Behaviors for Getting Conscious Responses

Toshihiro Osumi*, Masato Noda*, Hirotaka Osawa**, Yuki Kuwayama*,
Kazuhiko Shinozawa*** and Michita Imai****

*Graduate School of Science and Technology, Keio University, Yokohama, Kanagawa, 223-8522, Japan
(tosihiro@ayu.ics.keio.ac.jp)
**PRESTO, Japan Science and Technology Agency, Chiyoda-ku, Tokyo, 102-0075, Japan
***ATR Intelligent Robotics and Communication Laboratories, Hikaridai, Kyoto, 619-0288, Japan
****Faculty of Science and Technology, Keio University, Yokohama, Kanagawa, 223-8522, Japan

Abstract: This paper investigates robot's behaviors to get voluntary conscious responses from users. Our final goal is to construct an asynchronous human-to-human communication mediated by a potable robot. The robot has a behavior system which makes the robot behave in response to the acquired conscious response. The system also enables the user to give the robot feedback at anytime and anywhere while the robot presents a script which an author prepared. We investigate how well the behavior system encourages the users to give the robot feedback and how much the users consider inputting the response to be meaningful. The results show that there are definite relation between response behavior and the acquisition of the conscious responses.

Keywords: Conscious response, Computer-Mediated Communication, Input and Interaction technologies

I. INTRODUCTION

In this paper, we investigate robot's behaviors to get a voluntary conscious response from users. Our final goal is to construct an asynchronous human-to-human communication mediated by a portable robot (Figure 1). The robot has an advantage over the other interface when giving user information. It can tailor the contents of the information to him/her based on his/her environment by using emotional expressions and gestures [2, 3]. In particular, the emotional and gestural expressions provide an author with the memorable way of presenting his/her view and emotion experienced at a certain place. The embodied expressions of a pointing gesture and a gaze movement also provide him/her with the exact way of presenting information related to a certain place or an object. The author-to-user communication via the robot increases the author's motivation for creating and revising the content of the interaction. In addition, the interactive presentation by the robot can prompt a user to prepare his/her response to the presented information. To substantialize the robot mediated communication, we must develop an individually-owned robot, an environment that author can create contents without an expert knowledge and a behavior system that generates robot's behaviors for presenting information and encouraging the user to give his/her response to the presentation. In this paper, we focus on the acquisition of a conscious response and investigate the effect of the robot's behaviors when getting the users responses.

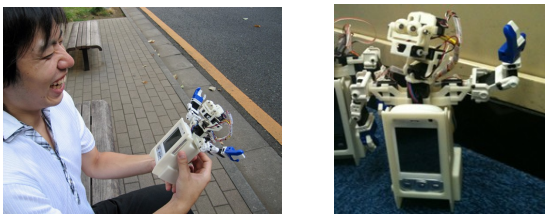

Fig.1. Communication via the portable robot

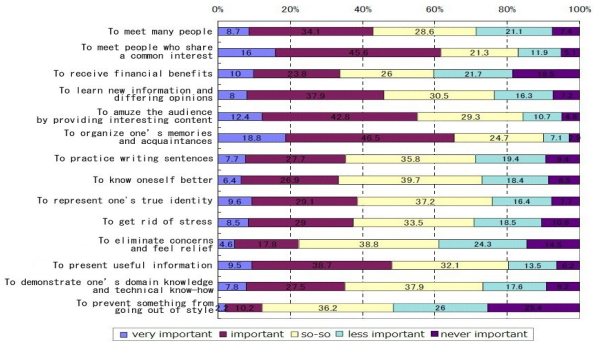

Fig.2. Motivations for updating blogs

The style of the author-to-users communication is the common on the web. The style is that an author creates his/her original content and a PC user provides a comment after reading it. For example, blogs and social networking services have the function which is able to be posted comments about the entry as the feedbacks from users. The feedbacks are strongly linked to motivation to use the service. In Japan, more than half of users said that getting to know people who share their interests and including entries that visitors enjoyed were great motivations for them to update their blogs [5] (see Figure 2). This result suggests the significance of

feedback such as a comment, a reply and a ReTweet. Nico Nico Douga [6], a characteristic video-sharing website in Japan, has caught on with many people. In contrast to other video-sharing sites such as Youtube, Nico Nico Douga allows comments on specific time code and can superimpose the comments directly on the video when showing the commented video frames. The feedbacks on the web are posted voluntarily and consciously from users and are not the one that a system obtains by analyzing the user's behavior of browsing or access logs.

However, many communication robots acquire feedback from a user by using sensors (e.g. cameras, touch sensors, laser range finder and other devices) or the user's choices in a scenario. The feedback is the unconscious responses of the user's behaviors. It is different from the communication services on the web acquire conscious feedback which is provided voluntarily from the user. But feedbacks by using sensors and the users' choices are insufficient for the use as the author-to-user communications, because the unconscious feedbacks do not reflect the user's impression of the presented content. To communicate with other people via a robot, the robot requires the function that can acquire voluntary conscious feedbacks from users, like the services on the web.

The design which gives users a motivation for inputting conscious feedback is necessary to acquire conscious feedbacks efficiently. Kuno et al. [1] showed that museum visitors' nodded and mutually gazed more frequently when a robot turned its head at significant points than when a robot did not. This result suggests that felicitous behavior at a relevant point establishes joint attention and arouses interest in the robot. Therefore we developed a behavior system which generates a behavior for encouraging the user to feed conscious response anytime and anywhere while the robot presents the content which an author provided. The behavior is generated in response to acquired conscious responses. The reactive behavior induces natural interaction which includes the conscious responses. We installed the system into the mobile phone based robot called "TenoriAvatar". We also conducted two experiments to observe the effects of the behaviors on the frequency and range of the conscious response and on how meaningful users thought their response was. We believe that the acquisition of the conscious response from users is necessary in the author-to-user communication via a robot or an agent. The study provides a fundamental knowledge to acquire conscious responses.

II. EXPERIMENT

1. Apparatus

In our experiments, we used a phone based portable robot called "TenoriAvatar" (Figure 1), a modified version of "BlogRobot" [4]. TenoriAvatar is HTC Corporation's mobile phone HTC P3600, upon which a robotic head and robotic arms are installed.

In the experiments, we used simple linear scenarios which were composed only of sentences for utterances and tags for gestures and images. Thus, the scenarios had no branches. When a scenario is selected, TenoriAvatar loads the scenario and utters sentences in turn. If TenoriAvatar loads a gesture tag in a sentence, TenoriAvatar does the gesture associated with the loaded tag right there. The gestures come in twelve types including happy, unhappy, bye-bye, wow, and walking. In addition, when TenoriAvatar is not doing a gesture, it blinks at fixed intervals to show the system is running.

2. Behavior system

The user feeds conscious response by pushing a feed button set up on the display of the mobile phone. Only two types of conscious response can be fed: positive and negative. The arrangement of feed buttons is shown in Figure 3. The lower left button is the positive feed button, and the lower right is the negative feed button. When the user sympathizes with the content or finds a content funny, s/he pushes the positive feed button. When the user does not sympathize with the content or finds the content anemic s/he pushes the negative feed button.

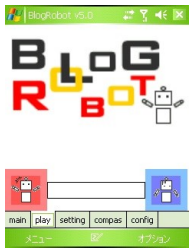

Fig.3. Arrangement of feed buttons

When the user pushes a feed button, TenoriAvatar plays the sound and stops the playback and then performs a response behavior for the fed conscious response. We believe that a break in the playback gives the user the impression that the robot responded to the

fed conscious response. The response behavior is a random combination selected from a gesture list and an utterance list that are prepared based on type of conscious response. The list consists of suitable utterances and gestures for the type of feed button. Thus, a response behavior that is suitable for the feed button that the user pushed is executed. After the response behavior, TenoriAvatar utters a sentence selected from the utterance list for restarting the playback scenario. When restarting, the scenario is played back from beginning of the line of the interrupted sentence. To prevent the same sentence from being uttered over and over, if a user already fed response at the sentence, the response behavior is not executed when s/he feeds conscious response again. Therefore, the response behavior is executed only once for each sentence. If conscious response was fed between the end of the utterance of one sentence and the start of the utterance of the next sentence, the response is contained within the sentence which was uttered at that time. In this case, response behavior is executed, but TenoriAvatar will not play back the uttered sentence and will start playing back from the next sentence.

3. Evaluation of Response Behaviors

Conscious response function attempts to help the user to feel meaningful in input conscious response. We conducted two experiments to observe the effects on the frequency and range of conscious response inputs and on how meaningful users thought their response was. The playback time for each scenario was about two minutes, and each scenario had about ten gesture tags. Each participant held TenoriAvatar in one hand at about 50-cm distance from them. Before the experiment, the participants received a briefing from an experimenter on TenoriAvatar and on the response input method. Participants did not receive an explanation about the response behavior, regardless of the function of the response behavior.

A. Evaluation of Frequency

The experiment on conscious response input frequency was conducted at our university festival. Fifty-eight Japanese people (10 - 59 years old) who came to view our booth participated. Participants played back the scenario with TenoriAvatar with or without response behavior and fed conscious response. The content of the scenario was about expressing a sentiment about the robot, the device, and TenoriAvatar, which were displayed in our booth.

An experimenter handed TenoriAvatar with or without the response behavior to a participant, and the participant played back the scenario about our booth and fed conscious response. An experimenter randomized participants to receive TenoriAvatar with or without it, and to the extent possible, kept the number of experiments with or without the response behavior the same.

B. Evaluation of Motivation

The experiment on conscious response input motivation was conducted at our university laboratory. Fourteen Japanese engineering students (20 - 29 years old) participated. Participants played back the two scenarios with and without the response behavior. We investigated the effect of the response behavior on the motivation to provide conscious response input from the questionnaires that participants filled out after the experiment.

Participants played back two scenarios that explained a college cafeteria and a local character in Japan with TenoriAvatar. One scenario was with the response behavior, and the other was with only sound. To avoid the order effect, the order of scenarios with the response behavior and with only sound was changed for every participant. The order of the scenarios remained the same. After the playbacks, the experimenter had the participants answer questionnaires about their impressions of the first and second playbacks. Evaluation items were about how meaningful they felt their input conscious response was, pleasantness of the process, and whether they would use continuously in seven levels.

III. RESULTS

Figure 4 plots the mean number of conscious responses in the experiment on the response input frequency. In the response behavior condition, the mean number of positive feedback responses was 9.19, negative feedback was 2.90, and the sum total was 12.09. In only the sound condition, the mean number of positive feedback responses was 7.50, negative feedback was 1.04 and the sum total was 8.54. There were no significant differences in mean number of positive feedback responses ($p=.44$) or in the total conscious feedback ($p=.18$). There was a significant difference in the mean number of negative feedback responses ($p=.02$).

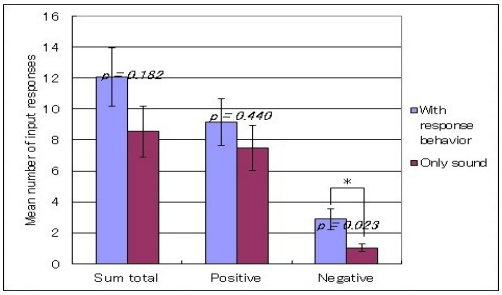

Fig.4. Mean number of input responses with SE

Figure 5 shows the mean number of sentences in which positive or negative feedback was fed. In the response behavior condition, the mean number of sentences was 7.38. In only the sound condition, the mean number of sentences was 5.29. There was a difference in the mean number of sentences in which feedback was fed (p=.07).

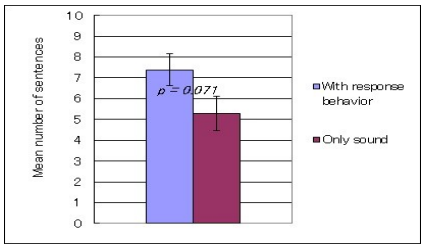

Fig.5. Mean number of sentences with SE

Figure 6 shows the questionnaire results from the experiment on conscious response input motivation. In the response behavior condition, the average mark of meaningfulness in conscious response input was 5.53, pleasantness was 6.00, and will use continuously was 5.13. In only the sound condition, the average mark of meaningful in conscious response input was 3.20, pleasantness was 4.98 and will use continuously was 4.27. There was a significant difference in meaningfulness (p=.01) in conscious response input and pleasantness (p=.02). There was no significant difference in will use continuously (p=.14).

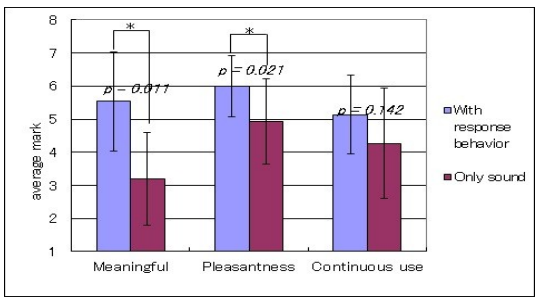

Fig.6. Questionnaire results with SD

VI. DISCUSSION AND CONCLUSION

This paper reported our investigation of the effect of response behaviors on the acquisition of the conscious responses. The results of the first experiment indicated that the existence of the response behavior enhanced the acquisition of negative feedback. These data indicate the possibility of increasing the number of fed conscious responses. Without response behavior, many users pressed the negative feedback button only once. With response behavior, the negative feedback button was pressed more than two times. The result indicates that the input of negative feedback is not done casually like positive feedback is, and response behavior makes it easier to input negative feedback. From the results of the second experiment, the existence of response behavior had an effect on significance and enjoyment. We believe that the result indicate that frequency of acquiring conscious responses motivates the scenario author.

The results indicate that there are definite relation between response behavior and the acquisition of the conscious response. In obvious, the methods using only positive and negative feedback have limitations. We must therefore think of more appropriate ways to obtain conscious responses. If the robot can obtain the rich content of the conscious response, the robot can behave in a very adaptive way.

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