Inducing change in user's perspective with the arrangement of body orientation of embodied agents

Satoshi V. Suzuki and Hideaki Takeda

Abstract— **We set out to reveal that arrangement of embodied agents' body orientation can influence the perception of body schema and the thought of users. Embodied agents are one type of media that can socially appeal to the user's intuitive thought, especially through their body expression. We focused on embodied agents' body orientation as a means to induce the user to perceive his/her body schema inside virtual space and to accept the perceived thought of an embodied agent. A psychological experiment was conducted, since arrangement of body orientation between two people or between a user and an embodied agent often influences the social relationship between them. The result of the experiment suggested that an embodied agent whose thought was different from the user's at first and whose body orientation corresponded with the user's could trigger the user's consideration of its opinions more strongly than when this agent showed the side of its body to the user. However, difference in the perception of the body schema in virtual space by the agent's body orientation arrangement was not observed. We investigated the relation between body orientation of embodied agents and change in user's perspective, and suggested a design principle embodied agents' body orientation for enhanced association between the agent and the user.**

I. INTRODUCTION

Social artifacts, such as robots, computers, embodied agents, and so on, should be function as "peer" of human interactants to succeed communicating socially. For example, designing social artifacts as "teammates" can make interaction with people smooth [1], [2], and make people change their attitude and behavior [3]. In this case, people can regard a social artifact as their peer by the social role of "teammates." Another study tried to express the embodied agent as user's peer by showing facial expression that matched his/her emotion [4]. Social artifacts as interactant's peer designed in these way can promote and maintain good relationship between the interact and them. Therefore, inventing explicit principles to enable social artifacts to function as peer of an interactant is needed.

We focused on embodied agents among many social artifacts. While software for Web navigation, presentations, and interactive drama, in which embodied agents appear, has been increasing [5], [6], few studies have paid attention to embodied agents' body expression besides verbal information which can influence user's attitude and behavior [7], [8]. Thus, investigating the social influence of embodied agents via their body expression is meaningful. Especially, we inspected their body orientation of embodied agents among such body expression. By showing the back of an embodied agent so that the gaze direction of the user matches the body orientation of the embodied agent, we attempted to express that the embodied agent is user's peer. We conducted a psychological experiment focusing on how the user accepts the thought of an agent whose body orientation corresponds with the user's in order to determine how the body orientation of the embodied agent influences the user's perception.

In this article, first, we review some studies on body orientation of people and embodied agents. Second, we propose the hypothesis that the body orientation of embodied agents influences the user's thoughts. Third, based on this hypothesis, we describe the psychological experiment that we conducted to examine the influence of the body orientation of embodied agents on the user's attitude toward the agents' opinions. In the context of the results of the experiment, we then discuss the social influence of the body orientation of embodied agents and the possibility of interaction design that lets a user consider another's thoughts as much as possible.

II. RELATED WORKS

In this section, through discussion of studies regarding social influence of the body orientation both of people and of embodied agents, we clarify the existence of relation between the user's perception of perspective of embodied agents and the arrangement of body orientation of a user and embodied agents.

A. Influence of human body orientation

Two people arranging their bodies in the same orientation can mean that they share the same perspective. When one person who has leadership in a group, the other members of the group tend to talk to others located beside themselves [9]. In addition, two people given a task to solve collaboratively are prone to sit down side by side [10]. Actually, in some stores, mainly those selling jewelry and cosmetics, customers and clerks can match their body orientations by removing a counter [11]. In such an environment, the customer can regard the clerk as more familiar than when the customer and the clerk are face-to-face over the counter. This evidence suggests that matching body orientation between two people means that they are close.

We predicted that correspondence of body orientation between a user and an embodied agent enable the user to share social perspective with the embodied agent, and induce

S. V. Suzuki is with Department of Computational Intelligence and Systems Science, Interdisciplinary Graduate School of Science and Engineering, Tokyo Institute of Technology, J2–53, 4259 Nagatsuta, Midori-ku, Yokohama 226–8502, Japan ssv@ntt.dis.titech.ac.jp

H. Takeda is with National Institute of Informatics, 2–1–2 Hitotsubashi, Chiyoda, Tokyo 101–8430, Japan takeda@nii.ac.jp

the user to change his/her attitude to accept the embodied agent's opinion.

B. Influence of embodied agents' body orientation

Designing embodied agents showing their back to a user has been regarded as impolite to the. This is because showing their face to the user and keeping eye contact with the user are seen as "etiquette" that embodied agents should obey [1]. Nevertheless, some studies mention the influence of embodied agents' body orientation. Based on the results of a psychological experiment, Miyazaki [12] insisted that a character depicted from a perspective behind it in a picture book induced the reader to imagine the context of story considering the character in the book more than when the story was presented from a perspective at the side of the character. through a result of a psychological experiment. Okamoto et al [13] claimed that an embodied agent that showed its back to a user should provoke empathy from the user toward the embodied agent. None of these studies, however, used empirical evidence to argue, that the correspondence of body orientation of an embodied agent with that of a user triggers the user to accept the opinion of the embodied agent.

Some studies assert the contrary position that people tend to focus on the figure of a person that shows its front in pictures [14] and movies [15]. A user may indeed feel motivated to consider the opinion of an embodied agent when it expresses interest by facing him/her when it is trying to persuade him/her [8]. Thus, we also examine whether the embodied agent that shows its front socially influences the user.

Consequently, this study deals with the user and the embodied agent in the same perceived social relationship and the acceptance of the embodied agent's perspective by the user, focusing on the arrangement of their body orientation.

III. TWO LEVELS OF PERSPECTIVE

We use the terms on perspective based on Vogeley and Fink [16]. There are two levels of description in perspective. One is *phenomenal level* which refers to perspective on a visual scene; the other is *representational level* which mentions perspective on a cognitive level conceptualized by the observer.

Some studies already exist that where the perspective of a user and embodied agents should take in virtual space at the phenomenal level (for example, He et al [17]). However, these studies did not consider where the user perceived he/she was in the virtual space. In other words, no studies attempted to discover user's *body schema* in the virtual space when interacting with embodied agents. Considering arguments in section II, we suggest the hypothesis that perspective sharing between the user and the embodied agent at the phenomenal level can induce a change in the user's perspective in the representational level so that the user accepts the agent's perceived perspective, and consequently the user can regard the embodied agent as user's peer.

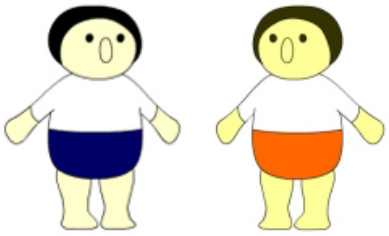

Fig. 1. *Con*-agent (left) and *Pro*-agent (right)

IV. PSYCHOLOGICAL EXPERIMENT

We expected that the degree of the user's perception of the same social relationship with an embodied agent would be reflected in how much the user accepted the opinion of the embodied agent. The degree of acceptance of the embodied agent by the user was measured in an experiment conducted as follows.

A. Predictions

Based on the hypothesis that opinions of an embodied agent regarded as social entity which share perspective with a user at the representational level tend to be accepted by the user, we predicted result of the experiment:

P1 A user will change his/her opinion to agree with an agent whose body orientation matched with his/her own.

P2 A user will evaluate an agent whose body orientation matches with his/her own as better than other agents whose body orientation does not agree with his/hers.

B. Experimental design

In this experiment, two embodied agents shown in Figure 1 appeared as represented in Figure 2–4. One of the embodied agents, which appeared on the right side of each figure, is called ***Pro*-agent**, and the other one is called ***Con*-agent** in this article. The *Pro*-agent always agreed with the participant's opinion, while the *Con*-agent always disagreed with it. They were standing face-to-face over a table, but the perspective that a participant could take was different dependent on which condition he/she was assigned to. In the ***Con*-behind** condition (Figure 2) and the ***Pro*-behind** condition (Figure 4), the participant took the perspective from behind the *Con*-, or the *Pro*-agent, respectively. On the contrary, the participant took the perspective from between the two embodied agents so that he/she could see side of its body in the **Square** condition (Figure 3). Participants were assigned one of these conditions randomly. Then, one independent variable (the perspective that the participant could take in the virtual space, between-participant factor) existed.

C. Procedure

Forty-eight Japanese undergraduate and graduate students (24 males and 24 females, mean age: 24.3 (SD: 4.46) years

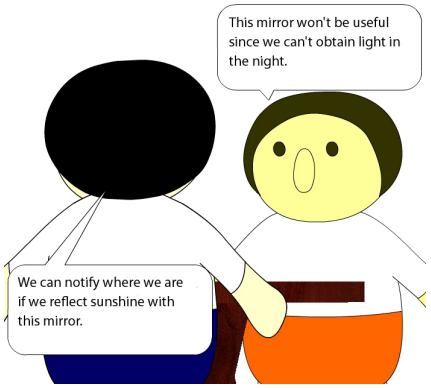

Fig. 2. Body arrangement of two agents in ***Con*-behind** condition

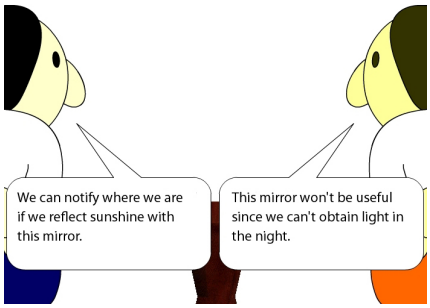

Fig. 3. Body arrangement of two agents in **Square** condition

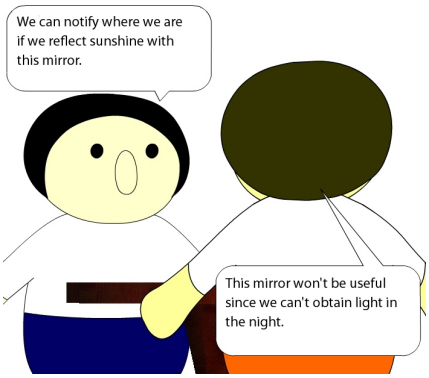

Fig. 4. Body arrangement of two agents in ***Pro*-behind** condition

old) participated in this experiment. All of the participants had been using PCs and browsing the WWW for at least 2 years. They were randomly assigned to one of three conditions explained in Section IV-B. Thus, for each condition, there were 16 participants (8 males and 8 females).

First of all, each participant solved the desert survival problem [18]. We used this task because this has been used in other studies [3], and we thought that it could easily produce a difference of opinion between the two embodied agents without crucial noise factors. For the 14 items (flashlight, jackknife, sectional air map, raincoat, magnetic compass, compress kit, pistol, parachute, salt tablets, water, book entitled "Edible Animals of the Desert," vodka, top coat, and cosmetic mirror), the participant ranked each of items depending his/her opinion on how important they were for survival. The participant input the rank of each item in a laptop PC and then the *Pro*-agent ranked the items the same as the participant, while the *Con*-agent ranked the items so that the rank of each item was different from that which the participant chose. The ranking of the *Con*-agent was determined automatically. For example, if the participant ranked item *A* as number 2, *A*'s ranking by the *Con*-agent was number 8 regardless of what item *A* was. Based on the ranking decided in this process, for each item, the embodied agents suggested why they had ranked the item higher (or lower) than the other in randomized order. The speech of the embodied agents was shown to the participant solely with text in speech balloons; no acoustic medium was used in this experiment. The speech balloons for the embodied agents did not appear simultaneously. One of the balloons appeared first with animation in which the embodied agent that was speaking nodded. Then the other speech balloon appeared with animation in which the embodied agent that was speaking shook its head. Which of the embodied agents started to speak first was decided randomly, but the frequency with which each agent spoke first was the same. That is, for 7 items randomly chosen, the *Pro*-agent was first to suggest its opinion about the item's rank, and for the others, the *Con*-agent was first to tell its opinion. The participant could change the ranking of the items if he/she wanted to do so after considering the two embodied agents' opinion. The two embodied agents were implemented with Macromedia Flash and embedded in a Web page displayed with Mozilla Firefox (full screen mode), and experimental data were collected via the WWW with the CGI program. After finishing modifying the item ranking, the participant evaluated the impression of the two embodied agents and their inter-agent interaction with the paper-and-pencil questionnaire. Finally, the participant was debriefed, thanked for his/her participation, and dismissed. The experiment took around 30–40 minutes for each participant.

V. RESULTS

In this section, based on analyses of the results of the experiment, the data is discussed in detail.

A. Measures

First, as measures of attitude change, we classified the participants' ranking of items in the following manner. For example, any item ranked as number 3 by a participant and the *Pro*-agent was ranked as number 6 by the *Con*-agent. In this case, if the participant modified the rank of this item higher than number 2, this item was classified as *items whose ranking were changed with the* Pro-*agent's opinion* (*P*); if he/she modified the rank lower than number 4, it was classified as *items whose ranking were changed with the* Con-*agent's opinion* (*C*). On the contrary, for the case that an item ranked as number 10 by a participant and *Pro*-agent and ranked as number 7 by *Con*-agent, if the participant modified ranking of this item higher than number 9, this item was classified as *C*; if he/she modified the ranking of this item lower than number 11, it was classified as *P*. Any items for which the participant did not modify the ranking, the items were classified as *items whose ranking was not changed* (*N*). We adopted this measure to inspect more subtle attitude change of the participant than rank correlation coefficient between the initial ranking and the final ranking like Nass et al [2].

Evaluation of each embodied agent's impression consisted of twenty-nine 7-point scale questions. The questionnaire

was made taking into account previous studies [2], [8]. Then, we adopted three indices suggested by factor analysis.

Perceived similarity This represented the user's perceived similarity to the embodied agent. It was an index of ten items: perceived similarity of final rankings to the embodied agent's hypothetical final ranking, relevance of thought, acceptance of the embodied agent's advice, perceived similarity of approach, perceived similarity of interaction style, perceived similarity of final ranking to the embodied agent's initial ranking, perceived similarity of initial rankings, receptivity to the embodied agent's suggestions, degree of empathy to the embodied agent, and perceived similarity of suggestions (Cronbach's $\alpha = .945$).

Perceived intelligence This expressed the user's perceived intelligence to the embodied agent. This index is made from eight items: capability of the embodied agent, trust in the embodied agent's information, helpfulness of the embodied agent's information, articulateness of the embodied agent's suggestions, intellectuality of the embodied agent, insightfulness of the embodied agent's information, dependence on the embodied agent's suggestions, and cleverness of the embodied agent ($\alpha = .896$).

Friendliness This regarded the user's perceived friendliness of the embodied agent. This consisted of two items: warmth, and kindness of the embodied agent (Pearson's $r = .909$).

B. Attitude change

Table I indicates how many items for which each agent was and was not change the participants' ranking. The result of a χ^2-test revealed that there was significant difference in the distribution of three variables among these three conditions ($\chi^2(4) = 15.34,\ p < .01$). Moreover, the number of items whose rankings were changed with the *Pro*-agent's opinion was significantly highest in the ***Con*-behind** condition (adjusted residual: $z = 1.79,\ p < .10$), and lowest in the **Square** condition ($z = -2.68,\ p < .01$) among the three conditions. Meanwhile, the number of items whose ranking were not changed was significantly lowest in ***Con*-behind** condition ($z = -3.16,\ p < .01$) and highest in **Square** condition ($z = 3.38$, $p < .01$) among three conditions. Additionally, in the ***Con*-behind** condition, the number of items whose ranking changed with *Con*-agent's opinion was significantly higher than other conditions ($z = 1.88$, $p < .10$).

C. Evaluation based on impression of two embodied agents

Table II shows result of evaluation based on participants' impressions of the embodied agents. To analyze these results, we applied split-plot design that consisted of two independent variables: embodied agents (within-participant factor)

$$EA = \{Pro\text{-agent}, Con\text{-agent}\}$$

and experimental conditions (between-participant factor)

$$EC = \{\textbf{\textit{Pro}-behind}, \textbf{Square}, \textbf{\textit{Con}-behind}\}$$

when conducting two-way analysis of variance for each dependent variable.

First, for each condition, the evaluation of the similarity of the *Pro*-agent was higher than that for the *Con*-agent. Indeed, according to 2×3 two-way analysis of variance, the main effect of *EA* was significant ($F(1,45) = 97.90$, $p < .001$). However, there was no interaction between the experimental condition factor *EC* and the embodied agent factor *EA*, then no influence from experimental condition should appear. Second, while Table II shows that the evaluation of the intelligence of *Pro*-agent was slightly higher than that of the *Con*-agent, this difference was not significant ($F(1,45) = 1.862$, *n.s.*). Finally, according to Table II, on the evaluation of the friendliness of the *Con*-agent, the participants in the ***Con*-behind** condition evaluated the *Con*-agent lower than did those in other condition, despite the fact that there seemed to be little difference in the evaluation of the friendliness of the *Pro*-agent among the three conditions. Actually, interaction between *EC* and *EA* was significant ($F(2,45) = 2.957,\ p < .10$). Thus, examining the significance of difference of *Con*-agent among the experimental conditions by testing simple main effect with Tukey's HSD, a significant difference between the ***Con*-behind** and the **Square** condition found ($p < .10$).

VI. DISCUSSION AND FUTURE WORK

Considering the result of our psychological experiment, we discuss the user's perspective change at the representational level by the perspective sharing with the embodied agent at the phenomenal level, the change of the impression that the user has of each embodied agent, and user's motivation to involve interaction between the embodied agents. We also suggest future works in this section.

A. Social influence of embodied agents' body orientation on a user

As discussed in Section V-B, we observed a tendency for the participant to change his/her opinion with the embodied agent whose body orientation corresponded with his/hers. Then, the prediction **P1** was partially supported since participants in ***Con*-behind** condition changed their opinion more often than those in **Square** condition. This may be because the rank correlation represented not only the acceptance of embodied agent's perspective by the participant at the representational level, but a kind of amount of externalized thought. One reason why the participants in the ***Pro*-behind** condition changed their opinion (not significantly, nevertheless) more than those in **Square** condition was that the existence and arrangement of body orientation of the *Pro*-agent provoked the participant to participate in the activity of desert survival problem; the participants in the **Square** condition did not much change their opinions. Especially, three of the participants did not change his/her opinion at all in spite of the embodied agents' interaction. Contrary to the prediction, participants in the ***Con*-behind** condition changed their ranking of the items considering the *Pro*-agent's opinion more than in the other two conditions. This

TABLE I

FREQUENCY OF CHANGE DIRECTION OF EACH ITEM'S RANKING

	Total number of items classified as			
	P	*N*	*C*	Total
***Con*-behind** ($n = 16$)	77	91	56	224
Square ($n = 16$)	52	131	41	224
***Pro*-behind** ($n = 16$)	72	109	43	224
Total	201	331	140	672

TABLE II

MEAN (SD IN PARENTHESES) FOR VARIABLES ABOUT EVALUATION BASED ON EMBODIED AGENTS' IMPRESSION

	***Con*-behind** ($n = 16$)	**Square** ($n = 16$)	***Pro*-behind** ($n = 16$)
Perceived similarity			
Pro-agent	5.32 (0.92)	5.15 (0.99)	5.14 (1.23)
Con-agent	3.05 (0.92)	3.19 (0.70)	3.07 (0.83)
Perceived intelligence			
Pro-agent	4.49 (0.95)	4.27 (0.76)	4.42 (1.14)
Con-agent	4.14 (0.88)	4.20 (0.91)	4.09 (0.87)
Friendliness			
Pro-agent	4.47 (1.27)	4.06 (0.79)	4.09 (1.13)
Con-agent	2.53 (1.23)	3.44 (1.15)	3.19 (1.03)

may be interpreted as a side effect of the ranking change of the items considering the *Con*-agent's opinion, but the influence of the difference of the degree of paying attention to the *Pro*-agent's opinion can be possible since a user can regard an embodied agent that shows its front to him/her as important, as argued in Section II-A. Therefore, motivation to participate in an activity should be examined separately from acceptance of the embodied agent's mental state, and the influence on such motivation of the perspective of the embodied agent at the phenomenal level should be examined. This argument is relevant to user's perceived body schema in virtual space in which embodied agents appear, and discussed in Section VI-C.

Additionally, we should mention that whether the influence of body orientation correspondence between a user and an embodied agent continues is unknown. If the user interacts with an environment where embodied agents appear and some of them match their body orientation with the user's for a long time, whether the influence of body orientation correspondence between them is reinforced or diminished cannot be judged with a psychological experiment inside a laboratory in the limited time of half an hour. Therefore, observation of interaction between the user and an environment in which embodied agents appear for a long time is needed, and establishing a technique to examine such kind of influence should be indispensable.

B. Influence of body orientation and impression of embodied agents

Generally, considering the result of impression evaluation of embodied agents discussed in Section V-C, the impression of embodied agents should be influenced mainly by the perceived thought of each embodied agent. Thus, the prediction **P2** was rejected. In most cases, regardless of experimental conditions, participants evaluated the *Pro*-agent higher than the *Con*-agent in the impression evaluation. This result suggests that what kind of role each of embodied agents is assigned what they are designed strongly influences the user's perceived impressions about each of embodied agents.

Nonetheless, some influence of the body orientation of an embodied agent on the user's impression was seen to exist. Participants in the ***Con*-behind** condition evaluated the friendliness of the *Con*-agent to be slightly lower than they did in the **Square** condition. This result partially contradicts prediction **P2**, but allowing for the result that participants in **Square** condition evaluate the friendliness highest of the three experimental conditions, body orientation of embodied agents unfamiliar with a user should be designed not to match the body orientation with the user, and to enable the user to show agents' face. While Suzuki and Yamada [8] discussed the negative effect of embodied agent's direct gaze to the user, however, hiding embodied agent's face to the user can elicit him/her to perceive unfamiliarity toward the embodied agent. This result suggests that we should design embodied agents which do not directly interact with a user from the aspects of body orientation and gaze.

In this experimental environment, the possibility of existence of influence from perceived distance between the user and the embodied agents cannot be denied. If there are two agents and arranged as Figure 2 or Figure 4, one of them which shows its front should be perceived as more distant than the other. To exclude the influence of perceived distance between the user and the agent, as well as to extract the influence of body orientation of the agent more accurately, the influence of body orientation if only one agent appears on the screen should be examined.

C. Motivation of a user to participate embodied agents' activity

In the psychological experiment conducted, we adopted some measures regarding to ranking change in the desert survival problem. However, these measures may consist of at least two factors: the effect of how much a user accepts to an embodied agent's thought and his/her level of enthusiasm to participate in solving the problem with the embodied agents. The latter factor probably led to the result that the participants in the ***Con*-behind** condition modified their ranking of the items considering the *Pro*-agent's opinion more than they did in the other two conditions, as pointed out in Section VI-A. Then, other means to examine the user's level of motivation to solve the problem with the embodied agents should be explored with behavioral measures.

Strategies to tacitly encourage a user to get involved in the embodied agents' activity with visual expression other than the body orientation of the embodied agents should be explored, since how much the user is involved in the embodied agents' inter-agent interaction can depend on how his/her body schema is perceived in virtual space. Taking into account the result of the psychological experiment, it should be insufficient only with body orientation correspondence with an embodied agent to induce body schema in virtual space to the user so that he/she perceive his/her body and the agent's body are side-by-side. It may be able to explicitly express user's body schema in virtual space which embodied agents appear if user's virtual body partially appears, or the user can directly manipulate an object (letting embodied agents have cards and enabling the user to move them, for example) in this environment. Thus, the perceived body schema of the user in virtual space can be relevant to his/her motivation to get involved with the embodied agents' activity, and relationship between these should be examined.

VII. CONCLUSION

We have examined that social influence of the body orientation of embodied agents from the standpoint of the acceptance of the embodied agents' opinion by a user. The result of our psychological experiment suggested that an embodied agent's opinion that was different from the user's was acceptable for the user when body orientation of the embodied agent corresponded with one of the user, compared to the environment in which the body orientation of the embodied agent and the user did not match. Through further experiments on the process of interaction between a user and embodied agents, influence of body orientation of embodied agents and perception of body schema in virtual space in a long time span should be discovered. Moreover, focusing not only on acceptance of embodied agents' opinion by a user, but on eagerness of the user's involvement into embodied agents' inter-agent interaction should be considered crucial when designing environments in which embodied agents appear. Finally, we aim to discover design principles of embodied agents' body expression that can let a user understand others' mental perspective that are different from him/her.

ACKNOWLEDGMENTS

We would like to express our gratitude to those who participated in our psychological experiment in this study, and those who cooperated in recruiting the participants and offered a space for the experiment. Also, we would like to thank to Yugo Takeuchi in Shizuoka University and Hirokata Fukushima in the University of Tokyo for their valuable advice for this study.

REFERENCES

[1] B. Reeves and C. Nass, *The Media Equation: How people treat computers, television, and new media like real people and places*. New York: Cambridge University Press, 1996.

[2] C. Nass, B. J. Fogg, and Y. Moon, "Can computers be teammates?" *International Journal of Human-Computer Studies*, vol. 45, no. 6, pp. 669–678, 1996.

[3] B. J. Fogg, *Persuasive Technology: Using Computers to Change What We Think and Do*. San Francisco, CA: Morgan Kaufmann Publishers, 2003.

[4] Y. Morishima, H. Nakajima, S. Brave, R. Yamada, H. Maldonado, C. Nass, and S. Kawaji, "The role of affect and sociality in the agent-based collaborative learning system," in *Affective Dialogue Systems, Tutorial and Research Workshop, ADS 2004*, ser. LNAI 3068, E. André, L. Dybkjær, W. Minker, and P. Heisterkamp, Eds. Kloster Irsee, Germany: Springer, 2004, pp. 265–274.

[5] J. Cassell, J. Sullivan, S. Prevost, and E. Churchill, Eds., *Embodied Conversational Agents*. Cambridge, MA: MIT Press, 2000.

[6] H. Prendinger and M. Ishizuka, *Life-Like Characters: Tools, Affective Functions, and Applications*. Berlin: Springer, 2004.

[7] Y. Takeuchi, K. Watanabe, and Y. Katagiri, "Social identification of embodied interactive agent," in *Proceedings of the 13th International Workshop on Robot and Human Interactive Communication (ROMAN-2004)*, Kurashiki, Japan, 2004.

[8] S. V. Suzuki and S. Yamada, "Persuasion through overheard communication by life-like agents," in *Proceedings of the 2004 IEEE/WIC/ACM International Conference on Intelligent Agent Technology (IAT'04)*, Beijing, China, 2004, pp. 225–231.

[9] G. Hearn, "Leadership and the spatial factor in small groups," *Journal of Abnormal Psychology*, vol. 54, no. 2, pp. 269–272, 1957.

[10] R. Sommer, *Personal Space: The Behavioral Basis of Design*. Englewood Cliffs, NJ: Prentice Hall, 1969.

[11] P. Underhill, *Call of the Mall*. New York: Simon & Schuster, 2004.

[12] K. Miyazaki, "The effect of the ghost-at-the-back's point of view on the empathic understanding in visual media," *Bulletin of Otsuma Women's University, Home Economics*, vol. 30, pp. 161–173, 1994, (in Japanese).

[13] M. Okamoto, K. Okamoto, Y. I. Nakano, and T. Nishida, "Supporting the creation of immersive CG contents with enhanced user involvement," in *Proceedings of the Symposium on Conversational Informatics for Supporting Social Intelligence and Interaction — Situational and Environmental Information Enforcing Involvement in Conversation, AISB'05: Social Intelligence and Interaction in Animals, Robots and Agents*, Hatfield, UK, 2005, pp. 87–96.

[14] J. P. Spiegel and P. Machotka, *Messages of the Body*. New York: Free Press, 1974.

[15] D. Arijon, *Grammar of the Film Language*. London: Focal Press, 1976.

[16] K. Vogeley and G. R. Fink, "Neural correlates of the first-person-perspective," *Trends in Cognitive Sciences*, vol. 7, no. 1, pp. 38–42, 2003.

[17] L. wei He, M. F. Cohen, and D. H. Salesin, "The virtual cinematographer: a paradigm for automatic real-time camera control and directing," in *Proceedings of the 23rd annual conference on Computer graphics and interactive techniques*, 1996, pp. 217–224.

[18] J. C. Lafferty and P. M. Eady, *The desert survival problem*. Plymouth, MI: Experimental Learning Methods, 1974.