A Study on Persuasive Effect of Preference of Virtual Agents

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Abstract A virtual agent can have a graphical appearance and give users non-verbal information such as gestures and facial expressions. A computer system can construct intimate relationship with and credibility from users using virtual agents. Although related work have been discussing how to make users feel better about computers, a room for discussing effectiveness of letting users choose their favorite characters still exists. If a user's favorite agent is more believable than not favorite one for him/her, the computer system can construct better relationship with the user through an agent. In this paper, we have examined an effect of making user's favorite agent selectable on his/her behavior by conducting an experiment. We divided participants into four groups according to these conditions and ask them to have a conversation with an agent. As a result, we found a possibility of increasing credibility of an agent from users by letting them choose their favorite one.

Introduction

Persuasion and Agents

Persuasion is an attempt to encourage an individual to change his/her behaviors or attitudes [1]. Researches on persuasive computer systems have accelerated as the prevalence of computers and the Internet.

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Using a virtual agent as a persuader is one of methods of constructing closer relationship between a computer and a user. In this paper, we use a word "virtual agent" as the meaning of visual entity represented graphically by a computer; specifically a character which can have a conversation with its user. Related work on using conversational agents as a user interface has also been exists. For example, Bickmore et al. have discussed a model of dialogue building trust from users mentioning a *relational agent* which uses verbal and nonverbal conversational strategies same as human uses [2].

Credibility of Computer Systems

Whether a user credits a computer or not also influences on outcomes of persuasion from the computer; for example, Fogg has described credibility in persuasion [1].

Credibility can be used as a clue of whether one can believe computers or other individuals. For example, credibility which is called *surface credibility* is one of four types of credibility described in [1]. This kind of credibility comes from first impression of surface traits such as appearance [1].

A room for discussion of making users' impression of computers better in an aspect of credibility still exists. Attempts of giving users favorable impression have existed and the discussed agents have varied from text-based to graphical ones (for example, [2] has summarized related work). In addition, a computer system which user can choose and interact with his/her favorite agent also exists [3]. However, a comparison between the case an agent can be chosen by a user and an agent is fixed regardless of a user's preference can give a profound aspect. That is, if the agent just meets a user's preference or a character from a user's favorite anime or games, s/he is expected to interact with the agent with eagerly by enhanced persuasive effect.

Our Purpose

In our research, we examine a degree of persuasiveness of conversation with an agent considering two cases. One case is that a user can choose an agent according to his/her preference and the other is that a user can not choose his/her favorite agent.

We constructed an agent system using existing software and conducted an experiment using our system. In the experiment, we asked male participants who belong to one of four groups combining two different conditions to talk with a female agent; after the conversation, we interviewed them about the talk with the agent.

Based on the results of the experiment, we will also discuss an effectiveness of reflecting preferences of a user to selection of an agent; in an aspect of designing credible persuasive computer systems which incorporate with agents.

Related Work

In this section, we introduce related work on an agent and discuss the relationship with our case.

An Appearance of an Agent

Zanbaka et al. have examined effect of gender and appearance of a virtual agent as a persuader [4]. In this research, an experiment has been conducted where three kinds of agents persuade users about the same topic. One agent is a picture of a real person (human), another is a CG based human-like agent (virtual human) and the other is a CG based not-human-like agent (virtual character).

As a result, a user has been more persuaded by an agent with different gender than with same although significant effects of appearance and gender on persuasion did not exist. In addition, although users had positive impression toward the virtual agents, a virtual character can be perceived as bolder than other types of an agent.

Affiliation Need

Katagiri et al. have mentioned a need to establish and maintain affinitive relationships with others, called as affiliation need. They have examined construction of relationship between an agent and a user based on affiliation need using an exhibition guidance system incorporates with an agent [3]. With this system, a user can receive explanations and recommendations of exhibition transferring an agent from his/her portable device to an information terminal besides the exhibition.

A user can choose his/her favorite agent out of nine kinds of agents. An agent tells the user that it will wait for him/her at the exhibition which has been recommended by the agent after the fourth visit to exhibitions. If the user goes to the recommended exhibition, the agent appreciates him/her; on the other hand, if the user does not, the agent complains about it. The study has confirmed whether these reactions of the agent induce affiliation need from the user and affect later behavior of the user.

Consequently, the result has showed that those who had visited more than four exhibitions had changed their behavior after the fourth visit. In this experiment, participants have been divided into two groups and asked to walk around the exhibitions using the guidance system. Each member of one group finished after four visits of exhibitions while a member who belongs to the other group was able to visit more than four exhibitions. Although they have said that they need more participants in order to obtain statistically clearer results, they concluded that the interaction from the agent had had an effect on behavior of a user.

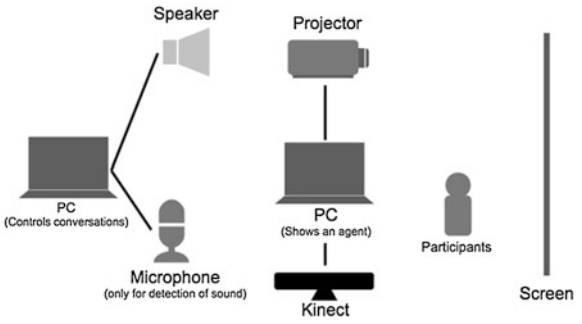

Fig. 1 An overview of the conversation system

System Design and Materials

We conducted an experiment in order to examine how will a user responds to an agent when we let them choose their favorite agent. Before the study, we constructed a conversation system which incorporates with an agent and interacts with users. We will describe details of this system in this section.

Overview

Figure 1 shows an overview of our conversation system. A user can have an oral conversation with a virtual agent which can speak in synthesized voice. An appearance of an agent and speech were presented in a wizard-of-oz style. More precisely, an agent was controlled by gestures of the researcher using a Kinect and the each sentences of speech were stepped by key input on a shell.

An agent and the speech components were deployed on different computers separately because of the difference of operating systems. An agent was controlled via a PC on which Microsoft Windows 7 was installed and the speech was generated on a virtualized Debian Linux (Squeeze) environment of another computer.

Agent

An agent was a 3D character which has been generated by software which is called as MikuMikuDance (MMD)[1]. The MMD has been originally developed a software tool to enable authors to generate a music video using 3D virtual character with synthesized vocal and music notes. We chose a Kinect to control behaviors of an agent by gestures using a plugin[2] instead of programming numerically.

[1] http://www.geocities.jp/higuchuu4/index_e.htm

[2] http://www.xbox.com/ja-JP/kinect

We used 3D character models bundled with books which were published by Shinyusha featuring the MMD. Such models have been provided by many people sometimes based on anime characters or games and they can be loaded to the MMD.

Speech of an Agent

The speech of an agent was synthesized by OpenHRI[3]. This software is a collection of components for Human Robots Interaction including speech synthesis and recognition. We used the speech synthesis feature based on Open JTalk[4], which is supported in the OpenHRI.

We prepared a component which receives text input from a shell and command speech related components in order to generate synthesized speech. The OpenHRI provides each features such as speech recognition or speech synthesis as components. These components can be connected to each other graphically via an input port and an output port using RT System Editor which was installed on Eclipse.

We chose a female voice because all of the character models we had prepared were female and we used the same voice for all characters. The conversations are constructed partially based on social dialogue [5]. For example, we used "empathetic statements" (line 3 in Fig. 2) and "prompting for self-disclosure by the participant" (line 5 in Fig. 2).

A: An agent / **B**: A participant
****** or -- : variable parts
Sentence no. from 13 to 16 are conditional branch

1. A: Hello, my name is --. Nice to meet you.
2. B:*****
3. A: Thank you for coming all the way here. I'm glad to see you.
4. B:*****
5. A: What is ** san's hobby?
6. B:*****
7. A: That's great! Please tell me more next time!
8. B:*****
9. A: I like music. I often listen to especially classical music.
10. A: Well, let me move to the main topic. Today I'd like to talk about exercise, all right?
11. B:*****
12. A: By the way, do ** san exercise regularly? Say, walking, cycling...
13. B: 1. Yes, 2. Sometimes, 3. Not so much
14. A1: Really? Then you must be healthy!
15. A2: Well, do you walk or ride a bike? I heard that your brain become active if you change your route to different one. You may come up with new idea.
16. A3: Well, do you know this story? Your brain becomes active if you have some exercise. You may be able to refresh your mind and spend comfortable time if you exercise weekend.
17. B:*****
18. A: Come to think of it, exercising reduces your stress and improves depressed feelings.
19. A: Exercise is surprisingly good for mental side. Have you refreshed when you get some exercise?
20. B:*****
21. A: I also started to walk as refreshment these days.
22. A: And then, I'm becoming fond of walking where I haven't been to and I found a nice cafe the other day.
23. B:*****
24. A: Oh, sorry, I have to go out. Although I can talk with you for short time, I will appreciate if you remember what I said.
25. B:*****
26. A: See you again!
27. B:*****

Fig. 2 The script of conversation

[3] http://openhri.net/?lang=en

[4] http://open-jtalk.sourceforge.net

Table 1 Groups of the participants (the unit is [person(s)])

	(A) person(s)	(B) person(s)
1	3	1
2	1	1

The microphone was used only for indicator of sound levels because the researcher attempted not to hear the speech of a participant in order to let them talk without pressure.

Experiment

An experiment consists of three parts. These parts include a pre-questionnaire, a conversation session with an agent and an interview.

Participants and Tasks

We recruited 6 participants (5 Japanese, 1 Chinese) and divided into four groups according to two conditions (Table 1). One condition is whether a participant can choose his/her favorite agent from the book (a) or not (b); the other is whether s/he has a specific favorite character, game or anime regularly (1) or not (2). As the Table 1 shows, we named each groups as combination of an alphabet and a number; for example, the group whose members do not have specific preference (2) and they can select their favorite agent (a) is group A-2. One participant could not fully understand the content of the conversation and we inquired mainly the impression of the agent and imaginary-based opinion.

Gender of the participants was unified to be male so as to exclude an effect of difference of participants' gender. All of the agents were female and according to Zanbaka et al. female speakers are more persuasive toward male participants than male speakers [4].

In the main study, each participants had conversations related to exercise with an agent. The conversations took place in Japanese and look like Fig. 2 as an English translated form.

During the conversations, the researcher heard music via earphones in order to hide the details of the participants' talk letting them talk more naturally.

Interview

Participants were asked to give an open-style interview with the researcher about the conversation and the agent after the conversation. In the interview, we firstly

asked participants to tell us about the entire conversation freely and then we interviewed them according to following topics.

- How did you feel about the conversations with the agent?
- Did you really like the agent? Why?
- Did you have an interest with exercise? Why?
- Do you have a favorite character?

Results and Discussion

In this section, we will show the result of the experiment and discuss them. We will use fragments derived from comments of participants and these are edited for explanation.

Conversation with an Agent

From the results of the experiment, five participants felt the speech of an agent was unnatural. Such perception relates to all of or a part of the timing, the voice quality and the manner of speaking. For example, longer time lags or overlaps between speech of a participant and an agent have occurred. This was mainly because of manual conversation control without hearing the participant's talk. Besides, according to four participants, intonations of the speech was "machine-like".

Synthesized voice can have a negative effect on credibility of an agent with less reduction of persuasive effect. However, if we can increase credibility of agents using characteristics such as a visual appearance or a personality, negative effects of synthesized voice can be reduced. As for perception of synthesized speech, Stern et al. have compared synthesized speech and human speech. Their results have shown that synthesized speech was rated less knowledgeable and truthful. However, in terms of the persuasion, a significant difference between human speech and synthesized speech did not exist [6].

Favorableness of an Agent

In an aspect of the favorableness of an agent, a significant difference between the groups was not found. One of members of the group A-1 said that "Although I am not fun of a specific character, the agent which I have selected was favorable". On the other hand, a member of group A-2 said that "I did not feel especially about the agent". These results suggest that users' regular preference does not

significantly affect the immediate favorableness of an agent. We still have to examine other characteristics such as a personality and a voice of an agent in order to reduce unnatural impression from a user.

Other comments from four participants suggested the possibility of positive impression by a selectable character. We asked the participants how they thought that they can choose their favorite agents; as for those who are in group B, we asked them to imagine the situation. In addition, we also asked them what they think if an agent of our conversation system were replaced by their "regular" favorite characters of games, anime or any other media. Comments we received were "I am not feel like talking with the agent if she were not my favorite", "Choosing from many agents was difficult. But if I could not choose an agent, she may make me less impressed" and "I did not have special feelings toward the agent this time, but I may listen to my favorite character more". On the other hand, one of members of group B told us that he will have same feelings even if he could choose his favorite agent.

Persuasiveness of an Agent

Two participants were affected by the agent's persuasion. Both of them had chosen "I do not exercise regularly" on the pre-questionnaire about exercise. One participant said that "I have got to know new facts about exercise and I may remember them and exercise someday." On the other hand, four participants were not persuaded. The comment of such participant was "I will not change my behavior unless I start a conversation with an agent on my own will".

This result suggests relationship between a topic of a conversation and participants' current exercise behavior have to be considered while the experiment with significant number of participants is expected. Specifically, we did not assign the participants to a group according to exercise behavior of them; in addition, the conversation which we have prepared contained same persuasion for all participants except for a conditional branch on lines from 13 to 16 in Fig. 2.

Each option of the questionnaire about exercise can refer to a behavior model. According to Prochaska et al. behavior can be divided into five stages from *precontemplation* level to *maintenance* [7]. Among these stages, *precontemplation* is a stage for those who do not intend to change their behavior and *contemplation* is for those who are seriously considering changing their behavior. In addition, different processes of change are needed in order to move from one stage to another smoothly. For example, giving information about a target behavior to a *precontemplation* or *contemplation* individual is *consciousness-raising*. Informing participants of positive aspect of exercising can be consciousness-raising for those who answered "I do not exercise regularly" to our questionnaire; however, not to those who exercising regularly.

Conclusion

We discussed an effect of letting a user choose his/her favorite agent on behavior of the user. In addition, we also conducted an experiment constructing an agent system with which a user can have a conversation in order to examine the effect of a favorite agent. In the study, we divided participants into four groups according to two conditions. One condition was whether a participant can choose his favorite agent and the other condition was whether a participant has a "regular" favorite characters, game or anime in his/her daily life.

As a result, making an agent selectable by a user according to his/her preference has a possibility of increasing credibility of an agent system. However, we still have to adopt personalities, voices and the contents of conversations to the appearance of an agent in order to reduce unnatural feelings from participants.

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