Persuasive Conversational Agent with Persuasion Tactics

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Abstract. Persuasive conversational agents persuade people to change their attitudes or behaviors through conversation, and are expected to be applied as virtual sales clerks in e-shopping sites. As an approach to create such an agent, we have developed a learning agent with the Wizard of Oz method in which a person called Wizard talks to the user pretending to be the agent. The agent observes the conversations between the Wizard and the user, and learns how to persuade people. In this method, the Wizard has to reply to most of the user's inputs at the beginning, but the burden gradually falls because the agent learns how to reply as the conversation model grows.

Generally speaking, persuasion tactics is important to persuade people efficiently, but it is also useful to reduce the burden of the Wizard because it guides the Wizard to a way of persuasion. In this paper, we explicitly implement persuasion tactics into the persuasive conversation agent. Evaluation experiments show that the burden (the input ratio) of the Wizard was reduced from 55% (without tactics) to 33% (with tactics), although the success ratio of persuasion was little improved.

1 Introduction

A large number of e-shopping sites are available on the Internet, competing with each other to sell more goods to customers. Some sites like amazon.com employ a scheme to recommend items to the customers based on their purchase/browsing record stored in their database. Researchers in the field have been working to develop recommender systems that assist customers to select one from a huge number of items [1]. Recently, explanations of recommendation are becoming an important research issue to improve the performance of recommendation and persuasiveness is a key element of the explanations to convince the customers to select an item [2].

Persuasive technology draws attention as a means to create interacting computing systems that can change people's attitudes and behaviors [4]. Conversational agents will play an important role in such systems because they can interact with the users through conversation in a proactive manner [5]. Many of the conventional conversational agents aim at chatting with users as long as they can without any specific goal of conversation [3]. On the other hand, persuasive conversational agents have a clear goal to persuade the users to change their attitudes or behaviors. It is not appropriate for persuasive agents to leave the chat in the course of nature. As human persuaders change

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their responses depending on the opponent's utterance and on the situation, persuasive agents need to flexibly interact with the users to persuade them.

Developing a conversational agent requires a conversation model that represents how the agent responds to an input from a user. It is not easy to create a conversation model in which the agent interacts well with the users and a large number of conversation rules need to be created by experts. To reduce the burden, we integrate a learning agent and the Wizard of Oz method [7], in which a person called Wizard talks with a user pretending to be the agent. The agent learns from the conversations between the Wizard and the users, and constructs/refines its conversation model. At the beginning, the Wizard has to input most of the replies, but gradually the agent learns to reply appropriately as the conversation model grows. When a reply made by the agent is not appropriate, the Wizard can correct it.

We have developed a persuasive conversational agent using the Wizard of Oz method and have applied it to persuade users to change their preference from one camera to another one [12]. In the first experiment with 60 subjects, the agent with the help from the Wizard succeeded to persuade 25 (42%) out of the 60 subjects. In the second experiment, the agent that used the conversation model created in the first experiment succeeded in persuading one user (out of 10) without any help from the Wizard; another 2 subjects were persuaded with some assistance by the Wizard. These results show that the persuasive conversational agent is promising.

However, to develop such a persuasive conversational agent, we still have two problems; how to maintain a large conversation model and how to make an agent more persuasive. We, in this paper, introduce persuasion tactics into the persuasive conversational agent. We decompose a single set of conversation rules stored in a conversation model into multiple sets, each of which represents a phase of persuasive conversation with a sub-goal to achieve in the course of persuasion. Hence, the structure of the phases can be viewed as a persuasion tactics. By this decomposition, the persuasion tactics and the conversation rules are explicitly split and it is easier to maintain the conversation model than before. We evaluate the effect of persuasion tactics from two viewpoints; the performance of persuasion and the burden of the Wizard.

In Section 2, we address persuasive conversation agents and the conversation model to persuade users. We also explain the Wizard of Oz method to develop the conversation model through collaboration between a Wizard and a learning agent. In Section 3, we revise the conversation model to be the one with multiple phases to represent the persuasion tactics explicitly. In Section 4, we perform an experiment to show the advantages of the conversation model with tactics by using a task to persuade participants to choose a digital camera. We measure the performance of persuasion along with the burden of the Wizards. We conclude this paper with our future work in Section 5.

2 Persuasive Conversational Agents

2.1 Conversational Agents and the Wizard of Oz Method

Conversational agents interact with users through conversation to assist them in their information processing tasks such as information retrieval from the Web [6]. ALICE

(Artificial Linguistic Internet Computer Entity) is representative of the conversational agents now available on the Web and is being used in a number of Web sites.[1]

The conversation model represents how an agent replies to inputs from users. There are two major approaches to construct a conversation model. The first one is by describing scenarios or rules as is used in ALICE, PPP Persona [8,9], and so on. ALICE uses a language called AIML (Artificial Intelligence Markup Language), based on XML, to describe rules, each of which links a pattern, which represents an input from the user, to a template, which represents a reply from the agent. This approach forces us to write a large number of rules to make the agent reply fluently to various inputs from the user.

The second approach is to utilize a conversation corpus as is done in Command Talk [10]. In this approach, we need to establish a very large conversation corpus in advance to construct a conversation model. However, the agent cannot reply appropriately to an input if the input is not in the corpus.

This paper takes the approach of integrating a learning agent and the Wizard of Oz method [11] as shown in Fig. 1. In the Wizard of Oz method, a person called Wizard interacts with the user pretending to be the conversational agent. The Wizard can reply to an input from the user when the agent cannot reply appropriately. The agent learns from the Wizard how to reply to an input by constructing a conversation model and can thereafter reply to the next instance of the same input. At the beginning, the Wizard has to reply to most of the inputs, but the burden of the Wizard falls because the agent learns to reply as the conversation model matures.

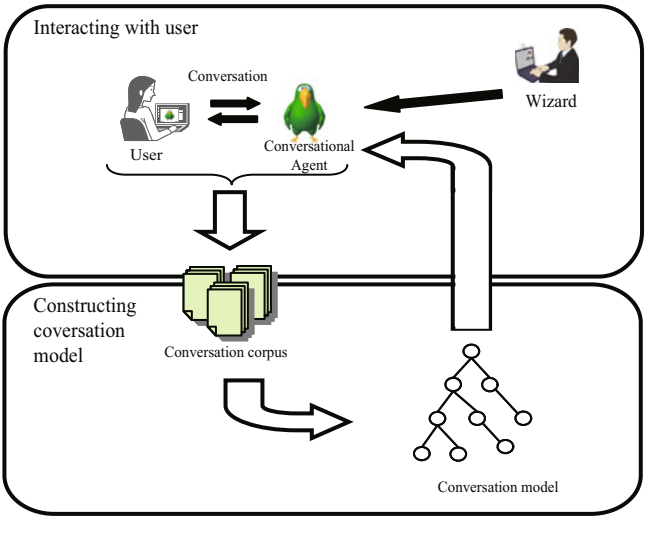

Fig. 1. Integrating a learning agent and the Wizard of Oz method

2.2 Persuasive Conversation

We introduce a conversational agent that persuades users as shown in Fig. 2. The user initially prefers Camera A over Camera B, and the agent tries to persuade her to change

[1] http://www.alicebot.org/

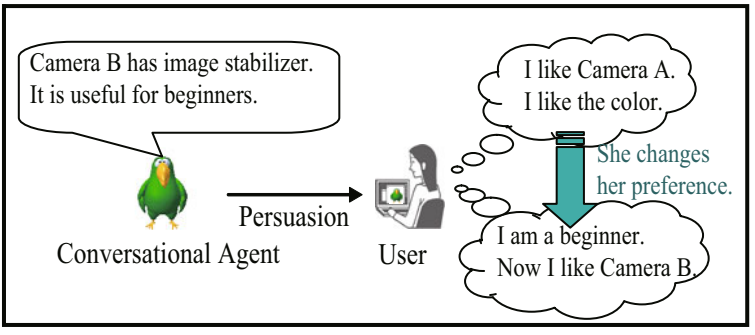

Fig. 2. Persuasion through conversation

her preference from A to B. If the user comes to prefer B, we define the persuasion as successful; otherwise, a failure.

Conventional conversational agents reply to an input from a user if the input matches a rule in the conversation model. When it matches multiple rules, one of them is selected. The selection process depends on the system and/or the applied domain. Persuasive agents, on the other hand, should select the rule that is more likely to lead to success. To this end, we have proposed a goal-oriented conversation model that considers the success probability of persuasion and a learning method to update the probability as derived from persuasive conversations between the Wizard and users [12].

Goal-oriented conversation model. The conversation model can be represented as a state transition tree where a statement is represented as a link to change a state from one to another as shown in Fig. 3. In this example, the agent tries to persuade a user to change his/her choice of camera. There are two types of states; user states, which represent the user talking, and agent states, which represent the agent talking. They are interleaved on a conversation path. A conversation path represents the flow of conversation between the agent and one or more users and begins with the initial state and terminates with either success or failure. Each state is assigned a success probability score.

The agent decides how to respond to an input from the user following the conversation path held by the model. If the input matches a statement on a link to an agent state, the agent chooses a statement that links the agent state to a user state with the greatest success probability.

For example in Fig. 3, the agent says “Which camera would you like to buy, A or B?” at the beginning. If the user says “I like A,” the agent then replies “Why do you choose A?” following the stored conversation path. If the user says “I like B,” there are two reply candidates. The agent chooses the reply “Why do you choose B?” because that link leads to a user state with higher success probability (0.25).

Updating conversation model. When an input from the user does not match any statement on the stored conversation path, the conversation path is branched and the success probability scores are updated depending on persuasion success/failure as shown in

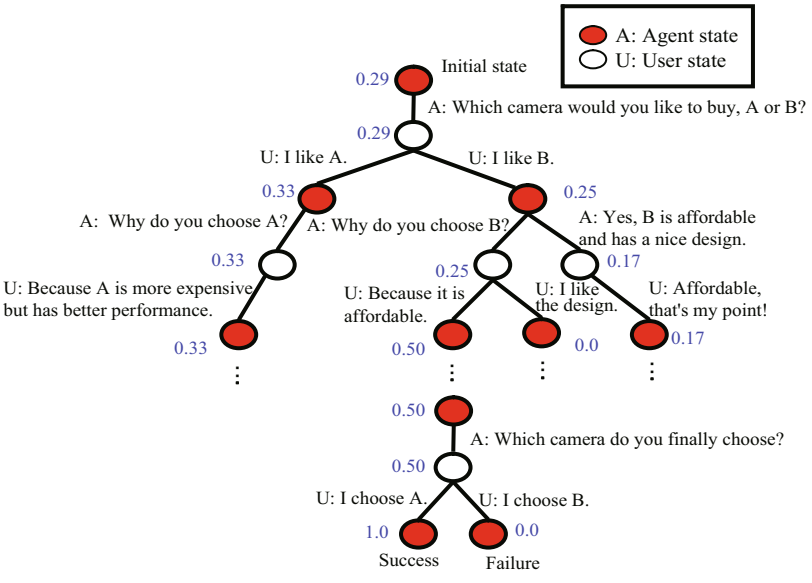

Fig. 3. Conversation model

Fig. 4. If the persuasion succeeds (fails), 1.0 (0) is assigned to the terminal state. The success probability score of each state except the terminal state in the conversation model is updated as below.

- Agent state s

$$Q(s) \leftarrow \max_{t \in succ(s)} Q(t)$$

- User state s

$$Q(s) \leftarrow \frac{1}{|succ(s)|} \sum_{t \in succ(s)} Q(t)$$

$succ(s)$ is a set of child states of s. At an agent state, the agent can choose what to say, so the success probability is set to be the maximum one among child user states. On the other hand, at a user node, the user chooses what to say, so the success probability is set to be the average one among child agent states. We here assume that the user takes a neutral attitude toward the agent. If we assume the user takes a negative attitude, the success probability should be the minimum one.

For example, when an agent says “Why do you choose B?” using the conversation model shown in Fig. 3, if the user replies “Because I seldom take photographs.” which is not contained in the model, a new conversation path is created by branching as shown in Fig. 4 following a persuasive conversation between the Wizard and the user. Let us assume the persuasion succeeds, so 1.0 is attached to the terminal state of the branched path and each state on the conversation path is updated as mentioned above.

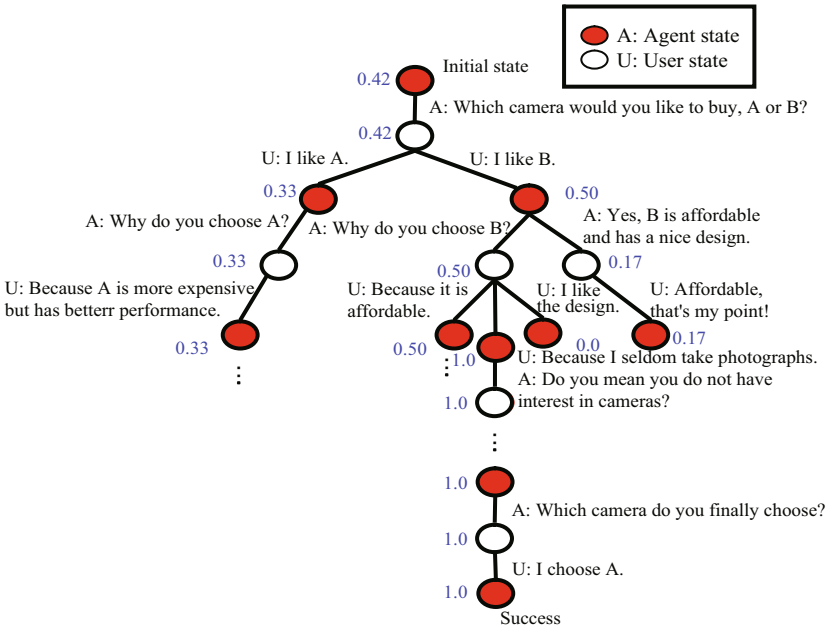

Fig. 4. Updated conversation model

Performance of Persuasive Conversational Agents. We performed two experiments to measure the performance of persuasive conversational agent [12]. In the first experiment with 60 subjects, the agent with the help from the Wizard succeeded to persuade 25 (42%) out of the 60 subjects. In the second experiment, the agent that used the conversation model created in the first experiment succeeded in persuading one user (out of 10) without any help from the Wizard; another 2 subjects were persuaded with some assistance by the Wizard. The experiments show that the persuasive conversational agent looks promising.

However, we have some problems to develop such a persuasive conversational agent.

1. We need a large conversation model to persuade users effectively. On the other hand, it is difficult to maintain such a large conversation model. It is not easy to change conversation rules in the model to make the agent more persuasive. Actually, it is difficult to analyze the model to know what rules are effective or not to persuade the users.
2. A conversation model for persuasive agents consists of two elements; one element is conversation rules to talk with the users fluently and another one is tactics to persuade them. We need good tactics to persuade them effectively. These elements are mixed in a conversation model and it is difficult to decompose clearly into two elements.
3. Persuasive agent requires a lot of assistance from the Wizard to persuade the users. As mentioned above, the Wizard needs two skills; one skill is to talk with the users and another skill is to persuade them. Generally speaking, it is easy to find a Wizard to talk well but not easy to find one who is a good persuader.

To cope with the above problems, we revise the conversation model into one with multiple phases. Each phase has a sub-goal to achieve in a course of persuasion, and the structure of the phases can be viewed as a persuasion tactics.

3 Persuasive Conversation Agent with Persuasion Tactics

The process of persuasive conversation can be represented as a sequence of utterances. The sequence can be decomposed into multiple sub-sequences of utterances and a subsequence is called a phase in this paper. Each phase has a goal to achieve such as "Ask which camera he/she prefers?" Hence the process of persuasive conversation can be represented as a sequence of phases. The sequence of phases may change depending on the responses from the user. If the user likes a camera because of the number of pixels, the agent tries to explain that the number of pixels is not important to choose a camera. If the user likes a camera because of its image stabilizer, the agent tries to explain that the image stabilizer is useless if photos are taken only in the day time.

The persuasion tactics hence can be represented as a flow chart shown in Fig. 5, which is an example of persuasion tactics to be used in digital camera sales. This tactics is derived from the conversation model created in the experiment in [12]. It represents that of the Wizard participated in the experiment.

We first show two digital cameras to a customer A and B as shown in Table 1. Camera A has better features about the number of pixels and image stabilizer than camera B, but the price and the weight of A are more than those of B. The purpose of this persuasion is to make the user change his/her choice from the initial one to another one. The tactics shown in Fig. 5 represents a phase as a box. The agent first asks the user which camera he/she prefers. If he/she prefers Camera A over B, the agent tries to persuade him/her to change his/her choice from Camera A to B. The agent then asks a reason why he/she prefers Camera A. If the number of pixels is appealing to him/her, the agent explains that the number of pixels is not important. If he/she does not accept the explanation, the agent tries to refute the advantage of another feature of Camera A. Finally, the agent explains the better features (price and weight) of Camera B, and asks again which camera he/she chooses. If he/she chooses camera B, then the persuasion ends with success. Otherwise, it ends with failure.

4 Evaluation

We evaluate our persuasive conversational agent from two viewpoints; (1) the input cost of Wizard when utilizing responses created by the agent, and (2) the persuasiveness of the conversation model, comparing to one without persuasion tactics.

We perform an experiment in which the persuasive conversational agent tries to persuade participants to choose one of two digital cameras using the following procedure.

1. Each participant reads the specifications of two digital cameras A and B, as shown in Table 1.
2. The participant chooses his/her favorite one from the first impression.

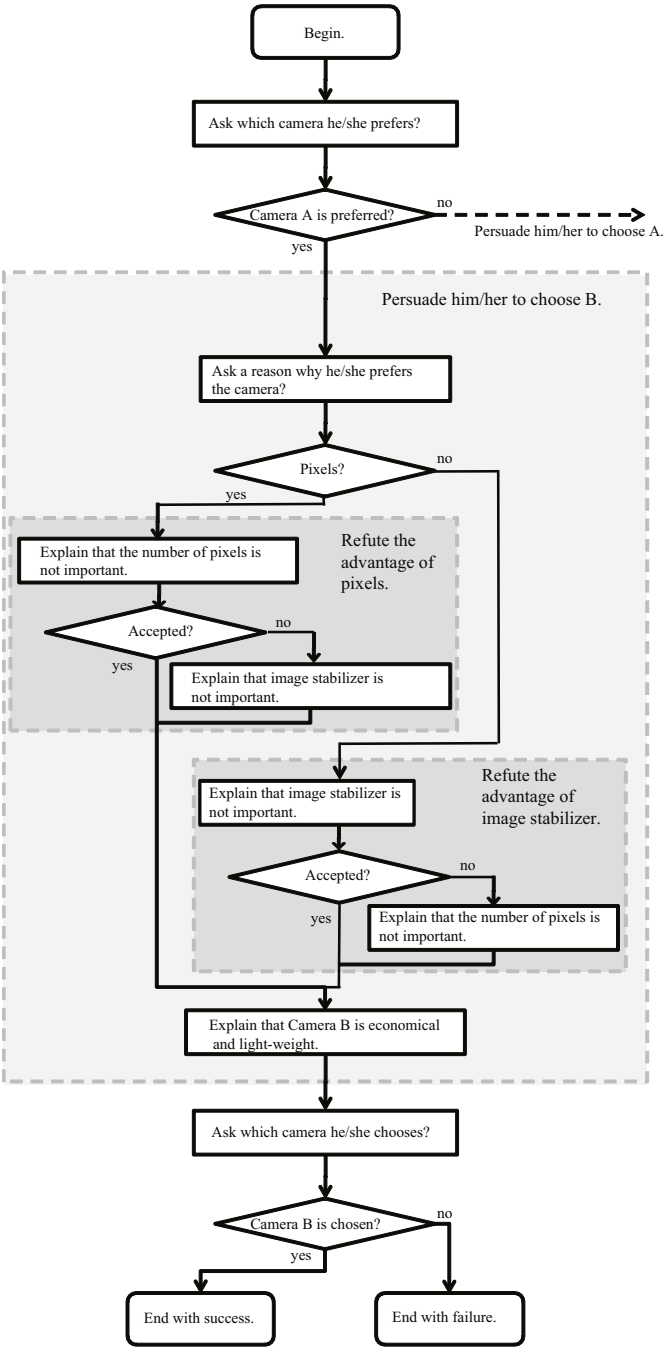

Fig. 5. Example of persuasion tactics

Table 1. Specifications of digital cameras A and B

	A	B
Price	¥35,000	¥29,800
Resolution	10M pixels	7M pixels
Weight	154g	131g
Image stabilizer	Yes	No

Table 2. Result of persuasion

System	Initial choice	Final choice	Number of participants	Success/Failure
With Tactics	A	B	7(20.0%)	Success
	B	A	6(17.1%)	Success
	A	A	7(20.0%)	Failure
	B	B	15(42.9%)	Failure
Without Tactics	A	B	8(36.4%)	Success
	B	A	0(0.0%)	Success
	A	A	6(27.3%)	Failure
	B	B	8(36.4%)	Failure

3. The agent, with help from the Wizard, tries to persuade the participant to choose the other one. It first asks why he/she chose the one selected, and then it tries to refute the reason and recommends the camera that he/she did not initially choose.
4. The participant is then asked which camera he/she prefers again. The persuasion succeeds (fails) if he/she changes (does not change) his/her choice.

In the experiment, we use a conversation model that has been made by persuasive conversations between a Wizard and 60 university students (48 males and 12 females) in the experiments in [12]. We employed 2 university students (2 males) as Wizards and new 57 university students (44 males and 13 females) as participants who are persuaded by one of the two Wizards with the agents. Each Wizard repeated to use one of two types of agents; one with tactics and one without tactics, interchangeably. How to present the persuasion tactics to the Wizards is described in [13].

The results are shown in Table 2. The agent with tactics succeeded to persuade 13 participants (37.1%) out of 35 and the agent without tactics succeeded to persuade 8

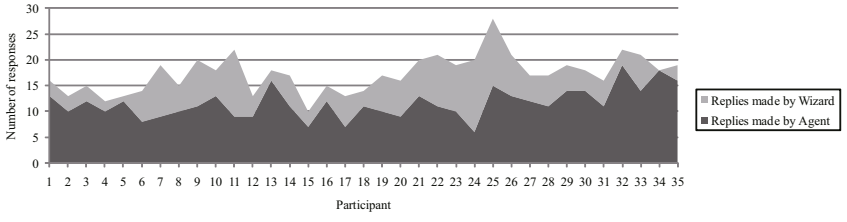

Fig. 6. Number of responses made by the agent with tactics

participants (36.4%) out of 22. There was no significant difference of the performance between two agents.

Fig. 6 shows the number of responses made by the agent with tactics to each participant. The responses are categorized into two groups; one is made by the agent and another is manually made by the Wizard. Fig. 7 shows the ratio of responses made by the agent with tactics to each participant. Overall, for the 35 persuasive conversations, the Wizard accepted 67% of the agent's responses as appropriate.

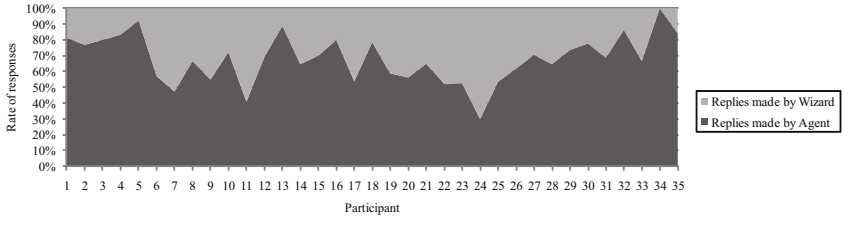

Fig. 7. Ratio of responses made by the agent with tactics

Fig. 8 shows the number of responses made by the agent without tactics to each participant. Fig. 9 shows the ratio of responses made by the agent with tactics to each participant. Overall, for the 22 persuasive conversations, the Wizard accepted only 45% of the agent's responses as appropriate. This means that the input cost of the Wizard with tactics was reduced more than that without tactics.

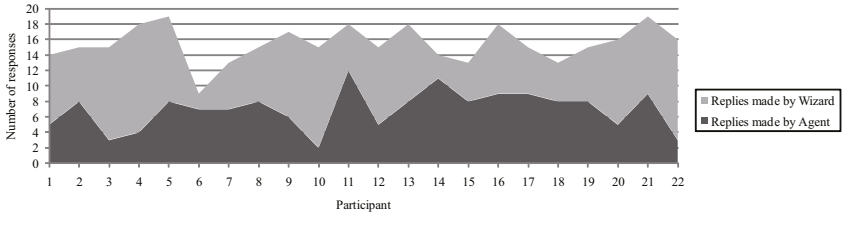

Fig. 8. Number of responses made by the agent without tactics

Introducing persuasion tactics into an conversation agent can reduce the burden of the Wizards. The goal of each phase is clearly shown to the Wizard, and it is easy for him to know how to persuade participants. Without tactics, the Wizard is not clear about the course of persuasion and he has to respond to the participants by himself. The number of responses made by the Wizard hence increases.

The difference of performance in the persuasion was not remarkable between an agent with tactics and one without tactics in this experiment. The Wizards used the two agents interchangeably, so they gradually learns how to persuade participants from the agent with tactics. To improve the performance, we have to improve the tactics itself, but how to deal with this issue is left as our future work.

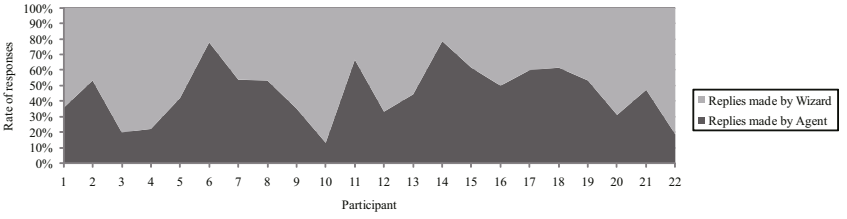

Fig. 9. Ratio of responses made by the agent without tactics

5 Conclusion

Persuasive conversational agents are expected to be virtual sales clerks on e-shopping sites. We have developed a persuasive conversational agent with the Wizard of Oz method. The agent learns how to persuade people through conversation between the Wizard and the users. Persuasion tactics is important to persuade people efficiently and we explicitly implemented persuasion tactics. Evaluation experiments show that the input ratio of the Wizard was reduced from 55% to 33% although the success ratio of persuasion was little improved.

In future work, we will improve the success ratio of persuasion by elaborating the persuasion tactics. To this end, we need to analyze the log record of persuasive conversation between the agent and the users. Another future work is to increase the maintainability of the conversation model. At present, it is not easy to modify the conversation model. We need to develop a GUI for this and to visualize the persuasion strategies contained in the model.

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