Takeuchi, Y. and Y. Katagiri, "Social Character Design for Animated Agents," in RO-MAN99. 1999.

Social Character Design for Animated Agents

Yugo Takeuchi Yasuhiro Katagiri

ATR MI&C Research Laboratories
Kyoto 619-0288, Japan
Tel: +81-774-95-1401 Fax: +81-774-95-1408
E-mail: yugo@mic.atr.co.jp, katagiri@mic.atr.co.jp

Abstract

Interface agent technologies have been aiming to provide people with a natural means to interact with computers and other electronic media. By combining with the human collaboration technologies, interface agents can also be employed to help manage, support and coordinate human-human collaborations in virtual environments. In order for a computer agent to be accepted and function properly within a community of people, an appropriate social interaction scheme has to be established. People tend to favor the opinions of those who previously made the same decisions as theirs. We conducted an experiment to investigate the effect of sharing opinions with interface agents on subsequent human behaviors. In the first stage of the experiment, either a positive sharing (Agreeable agent), a negative sharing (Disagreeable agent) or no sharing (Neutral agent) of opinions was reinforced between subjects and agents through simple human-agent interactions. The effect of the sharing of opinions was then tested, in the second stage of the experiment, in terms of the subjects' tendency to favor or disfavor agents' proposals. We found that the Agreeable agent was consistently in favor of the subject's decisions. We therefore examined how the subject indicated sympathetic responses to the Agreeable agent after he/she interacted with all of the agents. The results showed that people tend to behave favorably toward agents that previously agreed with their decisions. This suggests that Human-Computer interaction has the same social dynamics as Human-Human interaction.

1 Introduction

Social characters of personalized agents have a great power to make people respond socially to the agents. Personalized agent are naturally regarded as human-like interactants, and consequently, people tend to expect these agents to behave intellectually in the same way as humans.

Some studies have focused on human responses toward computer behaviors by applying psychological methods. Reeves and Nass have convincingly demonstrated, through a number of experiments, that Human-Computer interactions basically have the same nature as Human-Human interactions [1]. Nass *et al.* [2] and Takeuchi *et al.* [3] empirically demonstrated that people respond socially to ordinary computers as if they are humans. These studies have indicated that human responses to media technologies are fundamentally social in the sense that the social factors governing Human-Human interactions apply equally to Human-Computer interactions. These human behaviors are not due to the ignorance of people or psychological or social dysfunctions, but rather to the fact that social responses are commonplace and easy to generate, even without sophisticated AI or multimedia technologies.

It is easy to assume that people further envisage a society in which people interact with personalized agent as social beings equivalent to humans. Accordingly, when the agents behave contrary to human expectations, this leads some people to believe that the agents are not sociable at all. What people socially interact with humanlike personalized agents is probably inherent in human nature. Therefore, the design of an agent must be carefully considered to keep people from excessive anticipation.

This paper presents the results of a psychological experiment on an aspect of social interaction between personalized computer agents and humans, particularly establishing affinity relationships with humans. The experiment explores the possibility of forming affinity relationships through agents' agreement behaviors. It was found that by indicating agreement to users' decisions, personalized computer agents could form affinity relationships with users, which subsequently influence their later decision behaviors.

2 An Agent Agrees with a Human

2.1 Social Relationship between Human and Agent

We can more easily attribute personality to computers than to other machines. Personalized agents, therefore, are naturally regarded as human-like interactants, and consequently, people tend to expect these agents to behave intellectually in the same way as humans. However, disappointment is felt when the agents behave contrary to human expectations and this leads some people to believe that the agents are not useful at all. Accordingly, the design of an agent must be carefully considered to keep people from excessive anticipation. In general, computers are simply considered machines to support practical jobs. Therefore, people implicitly and naturally expect any computer to settle their affairs as an inherent function.

Interface agents, however, have changed the social relationship between humans and computers to an operator-collaborator relationship. In this study, we examine how to design collaborative relationships in order to establish the basis that computers have achieved equality with people.

left: A subject gives his/her decision to the agents.
center: One agent agrees to the subject's decision.
right: A subject gives his/her decision to the agents after an inquiry.

Figure 1: Interaction with three agents (**(Dis)Agreeable**, **Neutral**, **Presider** agents).

2.2 Design of the Agent

People tend to favor the opinions of those who previously made the same decisions as theirs[4, 5], which is well known in psychological studies. Furthermore, interactions with other persons who resemble them in their attitude can lead people to smoothly achieve their task[6]. Therefore, it is possible that the interactions between humans and computers can lead people to achieve the task in a friendly and effective way when the attitude of the agent is similar to the human's.

In this study, we designed personalized agents that perform in agreement with a human decision in order to examine the influence of such an agent on his/her subsequent behaviors. Humans tend to favor a person who agrees and sympathize with his/her decision. When the interaction between a human and an agent is social in the same was as between humans, there is the possibility of leading people to sympathetic responses based on the behavior of an agent. In other words, it is expected that people interact with agents in amicable and cooperative relationships when the agents motivate the human to feel affiliation toward them.

If the interaction between a human and an agent can be made social in the same way as between humans, then there is the possibility of leading people to sympathetic responses based on the behavior of the agent. In other words, it is expected for people to interact with the agent in an amicable and cooperative way after the agent motivates these people to feel affiliation toward itself.

We designed agents as follows in order to make subjects feel affiliation to an agreeable agent:

1. Agent A and B, which are regarded as two distinct and independent personalities, discuss a problem on the computer screen.
2. Agent C (**Presider**) asks the subject about his/her idea on the topic by voice and a cartoon-style GUI balloon.
3. The subject replies to the inquiry with a pull-down menu (Fig. 1 (left)).
4. Either agent A or B declares agreement with the subject's decision (Fig. 1 (center)). When agent A agrees with the subject's decision, it is called the **Agreeable** agent, and the other one is called the **Neutral** agent.

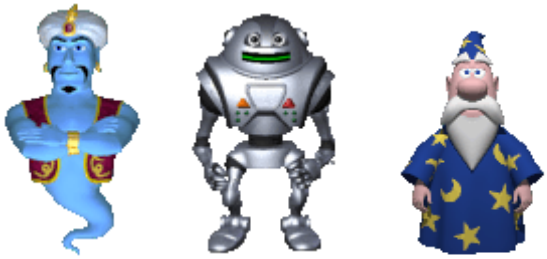

Figure 2: Microsoft Agents: "*Genie*"(left), "*Robby*"(center), and "*Merlin*"(right)

5. The problem is solved by the subject's suggestion.

In the reinforcement phase, the subject practices steps 2-5 four times. After the reinforcement phase, the **Agreeable** and **Neutral** agents suggest their opinions to the subject. Then the observation phase, the subject is asked by the **Presider** agent which agent's opinion he or she supports (Fig. 1 (right)). The subject has to express preference for either opinion. The subject practices the observation phase five times.

2.3 Agent Control

We used *Microsoft Agents* [7] to control the behaviors of each character. *Microsoft Agents* allow interactive presentation with brief movements, facial expressions, and voice on the desktop interface of *Windows 95/98/NT*, which is composed of a set of programmable software components. The behaviors of the agents were controlled by VB-Script and carried out in *Microsoft Internet Explorer 4.0*. In this experiment, we used three pre-designed agent characters named "Genie," "Robby," and "Merlin" (Figure 2). These *Microsoft Agents* were represented in 3D CG and had the capability of processing voice messages. Furthermore, their various movements could easily be controlled so that they behaved like people.

3 Psychological Experiment

3.1 Method

Fifty-four Japanese university students participated this experiment as subject. Twenty-four subjects assigned to *Agreeable condition*, which subjects interacted

with the **Agreeable**, **Neutral**, and **Presider** agents. The other thirty subjects assigned to *Disagreeable condition*, which subjects interacted with the **Disagreeable**, **Neutral**, and **Presider** agents.

Procedure

1. Experimenter instructed subjects that this experiment is intended to examine the practicality of voice-based interactions. All subjects were instructed that they were assigned to a "mouse base group" in this experiment. These instructions were in fact spurious.
2. In order to reinforce the affiliation to the **Agreeable** agent, the **Agreeable** agent determined by the first inquiry by the **Presider** agent consistently agrees with the subject throughout the reinforcement phase. In the other hand, we assigned remaining thirty subjects to interact with the **Disagreeable** agent that consistently disagrees with the subject.
3. Each set of reinforcement and observation phases is considered a session. Subjects interact with agents for three sessions to counterbalance any preference toward a particular agent.

Measures

The result is drawn from the frequency ratio of how many times the subject supports the suggestion of the **Agreeable**/**Disagreeable** agent in the three sessions, which is denoted $R_{(A)}$. The frequency ratio of how many times the subject supports the suggestion of the **Neutral** agent in the three sessions is denoted $R_{(N)}$.

$$R_{(A)} = \frac{N_{(A)}}{N_{(A)} + N_{(N)}}$$

$$R_{(N)} = \frac{N_{(N)}}{N_{(A)} + N_{(N)}}$$

$N_{(A)}$: Frequency of subject supporting the suggestion of the **Agreeable**/**Disagreeable** agent in the three sessions.

$N_{(N)}$: Frequency of subject supporting the suggestion of the **Neutral** agent in the three sessions.

Hypothesis and Predictions

Hypothesis

Humans display sympathetic responses to those who offer agreeable attitudes. By extension, Human-Computer interaction is expected to have the same social dynamics as Human-Human interaction.

Predictions

- Subject favorably supports the suggestion that is exhibited by the **Agreeable** agent in the reinforcement phase, which is based on affiliation motivation.
- Subject does not positively support the suggestion that is exhibited by the **Disagreeable** agent in the reinforcement phase.

Table 1: Questions of questionnaire.

1	How did you feel a `kindheartness` to [*Merlin*/ *Genie*/ *Robby*]?
2	How did you feel an `honesty` to [*Merlin*/ *Genie*/ *Robby*]?
3	How did you feel an `extroversion` to [*Merlin*/ *Genie*/ *Robby*]?
4	How did you feel a `tenderness` to [*Merlin*/ *Genie*/ *Robby*]?
5	How did you feel a `conscientiousness` to [*Merlin*/ *Genie*/ *Robby*]?
6	How did you feel a `sociality` to [*Merlin*/ *Genie*/ *Robby*]?
7	How did you feel an `affinity` to [*Merlin*/ *Genie*/ *Robby*]?
8	How did you feel an `intellectuality` to [*Merlin*/ *Genie*/ *Robby*]?
9	How did you feel a `positiveness` to [*Merlin*/ *Genie*/ *Robby*]?
10	How did you feel a `reliability` to [*Merlin*/ *Genie*/ *Robby*]?
11	How did you feel an `attractiveness` to [*Merlin*/ *Genie*/ *Robby*]?
12	How did you feel an `arbitrariness` to [*Merlin*/ *Genie*/ *Robby*]?

3.2 Results

All subjects answered to questionnaire after the three experimental session. The first result of regarding a question "Which agent did you most feel favor?" shows in Figure 3. In the *Agreeable condition*, 50% subjects answered *Merlin* as a favorite agent. On the other hand, 40% subjects answered *Robby* as a favorite agent in the *Disagreeable condition*. This result indicates that subjects' favor towards each agent was varied and biased.

From the 12 questions of questionnaire (Table 1), however, there are no significant differences between *Robby*, *Genie*, and *Merlin* in both *Agreeable* and *Disagreeable* conditions (Figure 4). Subjects uniformly assessed each agent at almost same impression even though the result of favorite agent was biased between each agent. In addition, it was practically same attitudinal responses in *Agreeable* and *Disagreeable conditions*.

The results of this experiment revealed that people tend to respond favorably toward those who previously agreed with their decisions (Figure 5). The comparison between **Agreeable** agent and **Neutral** agent indicated a statistical significant difference ($F(1, 23) = 7.345, p < .05$). On the other hand, there was any significant difference between **Disagreeable** agent and **Neutral** agent. Accordingly, the hypothesis that Human-Computer interaction has the same social dynamics as Human-Human interaction is supported. However, prediction of interacting with **Disagreeable** agent was not verified.

Figure 6 shows the results of responses towards each agent. Either agent agreement leads to subject agreement, and either agent disagreement does not necessarily lead to subject disagree. Compared with the results of attitudinal assessment of each agent (Figure 4), subjects equivalently responded to each agent in both *Agreeable* and *Disagreeable conditions*.

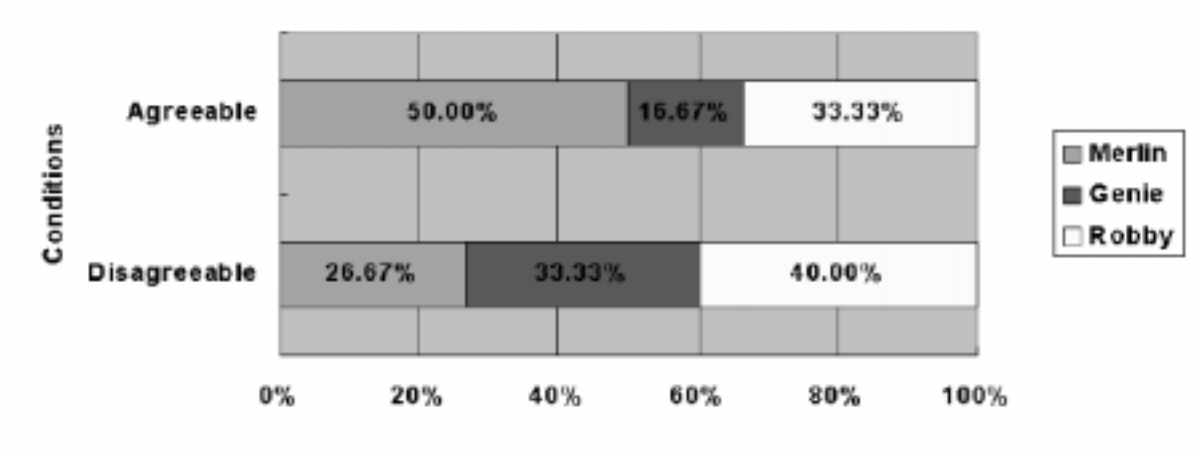

Figure 3: Ratios of the favored agent under the *agreeable/disagreeable conditions*.

Figure 4: Results of an experiment: Attitudinal evaluation.

3.3 Discussions

The results of this experiment revealed that people tend to respond favorably toward those who previously agreed with their decisions. Accordingly, the hypothesis that Human-Computer interaction has the same social dynamics as Human-Human interaction could be supported. The subjects automatically interacted with each of the agents as if it were a human. This human interaction with personalized computer agents was influenced by the establishment of affinity relationships through agreeable behaviors by the agents, in the same way as how people interact with other people.

In this experiment, none of the agents appeared to project a specific social role or character from its CG appearance, since our post-experiment questionnaire on psychological interpersonal impression did not indicate any bias toward particular agents, whereas the reports of favored agents did indicate a bias toward particular agents. However, people easily form stereotypes concerning the social role of a person from his/her appearance, e.g., dress, bearing, style of speaking, position, or situation. Therefore, if the agents used in this experiment had induced perceptions of special social roles or characters, the subjects might have been influenced in their responses toward the agents. Our results also suggested the possibility that differences in appearance do cause a secondary effect in human decision behaviors. We observed different degrees of "improvement" among different agents when they played a role of an agreeable agent. To clarify the correlation among the social properties of agents, stereotypes of social roles, and agent appearances certainly makes an important and interesting research direction to be pursued further. It is particularly relevant in the design of interface agents in virtual collaborative environments, since agents need to play distinctive roles in cyberspace, and their appearances and their roles have to be coordinated.

Another interesting issue will be to observe and characterize the effects of various types of negative agent behaviors. In real applications, interface agents must inevitably encounter situations where they must contradict with humans: denying users certain services, or recommending non-favored alternatives. In those situations interface agents are required to disagree with people gracefully. On the other hand, negative behaviors can sometimes work positively in establishing affinity relationships. People often exhibit and experience negative behaviors as friendly teasing or bantering to reinforce affective relationships.

It is difficult to predict human behaviors toward com-

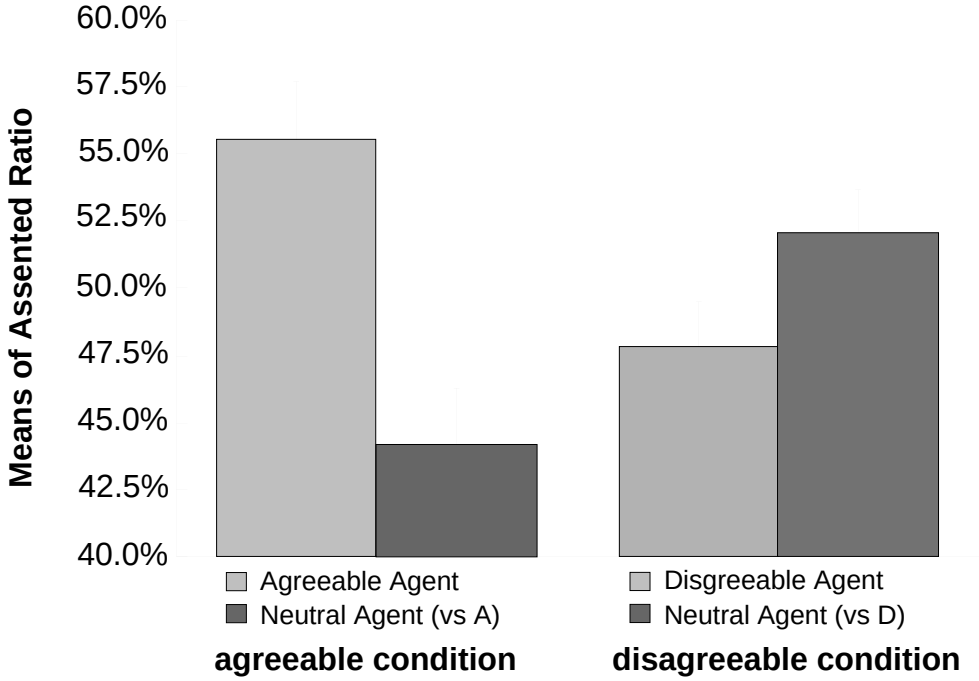

Figure 5: Results of an experiment: Behavioral measure.

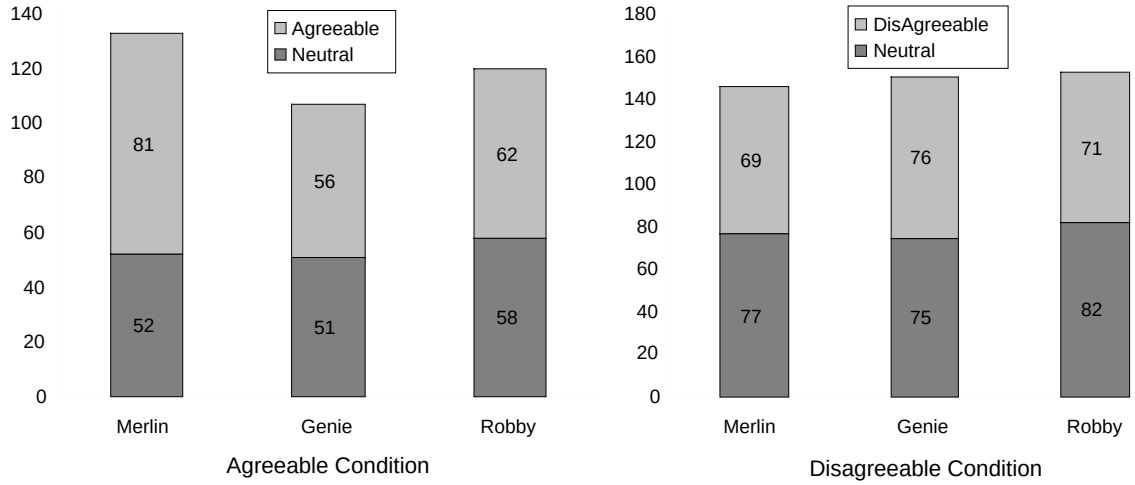

Figure 6: Results of an experiment: Responses towards each agent.

puters in general. However, when social relationships have been established between humans and computers, there is the possibility of people automatically and naturally conforming to social norms, rules, and common beliefs by appropriately managing the agent behaviors. The subjects automatically responded in favor of the **Agreeable** agent in our experiment, based on affiliation motivation. This evidence provides useful insight into designing personalized agents. People may not "automatically" interact with an agent when conscious of the physical machinery of the agent, but in cases where they are made to be conscious of not the physical aspects but the functional aspects of the agent, they may interact with the agent "automatically." If interpersonal responses can be made to be induced automatically, people will naturally interact socially with personalized agents when the behaviors of the agents conform to social norms, rules, and/or skills. On the other hand, it is hard to establish social relationships with agents which deviate from the standards of human social interaction. It is, therefore, an essential issue to investigate the structures of interaction between humans and com-

puters, to enable natural and enjoyably interaction with personalized agents in the future.

4 Conclusions

In order to explore and assess the importance and the scope of social factors in Human-Computer interaction, as well as in the use of computer agents in Human-Human collaborations, we focused on social interaction based on affiliation motivation between humans and interface agents in this paper. We conducted an experiment on the social influence of personalized computer agent behaviors on subsequent human decision behaviors and demonstrated that:

- Agreeable behaviors on the part of the personalized computer agents can establish affinity relationships between both sides, which subsequently exerts influence on the human decision behaviors.
- People implicitly apply rules for Human-Human social interaction to Human-Computer interaction and exhibit behaviors toward computer agents based on affiliation motivation.
- People commonly treat personalized agents as social actors and respond as though they are real humans.

These finding have tremendous significance for interface agent design as well as for broader Human-Computer interface design. Social interaction will enhance and improve human-agent interactions in intelligent agent applications such as those in CAI systems, navigation guide systems, and expert consulting systems, as well as in virtual environment systems inhabited by avators and agents that mediate human-human collaborations.

Acknowledgement

We would like to thank to Mr. Kazuyuki Nagasawa a graduate student of Toyohashi University of Technology for his effort to build this experiment system.

References

[1] B. Reeves and C. Nass, "The Media Equation," Cambridge University Press, 1996.

[2] C. Nass, J. Steuer and E. Tauber, "Computers are Social Actors," Proceedings of CHI'94, pp.72-78, 1994.

[3] Y. Takeuchi, Y. Katagiri, C. Nass and B. J. Fogg, "Social Response and Cultural Dependency in Human-Computer Interaction," Proceedings of Joint Workshop on Cross-Language Issues in Artificial Intelligence and Issues in Cross Cultural Communication – Towards Culturally Situated Agents –, PRICAI'98, pp.114-123, 1998.

[4] T. M. Newcomb, "The Acquaintance Process," Holt, Rinehart & Winston, 1961.

[5] D. Byrne, "Attitudes and attraction," In L. Berkowitz (ed.), *Advances in Experimental Social Psychology*, vol.4, pp.35-89, 1969.

[6] D. Davis, "Implications for interaction versus effectance as mediators of the similarity-attraction relationship," *Journal of Experimental Social Psychology*, vol.17, pp.96-116, 1981.

[7] Microsoft Corporation, "Microsoft Agent," Microsoft, 1998.