Can robots get "membership" through social interaction?

Hiroyuki FUJII and Michio OKADA
Department of Ecological Communications,
Network Informatics Laboratories, ATR
Hikaridai 2-2-2, "Keihanna Science City", Kyoto
fujii_h@atr.jp

Abstract

To investigate how robots behave as social entities, we analyzed the interaction of humans and "Muu," an embodied artificial entity, to find the salient patterns of behavior that distinguish the robot from humans in the course of interaction. Through exploratory observation, we found the manner of repetition and the address mismatch to be such salient patterns. We discussed how the social display of such patterns as "marked" features plays a very important role in mutual interaction.

Keywords: human-robot communication, social entity, quasi-interpersonal behavior

1 Introduction

Communication robots are expected to becocme a novel social entities that can interact socially with humans. For a communication robot to become an adequate participant in social interaction, it needs not only to implement the mechanism for the skill or ability of communication individually, but also to acquire "membership" in a community in the course of social interaction with other social entities.

Our research is based on the notion of categorizing the social membership of an artificial entity according to the degree of difference between the quasi-interpersonal behavior of humans interacting with the artificial entity and the natural interpersonal behavior of humans interacting with other humans. Humans tend to interact with a robot (or a computer or an animal) in nearly the same manner as they do with the other humans. Such behavior is referred to as quasi-interpersonal behavior.

We analyzed the interaction of humans and "Muu," a communication robot, to find the salient patterns of behavior that distinguish the robot from human in the course of interaction. Consequently, we explored how these salient patterns in interaction are linked to the categorized "membership" in a community.

2 Quasi-interpersonal behavior in human-robot interaction

Chatting or playing is a form social interaction, and, under limited conditions, we can perform this "social" interaction with robots. Humans tend to interact with an object (robot, car, computer, or animal) in nearly the same manner as with other humans. Such behavior is referred to as " quasi-interpersonal behavior" (cf. Yamamoto (1994)[8] , and Takeuchi (1995)[7]).

A series of research using the "Media Equation [6]" paradigm showed that humans considered computers to have social existence along with personality, despite knowing that the computer is merely a machine that certainly does not have a personality. However, the behaviors in interaction sequences with artificial entities have many features that are different from the interaction behaviors among humans. The authors believe that these differences are linked to the definition of the social entities of robots. To define the social aspects of robots, it is necessary to identify the characteristic patterns of interaction sequences that let us distinguish whether an interaction partner is a robot or another human.

In this research, we try to describe such characteristic patterns by analyzing the social interaction between humans and "Muu."

3 Analysis of Interaction between Humans and "Muu"

In the authors' research group, the "Muu project," we have attempted to observe the social interactions between humans and "Muu" in various domains. The communication robot "Muu" was developed for research on social interaction (Fig. 1). Muu was designed for human-robot communication mediated by social display such as contingent utterances, orienta-

Figure 1: Muu : Embodied Artificial Creature

Figure 2: Interaction with "Muu" observed at Kids plaza Osaka

tions of the body, and mutual coordination of body arrangement. Muu has a big fish-like eye, and his rounded body is covered with soft urethane rubber. Muu's shape and behaviors are based on Lorentz's "baby schema," which was assumed to elicit the empathetic attitudes of participants.

In this paper, for analysis, we focused on the situation of participants playing with building blocks while talking with Muu.

Experimental Settings This experiment was implemented in the field at a workshop in a children's museum, 'Kids Plaza OSAKA,' for three days in June 2004 (Fig. 2). In the experimental session, Muu was presented to the participants as behaving autonomously and spontaneously. The utterances made by Muu were selected from 150 prepared sentences by a hidden operator (Wizard of Oz [4] method). These 150 sentences were synthesized by CHATR (speech synthesizer system [1]) for use in the situation of playing with building blocks with children (greetings, operations of blocks, color of blocks, evaluations). One session was about 5 minutes. Every interaction session was video recorded, with the agreement of the participants. As long as the behavior of a participant followed the context of playing with building blocks according to the instructions of the experimenter, Muu could behave appropriately, to some extent, by using suitable timing and contents to initiate, continue, and finish an intaractive session.

4 Analysis

From observing the participants' behaviors at the event, it was clear that the adults acted in a more awkward manner with Muu than did the children. To clarify the pattern of such quasi-interpersonal behavior, we focus here on an interaction session between an adult female and Muu. In that session, the participant seemed to be able to play with the building blocks while talking with Muu for about five minutes. For closer analysis, that session was decomposed into a sequence of pairs of robot-human utterances. This session consists of 32 pairs of robot-human uttarances. Then, an observer (one of the authors) identified the points at which some kind of "trouble" was assumed to occur if that behavior were actually carried out within common human-human social interaction. The identified instances were found in six cases. These cases were sorted into two categories, named "Manner of repetition" and "Address mismatch".

4.1 Manner of Repetition

Case 1 to 4 were included in a category named "manner of repetition." These are the cases in which the contingent responses of the participant with Muu (Fig. 3 b) were out of the normal manner (Fig. 3 a).

Case 1: Reply without adequate interval In about one fourth of the Muu-human uttarance pairs (9/32), the start timing of the human's uttarance followed the utterance of Muu too early. In these sequences, the intervals of two uttarances were 0.1 seconds or less. Commonly, the interval of two utterances is distributed around 0.7 seconds (cf. Nagaoka et al., 2002 [5]). These replies of insufficient interval length indicate that these behaviors were pre-fixed and not conducted in a manner of mutual coodination.

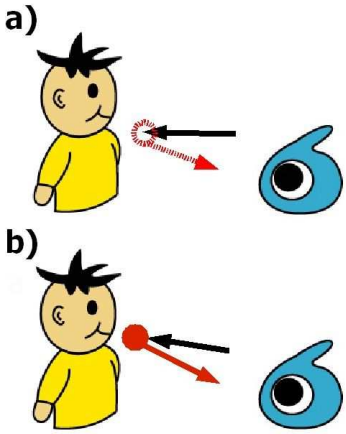

Figure 3: Manner of Repetition

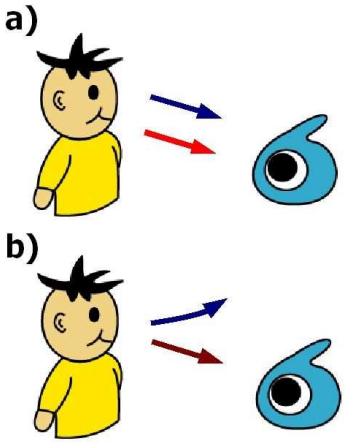

Figure 4: Address Mismatch

Case 2: Repetition without modification Many times (7/32) the participant simply repeated the preceding uttarance of Muu. In the common human-human interaction, simple repetition (like a parrot) is a "marked" pattern. This pattern is sometimes considered as a display of teasing, so it could be a source of "trouble" in the interaction. These simple repetitions usually make continuation of utterance sequences difficult. The frequent occurrence of simple repetition showed that Muu was a social entity that couldn't recognize possible source of trouble in the course of social interaction, and such a lack of ability in interaction could be exposed in public.

Case 3: Ignoring overlap Overlapping of the utterances of Muu and the human occurred two times, but both times the participant continued her utterance and did not seem to care about having been interrupted. These patterns also means that these behaviors were pre-fixed and not conducted in a manner of mutual coodination.

Case 4: Ignoring no-responce of Muu The participant sometimes mentioned "Lion" or "Table" built by the blocks, but these utterances did not seem to require a response from Muu. She didn't display an attitude of concern about the non-response of Muu. Rather she seemed to ignore the non-responce of Muu, and these patterns showed that Muu was a social entity that wasn't able to respond such spontaneous topics in social interaction.

4.2 Address Mismatch

Case 5 and 6 were included in a category named "Address mismatch (Fig. 4)."

These are the cases where the direction of gaze or focusing differed (Fig. 4 b) from the object predicted from the flow of utterance sequences (Fig. 4 a).

Case 5:Gaze Aversion while replying The participant sometimes responded or talked to Muu without changing the direction of her face or gaze. In a face-to-face situation, a speaker usually orients his/her face or gaze to the listener, or at least moves the direction of gaze. This pattern of behaviors showed that Muu was a social entity who didn't have the ability to care about the orientation of the face or gaze of the speaker in a face-to-face situation, and the deficiency could be exposed in public.

Case 6:Seeking other person The participant sometimes sought out another person when she seemed unable to hear the uttarance of Muu. This pattern of behaviors showed that Muu was a social entity that didn't have the responsibility for its own utterances, and the deficiency could be exposed in public.

5 General Discussion

5.1 Display for "marked" pattern

Our analysis showed that the awkward patterns in the observed session of human-robot interaction to be

pre-fixed and not conducted in a manner of mutual coodination. These cases suggested that Muu behave as a social existence that was unworthy of mutual interaction. These cases also suggested that Muu as a social existence was incapable of using the normal manners of mutual interaction.

The "manner of repetition" and "address mismatch" are "salient" or "marked" patterns in social interaction, awareness of such patterns is definitely an important aspect of social entities in social interaction. These results suggested that for mutual interaction, communication robots have to be aware of such "marked" patterns in the couse of interaction and have to display this awareness in approriate situations.

5.2 "Robots" from the viewpoint of "Membership Category Devices"

How to define a social entity in social interaction is not only a problem involving the ability of each individual. From the viewpoint of a socio-cultual approach, a social entity is also defined in social interaction by its "membership" in the community. In the socio-cultural context that we commonly use in mutual interaction, the "membership categorization device" functions as a "label" that has various attribute [2]. The fact that the participants could interact in some way with the robot in their first meeting with it at the event suggested that the "robot" could be categorized as having some kind of "membership" in the surrounding society. Peoples can use some kind of implicit schema of how to interact with the "robot" in human-robot interaction.

It is necessary to create not only a mechanism for social interaction but also the "common sense" of the robot to evolve a social entity that can participate in mutual interaction with humans, to become a social and cultural partner of people.

Acknowledgements

The research reported here was supported in part by a contract with the National Institute of Information and Communications Technology entitled, 'Research on Human Communication.'

References

[1] CHATR
URL:http://www.red.atr.jp/soft_page/chatr.html

[2] Gerfinkel,H.: Studies in Ethnomethodology; Prentice-Hall(1967)

[3] Goan, M., Fujii, H., and Okada, M., The first contact of children and robots: From the field observation in a public space, In Proceedings of Human Interface Symposium 2004, pp.503-508 (2004)

[4] Kelley, J.F.: An interactive design methodology for user-friendly natural language office information applications; ACM Transactions on Office Information Systems, Vol.2, issue 1, pp. 26-41, (1984).

[5] Nagaoka, C., Draguna, M., Komori, M., and Nakamura, T., The Influence of Switching Pauses on Interpersonal Perception in Dialogues, In Proceedings of Human Interface Symposium 2002, (2002).

[6] Reeves,B., Nass,C.: The Media Equation; Cambridge University Press, (1996).

[7] Takeuchi, S., About "Interpersonal behavior," Cognitive studies, **Vol.2**, No.4, pp.103-107, (1995).

[8] Yamamoto, Y, "Interpersonal behavior" Cognitive Studies, **Vol.1**, No.2, pp.95-99, (1994).