

Gradual development of human-agent social relationship

Satoshi V. Suzuki (ssv@ntt.dis.titech.ac.jp)

DCISS, IGSSE, Tokyo Institute of Technology; J2-53, 4259 Nagatsuta
Midori-ku, Yokohama 226-8502 Japan

Hideaki Takeda (takeda@nii.ac.jp)

National Institute of Informatics; 2-1-2, Hitotsubashi
Chiyoda, Tokyo 101-8430 Japan

To maintain sound social relationships between people and social actors including robots, embodied agents, and computers, both parties in any relationship should continue to have equal social positions. In other words, the social actor should serve as the human's "teammate" (Fogg, 2003) and not be thought of as a "slave." To enable the social actor to remain the human's "teammate," the human and the social actor should communicate with an appropriate amount and quality of information. That is, the social actor should not do such things as behave embarrassingly, make the human interactant think more deeply, or make him/her speculate what it really intends. For example, designing a robot is only to obey commands from the interactants should be avoided. The human interactant and the social actor should cooperate to accomplish the same task by sharing roles in the task. In this article, a model of human-robot social relational development is suggested. This model specifies what kind of information an embodied agent should offer to the interactant. The process of human-agent relational development through human-agent interaction is also examined, with a view to gearing interactions toward developing positive relationships.

Human-agent relationships should develop gradually. Human social relationships between two people develop with consideration of their existing closeness (Knapp & Vangelisti, 2005). For example, a person will communicate in a conventional way with others upon meeting for the first time ("initiating" stage of interaction), but once he/she opens up to the others, he/she chooses to show friendliness when communicating with them ("experimenting" stage of interaction). In this process, the person is always paying attention to the social relationship between himself/herself and the others. Similarly, an embodied agent should distinguish the interaction style with close interactants from that with strangers. In fact, in a psychological experiment of a human-computer social interaction study, participants preferred a gradual way of human-computer relationships to an abrupt way of developing them (Moon, 2000). This result suggests that the principle of gradual relationship development can be applied to human-robot interaction design. Through such a gradual relationship development, an interactant should find a novel viewpoint from a social actor and brush up his/her own thought with the social actor.

Another basis of the principle of gradual human-agent

relationship development is human cognitive structure. People often behave as if they act according to a script, that is, they often cause action based on "social scripts" without consideration (Langer, Blank, & Chanowitz, 1978) until they are aware that they should consider what happens around themselves. When a person communicates with others in the "initiating" stage, he/she will talk to others in a script-like, conventional way without trying to discover unknown information about others in most cases. In this case, the person does not have to worry about what to ask others. Then he/she will start asking others questions about unknown information about them when the stage of human interaction switches to the "experimenting" stage. To ask such questions, the person should consider whether the questions are suitable for the others to ask in this situation, and this consideration should be cognitive burden for him/her. In this article, the situation that people should consider what happens around themselves and robots is defined as the *threshold of consideration*, since such consideration often make the human-robot relationship worse until the interactant's credibility for the robot is not enough. Sundar and Nass (2000) discovered this threshold of consideration in human-computer interaction. In the experiment in their study, participants were told that they were interacting either with a computer itself or with a human interactant (e.g., a programmer or an informant over the network). The participants preferred interacting with the computer itself to considering the human interactant while interacting with the computer. This implication gives another aspect to Imai and Narumi (2005). In their study, a humanoid robot gave a participant a chocolate and a bottle of tea, either with telling them that these were delicious, or without telling so. As a result, the participants who were told by the robot that the chocolate and the tea were delicious tended to have anything that the robot recommended, but those who were not told so were not likely to do so. They concluded that the interactants read the robot's "mind" when the robot told them about preference of a certain item. However, it is possible to explain their finding by saying that the participant unconsciously obeyed the "social script" that people unconsciously tend to behave based on others' preference (Cialdini, 2001). Nevertheless, if the interactant's judgment of the credibility of the robot is high enough because of much interaction between them, such attempts of the robot to inter-

act with him/her beyond the threshold of consideration cause strong closeness between the interactant and the robot.

In this study, the influence of “mind-reading” of an embodied agent was investigated through a psychological experiment. As a study of interaction between a human interactant and a social actor, the argument of social response to the embodied agent should contribute to the human-robot social interaction design. A thought balloon emitted from the embodied agent for the human interactant to input its “mind” was focused on, since the thought balloon is a universal expression to express what a character thinks without utterance (Harrison, 1981). Through the comparison among three situations — the situation in which a blank thought balloon appeared, the situation in which a blank speech balloon appeared to let a participant guess what the embodied agent would say, and the situation in which no blank balloon appeared — the influence of “mind-reading” to an embodied agent was examined. Two competing agents, agent *A* and agent *B*, appeared to help the participant accomplish a task and then he/she evaluated the quality of their help. Before the evaluation, when agent *A* persuaded the participant to evaluate it higher than agent *B*, agent *B* emitted a blank balloon, either for speech or for thought, or answered for agent *A* in accordance with experimental conditions. Participants were assigned either of these conditions. Finally, the content of the thought balloon filled in by the participant was longer, and depicted agent *B*’s “mind” more intently than did the content of the speech balloon. Thus, despite the blank thought balloon served to induce the participant to read agent *B*’s “mind,” the participants who filled in the blank thought balloon gave agent *B*’s help a lower evaluation than did those who filled in the blank speech balloon. Besides, the participant who filled in the blank speech balloon evaluated agent *B* higher than did those were not required to fill in any blank balloon, although no significant difference was not observed between them.

The result of the psychological experiment implies that requiring abrupt “mind-reading” to the social actor can damage the social relationship with the interactant. Filling in the blank thought balloon emitted from an embodied agent without enough prior interaction with that agent seems to be beyond the threshold of consideration for the interactant. While the situation — that agent *A* and agent *B* were competing with each other — may have had some influence on the relationship, considering the argument on threshold of consideration, abrupt “mind-reading” induced by the blank thought balloon emitted from the embodied agent weakened the social relationship between the human interactant and the embodied agent. Although the prompt to read robot’s “mind” should be different from the agent’s, the situation in which an interactant needed to abruptly read the “mind” of the robot seems to have been harmful to the human-robot social relationship. Moreover, the participants who filled in the blank speech balloon evaluated agent *B*’s help higher than did those in other conditions. This result suggests that filling in the blank speech bal-

loon functioned as human-agent interaction under the threshold of consideration in this experimental environment. However, the experiment did not examine whether the explicit inspection of the agent’s thought after this interaction promotes or damages the human-agent social relationship. The change of the threshold of consideration in human-agent interaction should be taken into account with empirical approaches.

This study investigated the process of the gradual development of human-agent social relationships. To examine this process, the psychological experiment of interaction between a participant and an embodied agent was conducted to inspect the influence of “mind-reading” by a human interactant to a social actor on their relationship. The experimental results suggest requiring that abrupt “mind-reading” to the embodied agent negatively influences the interactant. A gradual way of encouraging human interacts to read the “mind” of the embodied agent should thus be investigated further. This would contribute to the gradual development of social relationships between human interactants and social actors.

References

- Cialdini, R. B. (2001). *Influence: Science and practice* (4th ed.). Boston, MA: Pearson Allyn and Bacon.
- Fogg, B. J. (2003). *Persuasive technology: Using computers to change what we think and do*. San Francisco, CA: Morgan Kaufmann Publishers.
- Harrison, R. P. (1981). *The cartoon: Communication to the quick*. Beverly Hills, CA: Sage.
- Imai, M., & Narumi, M. (2005). Immersion in interaction based on physical world object. In *The 2005 International Conference on Active Media Technology (AMT2005)* (pp. 523–528).
- Knapp, M. L., & Vangelisti, A. L. (2005). *Interpersonal communication and human relationships* (5th ed.). Boston, MA: Allyn and Bacon.
- Langer, E. J., Blank, A., & Chanowitz, B. (1978). The mindlessness ostensibly thoughtful action: The role of “placebic” information in interpersonal interaction. *Journal of Personality and Social Psychology*, 36, 635–642.
- Moon, Y. (2000). Intimate exchanges: Using computers to elicit self-disclosure from consumers. *Journal of Consumer Research*, 26, 323–339.
- Sundar, S. S., & Nass, C. (2000). Source orientation in human-computer interaction. *Communication Research*, 27(6), 683–703.