Change in Human Behaviors Based on Affiliation Needs
-- Toward the Design of a Social Guide Agent System --

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Abstract: We discuss, in this paper, the design of a life-like agent interface that considers the social aspects in human-agent interaction. The underlying hypothesis of the design is that human social behaviors toward life-like agents are on a par with those toward humans. Humans tend to sympathize with and follow other humans based on their affiliation needs. Therefore, it should be with life-like agents. We have designed and incorporated life-like guide agents into an exhibition guide system based on the hypothesis. The system was used at the 12th ATR Open House last November, where we had the opportunity to study the behaviors of its users. We observed that the behaviors of the users were directed toward maintaining their good social relationships with their life-like agents, thereby supporting our hypothesis. The results indicated the importance of incorporating an agent's capability to induce the effect of human affiliation needs in a system design.

1   Introduction

Interface agents that mediate between humans and computers are expected to play an increasingly important role in "human-oriented" knowledge-based intelligent information systems. The development in information technologies has made it possible for us to share a voluminous amount of information through its storage, processing and access via computers. However, the increasing amounts of information made available by the technologies has also created the situation of information overload in humans beyond their apprehension capabilities, and the "machine-oriented" systems may become a hindrance rather than a help for people to enjoy the benefit of the information technologies.

Recent developments in intelligent interface agent technologies have indicated that they have the potential of overcoming the information overload problem. Intelligent interface agents are designed to cope with information overload by providing an effective means for search, extraction and filtering of information[1, 2]. Intelligent interface agents are also intended to alleviate, through their life-like and personification features, the labor and mental burden that people experience in complicated tasks of working with computers. The characters of agents also enhance the social nature of interrelationships between human and computers. Reeves & Nass[3] demonstrated that the interaction between humans and computers is social and is similarly formed as the interaction between humans. Takeuchi & Katagiri[4] suggested that it is possible for system designers to affect users' behaviors by inducing human interpersonal reactions. The personification of interface agents is an essential factor in enhancing interpersonal reactions.

We have designed and implemented a set of life-like interface agents for an exhibit guide system to obtain experiences in social agent interface design and to observe human social responses toward interface agents in a real-use context. We installed the system in the ATR annual Open House exhibition and provided a guide service for the visitors. In this paper, we report on the design features of our guide agents and on an observational analysis of the users' responses toward our agents based on human affiliation needs.

2   Social Aspect in Human-Agent Interaction

2.1 Human Affiliation Need

This study is based on the hypothesis that the user of an agent-interfaced system feels a social relationship with her interface agent. If this hypothesis were supported, it would become possible to develop agent-interfaced systems that consider the social behaviors of human beings.

Various life-like interface agents have been researched, and these research efforts were also premised on the belief that human-agent interaction should be as fully socially formed as in the case of human-human social interaction[5, 6].

There is an essential need for human beings to establish and maintain affinitive relationships with others. This need is called the affiliation need. The affiliation need is important when we consider human relations or group formation. People who want to establish and maintain a friendly relationship with another person are apt to follow or sympathize with this person[7].

If such social relationships based on affiliation need are established between users and life-like agents, we can consider such human-agent relations when we design a system's agent interface. If we then succeed in designing an agent-interfaced system that induces the user's affiliation need toward the agent, we expect that the user will try to establish and maintain a relationship with the agents. Moreover, when the user feels the relationships with these capable agents are getting worse, we also expect that the user follows and sympathizes with the agents to recover the relationships.

To induce affiliation needs in users, we note the following two types of interpersonal attraction of life-like interface agents:

○attraction based on agent's appearance

The interpersonal attraction we feel based on the superficial aspects (appearance, vocal quality, etc.) and the internal aspects (character, orientation, etc.) of the life-like interface agents

○attraction based on agent's capability

The personal attraction we feel based on profits and benefits by interacting with life-like interface agents

2.2 Establishing Affinitive Relationship

The appearance of a person has a great effect on first impressions. The appearance-based interpersonal attraction of an agent will also have such an effect on the user's first impression of the agent. This will induce the user's affiliation need in the first encounter.

Therefore, the appearance of the interface agent is important in establishing the affinitive relationship between the user and the agent. We may have to prepare a variety of agent appearances so that a user may satisfy her particular preferences.

2.3 Maintaining Affinitive Relationship

The strength of the affinitive relationship can vary. Cooperative or agreeable behaviors enhance the relationship, whereas uncooperative or disagreeable behaviors damage it. When people find that their partner can provide benefit for them, they feel capability-based attraction toward their partner and try to enhance the relationship by increasing their affiliation needs. When their partner shows negative attitudes toward them, they might even assume that the partner has lessened the affiliation need toward them and try to compensate for this to maintain the affinitive relationship. They will then feel an enhanced affiliation need toward the partner and try to recover their former state of relationship by trying to sympathize with the partner and respond positively to the partner's requests. [8]

We assume that the orientation of maintaining an affinitive relationship may be adapted to interactions with life-like interface agents. Based on this assumption, it should be possible to design the behavior of an agent-interfaced system that implements life-like social interaction based on users' affiliation needs.

3 Implementation of Guide Agents

3.1 Basic Ideas

The goal of our study is to establish a methodology for the design of interactive systems that are mediated by social life-like agents. The term social life-like agent means, in this paper, a life-like agent that induces a user's affiliation need and makes an affinitive relationship with the user. If we could incorporate these social interactions, there would be benefits for both users and designers of systems. Users can put natural social interactions to practical use when using systems. Designers can prohibit unsocial behaviors by users and decrease the distress from unexpected user behaviors. Because of the user's affiliation need toward a life-like agent, the user may want to maintain this relationship and may involuntary interact with the agent socially.

In this paper, we analyze whether the social behaviors based on affinitive relationships between users and interface agents are really observed through the practical use of a life-like agent interfaced system.

3.2 Exhibition Guidance System

We studied the effect of inducing the users' affiliation need by incorporating life-like attractive guide agents in the C-MAP (Context-aware Mobile Assistant Project) Exhibition Guidance System. The C-MAP Exhibition Guidance System features a personal mobile assistant that provides visitors touring exhibitions with information based on contexts (spatial/temporal locations and individual interests)[9]. The user of this system carries a hand-held guidance system called PalmGuide while touring an exhibition. PalmGuide maintains user contexts such as user's name and affiliation, temporal and
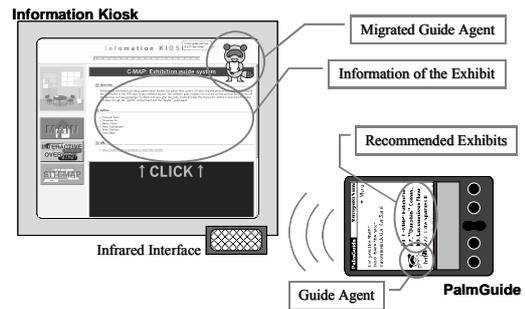

Fig. 1: Information Kiosk and PalmGuide

spatial situations of the exhibition, history of the tour route, and personal interests (Fig. 1).

A life-like personal guide agent (hereafter called a guide agent) runs on the user's PalmGuide and provides tour navigation information such as introduction of exhibit articles and recommendations of what to visit next. This recommendation is made from the result of calculating the user's interest by using information of other users' contexts.

At exhibitions using this C-MAP system, information terminals called Information Kiosks are installed at each exhibit. Information Kiosks usually provide information about the overall exhibition. When a user with a PalmGuide comes to an Information Kiosk, the user can connect her PalmGuide to the Information Kiosk by infrared communication. Then, the user's guide agent migrates to and personalizes this Information Kiosk.

The guide agent on the Information Kiosk gives interactive guidance of the particular exhibit with animated motion and synthesized voice. After the user finishes obtaining information with the agent's guidance, the agent returns to the original PalmGuide and goes to the next exhibit with the agent's user.

3.3 Interpersonal Attraction

In order to make a user feel the affiliation need toward an interface agent, it is necessary to design the agent with interpersonal attractions. As described in subsection 2.1, we have designed the following two elements of interpersonal attraction:

○attraction based on agent's appearance

Each user can select the appearance of her personal interface agent. In our system, the user can freely choose her favorite from a selection of nine prepared agents (Fig. 2).

○attraction based on agent's capability

The interface agent of this system always moves along with its user and constantly revises the user's personal data and interests from her tour history. Therefore, the agent has the capability to provide integrated information that is helpful to its user in various contexts.

Fig. 2: Appearance of Guide Agents

4 Observational Analysis

We analyzed the effect of inducing the user's affiliation need toward her guide agent by observing whether she behaves involuntary as we designed.

4.1 Setting

The subjects of this observation were 245 adult users of the C-MAP Exhibition Guidance System who applied to use the system. They were visitors of the 12th ATR Open House (Nov. 4-5, 1999), which was held in the authors' laboratories. At this open house, the various basic research topics related to Virtual Reality, Human-Computer Interaction, and so on were exhibited. All of the visitors came to the open house with intellectual interests in the exhibitions. The visitors received their PalmGuides and were able to freely access 21 Information Kiosks installed at the exhibit booths.

We compared the observed users' tour histories with the recommended exhibits. The recommendations change in accordance with a user's tour history and they appear as if the guide agent recommends them.

We designed the behaviors of the guide agents as follows:

Until the fourth access to an Information Kiosk, the user's guide agent returns to the original PalmGuide when the access ends, as mentioned in sub-section 3.2. However, at the end of the user's fourth access, the guide agent does not return to the original PalmGuide. At this time, the agent disappears from the current Information Kiosk after saying that it wishes to go to another Information Kiosk that was recommended in advance. The agent also says that it will be waiting for the user there. Then the user is required to tacitly chase her agent. Therefore, two situations are assumed when the fifth access to an Information Kiosk takes place: either the user accesses the Kiosk recommended by the agent or not.

➢ The user accesses the recommended exhibit.
   The agent thanks the user for her trust in the agent's recommendation.

➢ The user accesses an exhibit not recommended.
   The agent complains that the user doesn't follow the agent's recommendation.

When the user accesses the recommended kiosk and her agent thanks her, we expect her affiliation need toward the agent to be enhanced. On the other hand, when the user accesses another kiosk and gets a complaint from the agent, we expect her affiliation need toward the agent to also be enhanced. This is because the user worries that the social relationship with her agent would take a turn for the worse and hopes to recover the relationship.

In either case, we expect that the agent's reaction induces its user's affiliation need and has an effect on the user's subsequent behaviors. (In either case, the agent returns to user's PalmGuide at the end of the access to the fifth Kiosk's as it did until the fourth Kiosk.)

4.2 Analysis

Out of 245 users of the C-MAP system, we extracted two subject groups (S1 and S2). S1 consists of 22 users who accessed a Kiosk just four times and S2 consists of 12 users who accessed a Kiosk more than five times.

Figure 3 shows the psychological ratings related to users' attitudes toward their guide agents, toward them-
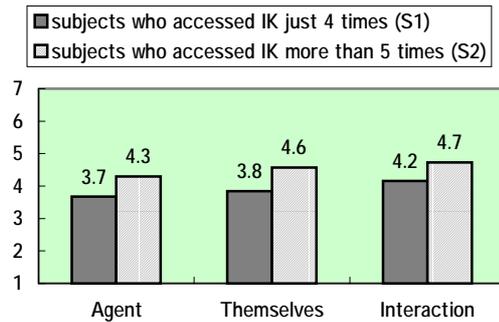

Fig. 3: Results of Users' Attitude toward Agent, Themselves, and their Interaction

selves, and toward their interaction with the guide agents. This rating is based on our questionnaire survey, which users answered at the end of using the system. Users evaluated their attitudes on a scale of 1 to 7, with 7 being the most positive attitude.

Though a statistically significant difference cannot be observed, the graphs show that the rating values of S2 are more than those of S1 in all cases. The results indicate the possibility that the feedback of the guide agent in the fifth access may be influential in setting user attitudes.

In the next phase, we analyzed the behavior of users of each group. Table 1 shows the result of analyses for the S2 group.

The first access to an Information Kiosk is selected at the user's own will. After the first exhibit, the guide agent recommends the next exhibit and continues this action up to the access of the fourth exhibit. Column II of Table 1 shows that the 12 users accessed the Kiosk of the recommended exhibit 1.25 times out of the three accesses on average. Specifically, the users behaved in accordance with the recommendation by their guide agents at a ratio of 41.7%.

On the other hand, column III of Table 1 shows that the users rarely accessed the required Kiosk at the fifth time. After the sixth access, however, the users behaved in accordance with the recommendation at a ratio of 66.2% as shown in column IV.

Figure 4 compares these acceptance rates of recommendations. The leftmost bar shows the mean accep-

Table 1: Results of Each User of S2

User	I	II	III	IV
A	7	67%	0	0%
B	12	0%	0	57%
C	8	0%	0	100%
D	6	33%	0	0%
E	7	100%	1	100%
F	15	100%	0	70%
G	8	33%	0	100%
H	8	33%	0	67%
I	7	33%	0	100%
J	11	67%	0	67%
K	7	33%	0	100%
L	8	0%	0	33%
Average		**41.7%**		**66.2%**

I.   Total number of accesses to an Information Kiosk
II. Ratio of access to recommended exhibit's IK up to fourth access
III. Whether users access the recommended IK in fifth access
     "0" corresponds to NOT accessed
     "1" corresponds to accessed
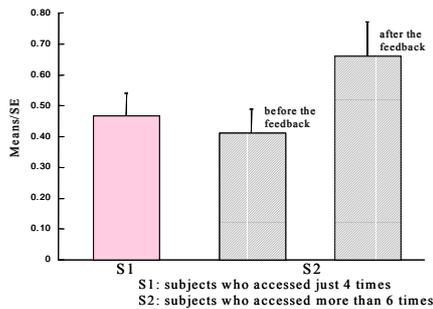IV. Ratio of access to IK after sixth access

Fig. 4: Acceptance rate of recommendation

tance rate for S1. Right two bars are rates for S2 before and after each user obtained feedback from her agent based on the user's response to the agent's recommendation in the fifth access. Left two bars show a similar behavior tendency, but the rightmost bar shows a higher rate than others.

4.3 Discussions

Figure 4 indicates that people tend to behave differently toward the guide agents' recommendations before and after the fifth access, when the agents simply went ahead and waited for their users at the recommended Information Kiosk. The data of the observational analysis exhibited only a statistical tendency ($F_{(1,13)}$ = 3.34, p=.092), mostly because we haven't been able to get a large enough number of users suitable for analysis. Nevertheless, we believe this difference in behaviors is important as it reflects the strength and effectiveness of the users' affiliation needs toward life-like guide agents in selecting behaviors.

Guide agents complained to 11 users out of 12 because these 11 users didn't access the recommended exhibit's kiosk directly after the end of their fourth access. Therefore, by comparing the data, we can conclude that the guide agents' action enhanced the users' affiliation needs toward the agent. The users hope and try to recover the affinitive relationship with the agent. Namely, we can explain the changes in user behaviors as being controlled by the enhancement of affiliation needs, which are effected by social interactions between the users and their agents.

In this study, guide agents can recommend a total of 21 exhibits. Guide agents do not recommend an exhibit that has already been accessed by their user. Therefore, as the number of accesses increases, the probability becomes higher that the user coincidentally accesses the recommended exhibit. Consequently, the probability that the user seems to be following her guide agent also becomes higher. In this study, however, users accessed Information Kiosks only an average of 8.67 times in their tours. Thus, the above probability factor is not applicable in this case.

5 Conclusions

In this paper, we have discussed two issues. The first is the design of the social guide agent system. It is designed to induce the user's human affiliation need and to make the user feel as if she has behaved appropriately. The second is the practical influence of a system interface implemented in such a design.

In this study, the fact that there was a small number of apposite users as subjects prevents a strict statistical consideration. Moreover, the observations we made

were in an actual exhibition, which increased the chances of environmental noises. Nevertheless, it is meaningful that the agent interface, designed to induce users' affiliation needs, does actually change user behaviors. This result may provide hints for designing interactive human-computer interfaces.

Our computers frequently require us to operate them in explicit messages such as "Insert a floppy disk into FDD," "Drop these files into trash box," or "Click this button to confirm." Consequently, users reactively comply with such instruction. In this strategy of system operation, however, users are always obliged to obey the messages, and the psychological stress of having to follow such commands builds up in the user's mind.

On the other hand, a user's affiliation need toward her computer can be effectively applied to maintain intimate relationships. Once a reciprocal relationship between human and computer is established, people strive to keep their intimate relationship as much as possible. Therefore, when computers blame users for their insincerity, negligence, or other unsocial behaviors toward computers, users unconsciously tend to obey computers' requirements to compensate for risks to their intimate relationships. In this case, the user does not feel psychological stress but realizes the positive effects of cooperating with the computer.

In a future experiment, we will take more control of the environmental conditions and thus reduce factors such as noise to search for evidence of induced human affiliation need caused by interface agents. In addition, we will continue to implement agent-interfaced systems by utilizing the social interaction between human beings and interface agents.

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