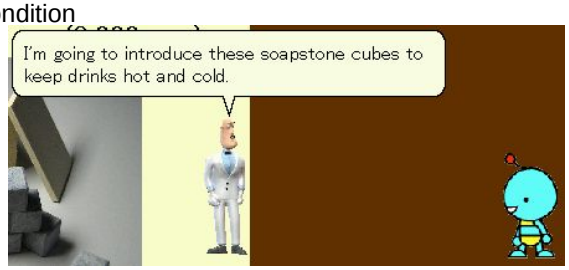

Figure 2: Explanation of characteristics of an item in OC condition

4 Psychological Experiment

4.1 Experimental Design and Prediction

In this study, we suppose two conditions for the psychological experiment. When a persuader agent explains characteristics of items, in the RC condition, it gazes toward a user in front of the screen; on the other hand, it gazes toward a persuadee agent in the OC condition. Considering the argument above, the OC by two life-like agents should promote a user's attitude change more than the RC by a life-like agent. Additionally, the OC by a persuader agent should emphasize its attractiveness which it provides more than the RC by it. Then, considering these hypotheses above, the following predictions should be determined:

P1 Participants in the OC condition will evaluate the purchase likelihood of items higher than those in the RC condition.

P2 Participants in the OC condition will evaluate the persuader agent's attractiveness which it provides higher than those in the RC condition.

4.2 Procedure

Valid experimental data were collected from 24 Japanese participants (19 males and 5 females). The participants consisted of undergraduate students, graduate students, and office workers. Their age ranged from 19 to 29.

They were randomly assigned to either RC condition or OC condition. Each condition contained equal participants.

Participants are asked to look at the explanation of items by a persuader agent on an online shopping WWW site with a note PC. In the RC condition, the persuader agent introduced items directly gazing at participants (Figure 1); in the OC condition, a persuadee agent appeared on the screen and the persuader agent introduced items gazing at the persuadee agent (Figure 2). The same item explanation phrases by the persuader agent were used in both condition. To preserve natural conversation context, the persuadee agent gave short responses to the persuader agent for each item explanation phrase in the OC condition. As introduction of each item ended, participants answered how much he/she want to purchase this item by a 10-point scale. The evaluation of purchase likelihood for the items which the participants had already possessed were omitted for analysis. The price of the items was considered so that the participant could afford to buy the item if he/she wanted it.

For all participants, the agent "James[1]" played a role of the persuader, and the agent "Cosmy[2]" played a role of the persuadee. These agents did not change their roles among participants. When participants finished the evaluation of purchase likelihood for 15 items, they answered the questionnaire about attractiveness of the persuader agent. The attractiveness was evaluated on a 10-point scale for four adjectives: kind, friendly, useful, and likable. After reporting the impression of this experiment, participants were debriefed, thanked for their participation, and dismissed. It took around 30 minutes to finish the experiment for each participant.

4.3 Result of Experiment

Mean and standard deviation values of all variables in this experiment were shown in Table 1.

First of all, the mean value of purchase likelihood scores in OC condition was significantly higher than that of RC condition. Since the difference of variance between these two variables was significant ($F(11,11) = 4.124$, two-tailed $p < .05$), Welch test was applied to confirming the significant difference between the mean values of them. As a result, the significant difference between them observed ($t(16.04) = 2.984$, two-tailed $p < .01$, $ES = 1.166$). Thus, the result supported the prediction **P1**.

However, there was no significant difference between the two condition in the score regarding impression toward the persuader agent. Despite the attractiveness score in the OC condition exceeded that in the RC condition, according to the result of two-tailed t-tests, significant difference between the two conditions did not appear in the score, as shown in Table 1. Then, the prediction **P2** was rejected by the result. Nevertheless, between the score of attractiveness and the score of purchase likelihood for each participant, there was a significant positive correlation. The values of Pearson's product-moment correlation coefficient and the significance test of these values proved there were significant correlations between the two scores for each condition (in RC condition, $r = .505$, $t(10) = 1.851$, two-tailed $p < .10$, and in OC condition, $r = .615$, $t(10) = 2.463$, two-tailed $p < .05$).

5 Discussion and Future Works

The result shown in section 4.3 suggested that the OC induced a user's purchase likelihood of products on online shopping Web site more than the RC. This result implied that life-like agents could play a role of a clerk and another customer virtually. One reason why the OC by life-like agents influenced user's attitude is because the persuader agent gazed at the persuadee agent when explaining feature of items and never gazed at the user. Therefore, the gaze of the persuader agent could be perceived as a important embodied expression to participants. In fact, one participant in OC condition reported: "It is good to see the conversation between two agents from the viewpoint of a stranger, since it may feel annoying if one agent directly talks to me." Another reason is because the persuadee agent existed on the screen. Thus, the existence of the persuadee agent could serve as a criterion for participants to consider whether they should buy the items or not. There were two participants who answered that he/she took the behavior of the persuadee agent into consideration. This fact suggests that the influence of the existence of the persuadee agent could not be ignored.

As for the impression of a persuader agent, there was no significant difference between the OC condition and the RC condition in three scores of impression. However, the scores of attractiveness is significantly correlated with the scores of purchase likelihood. This result indicated the influence of physical appearance of a persuader agent because we used the persuader agent with same appearance in both the RC condition and the OC condition. Fogg [5] argued physical appearance of life-like agents as a important factor of persuasion of a user by life-like agents, and some participants answered that the persuader agents used in this experiment looked "too strong" or "not so cute." However, participants' evaluation of attractiveness of the persuader agent was affected to their purchase likelihood both in the RC condition and in the OC condition.

[1]This agent is available at `http://www.cantoche.com/english/gallery/msagent.htm`.

[2]This agent is available at `http://www2.mic.atr.co.jp/agent/`.

Table 1: Mean (standard deviation in parentheses) values of measured variables for each condition and results of statistical tests

	RC cond. ($n = 12$)	OC cond. ($n = 12$)	t-value (d.f. $= 22$)	Effect Size (ES)
Purchase likelihood scores	4.127 (1.348)	5.421 (0.664)	2.984^{**} ★	1.166
Impression of the persuader agent	5.729 (1.760)	6.521 (1.694)	1.123	0.439

★ For the significant difference of variances between the two conditions, the t-value by Welch test was shown here (d.f. $= 16.04$). **: $p < .01$

In the OC by life-like agents, the persuader agent's gaze was functioned in the experiment. However, there are still few studies which focus on the function of a body of a life-like agent [8]. Thus, the influence of embodied expression triggered by the appearance and behavior of life-like agents is not clear so far. This influence should not only apply to human-agent interaction, but to human-robot interaction. If we hope that technology pervade many aspects of our life, we should emphasize the social aspect of human-agent interaction.

Besides, we did not mention the interactivity between a user and agents. First, this study does not consider the influence of the difference of a reaction by a persuadee agent since we focus on the existence of inter-agent interaction. Some persuasion studies reveal that the negative reaction of others toward a persuader gave people negative impression (for example, Axsom et al. [3]). The valence of reaction of a persuadee agent can influence the decision of users, and should be considered in future works.

In this study, we discussed the influence and potential of overheard communication by life-like agents. Particularly, it is pointed out that embodied expression, especially existence of the persuadee agent and the direction of the persuader agent's gaze, played an important role in the overheard communication by life-like agents. From the stance of social influence of the embodied expression of life-like agents to a user, the way to utilize life-like agents for the voluntary attitude change of users should be explored in the future.

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