

# Neut: “Hey, Let Her Speak”

## Design of a Speech Eliciting Robot that Intervenes in Brainstorming Sessions to Ensure Collaborative Group Work

Naoki Ohshima<sup>(✉)</sup>, Tatsuya Watanabe, Natsuki Saito, Riyo Fujimori,  
Hiroko Tokunaga, and Naoki Mukawa

School of Information Environment, Tokyo Denki University, Tokyo, Japan  
sima@mail.dendai.ac.jp  
<http://sar1.jp/>

**Abstract.** In this research, we developed a speech eliciting robot (Neut) that ensures a cooperative brainstorming environment. Neut creates an atmosphere that makes it easier for participants who are often overlooked to express their ideas, by promoting cooperation from the other participants. Neut moves freely on a table and approaches one or the other participant who has not yet had his/her speaking turn. After stopping in front of such a participant, it brings out a microphone and prompts the participant to speak, while looking around restlessly to suggest to others that they give the participant a chance to speak. In this paper, we will discuss the design of Neut in encouraging participants to speak out, while maintaining neutrality by not itself speaking as a participant.

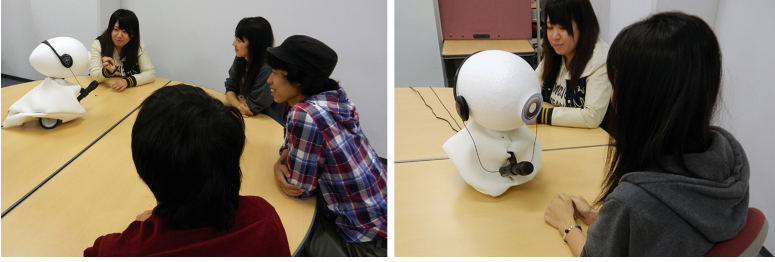
**Keywords:** Persuasive robot · Social etiquette · Conversation analysis

## 1 Introduction

In recent years, interactive artifacts that facilitate human-friendly relationships, such as through sociable robots and anthropomorphic agents, has attracted considerable interest. In particular, research on the development of persuasive robots that offer useful advice to improve person’s social lives is being actively promoted. Engaging and useful discussions are held each year at the ACM/IEEE International Conference on Human-Robot Interaction (HRI) and the International Conference on Social Robotics (ICSR).

An up-and-coming topic in the field of persuasive robotics research is whether a robot can remind humans of social etiquette without using words. If a robot can suggest humans without using words, interaction between robots and illiterate users (children, elderly people who may not be skilled at communication through words, as well as people with communication disabilities) can be realized.

Accordingly, our research focuses on a method of generating an effective suggestion, as in the case of a “Sociable Trash Box [2].” In general, if one wants to advise visitors to pick up garbage in a public facility, one may verbally or through non-verbal signs call attention to the appropriate disposal of garbage.



**Fig. 1.** Neut (speech eliciting robot) is encouraging a participant to speak

By contrast, the Sociable Trash Box uses a different approach. When a robot incapable of picking up garbage on its own (=Sociable Trash Box) was introduced to a public facility, visitors observing the robot began picking up garbage. In order to help this robot with its intended job — picking up garbage — the visitors ended up picking up all the garbage in the public facility. As shown by this example, even without the use of words, and by appealing to apparent inability to complete the task by itself, the robot can suggest people to appropriate disposal of garbage.

Therefore, as a method that uses a robot to remind people of social etiquette without the use of words, we focus on using a robot’s inability to complete a task that it ostensibly desires to accomplish in order to motivate people in the environment to observe decorum [4]. In this study, as part of the overarching project, we held a brain-storming session where the rules stipulated that everyone could speak out, and designed a robot called “Neut” (Fig. 1) that suggested participants to the need for those who had not spoken much thus far to be given an opportunity to do so. In Sect. 2, we detail the concept underlying Neut in encouraging participants to speak out while maintaining neutrality by itself staying silent as a participant. Its application scenarios (in Sect. 3), experiment (in Sect. 4) and case study (in Sect. 5), in order to find out basic effects of Neut are mentioned in this paper. The hardware configuration and the internal processing mechanism of Neut will be discussed in a future study.

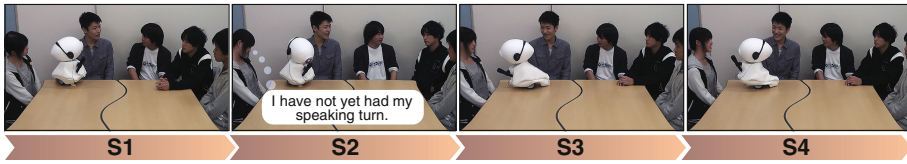
## 2 Neut as a Speech-Eliciting Robot

We called our robot “Neut<sup>1</sup>” based on the first four letters in the word “neutrality.” Neut was designed based on the following five concepts:

### 2.1 Robot of Silence

Neut does not have a speech function in order to avoid negative influence on topics during brainstorming sessions. A robot without a speech function is quiet

<sup>1</sup> Other robots by the same name have been developed. E.g., the SWAT law-enforcement robot “Neut.”



**Fig. 2.** Application scenario

and does not hinder human conversation but also appears a robot’s inability to speak out.

## 2.2 Microphone and Headphone to Elicit Participant Speech

Neut has a wireless microphone in order to elicit participants’ utterances, and a pair of headphones in order to appear to be listening to participants’ utterances by itself staying silent.

## 2.3 A Big, Single Eye

A thin, plastic board modeled on a big eyeball, was attached to Neut’s head. The robot looks around “restlessly” with this big eye to convince talkative participants to allow their more silent colleagues a chance to speak.

## 2.4 Height of a Robot

A group conversation involving more than five participants was assumed in this study. We set the height of Neut to approximately 40 cm, so that the robot’s eye is level with the eyes of a human seated on a chair.

# 3 Application Scenario

For brainstorming to work effectively, a cooperative atmosphere is needed where all participants can exchange their ideas in a collaborative manner. In such settings, occurrences where discussion shifts from one topic to the next without verbal contribution from a limited number of participants must be avoided. In this paper, our speech-eliciting robot (Neut) that ensures a cooperative brainstorming environment. Neut promotes an atmosphere that makes it easier for participants who are often overlooked to express their ideas by eliciting cooperation from the other participants to a discussion. Neut is a small robot that moves freely on a table (S1 in Fig. 2) and approaches a participant who has not yet had his/her turn to speak (left-side person of S2 in Fig. 2), having come to a stop in front of the participant (S3 in Fig. 2), it brings out a wireless microphone and prompts the participant to speak (S4 in Fig. 2), all the while looking around restlessly to suggest to others that they give the participant a chance to speak.

## 4 Experiment

From the behavior of Neut (described in Sect. 3) and the interaction among participants, we observed that the robot encourages participants (1) to speak, (2) to allow others to speak, and (3) to reconstruct the Participation Framework [1]. Furthermore, the results of preliminary investigations (personality testing of the participants) and experiments conducted to ascertain the effects of Neut on participants showed that extroverts deferred to their less talkative colleagues when reminded by Neut that they were speaking out of turn, and introverts became active speakers, hence resulting in improved cooperation among participants.

### 4.1 Experimental Task

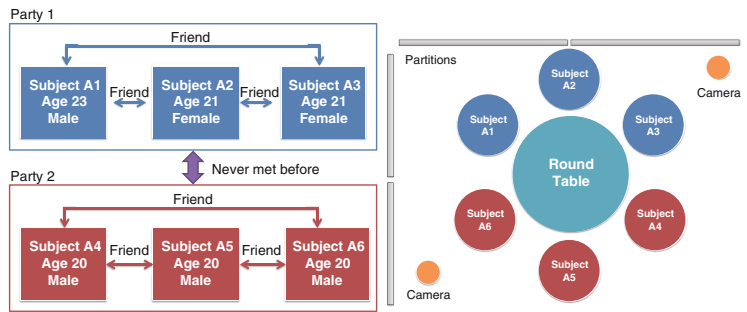
We built on the Desert Survival Problem [3] to create a brain-storming session. In a prototypical task, the participants were asked to imagine that they had crash landed in the middle of a desert. They had certain items, such as a torch, a jack knife, a bandage kit, a pair of sunglasses, and so on, with them. Their task was to rank these items in order of their capacity to increase their chances of survival.

### 4.2 Experimental Procedure

Participants were first given a brief description of the purpose and procedure of the experiment. They were asked to review and sign a consent form after a brief introduction. Following this, they filled out a preliminary questionnaire consisting of 60 questions (personality testing of the participants using the Big Five personality traits [5]) that measured five personality characteristics: extraversion, neuroticism, openness to experience, conscientiousness, and agreeableness. The experimenter then detailed the experimental task for the benefit of the participants. The participants were brought into an experiment room and seated at a table with the robot. The experimenter greeted a participant and prompted him/her to start the task. At the end of the task, the participants answered a post-experiment questionnaire regarding their perceptions of the robot. The task itself took an average of 15 and 20 min and the entire experiment procedure took an hour respectively.

### 4.3 Participants

A total of 11 participants (two groups), aged 20–23 years and with an average age of 20.9 years, participated in the study. The social relations in a group (Group 1) are shown in the left parts of Fig. 3 (we had to omit explanation of Group 2 for want of space).



**Fig. 3.** Social relations between subjects (left-side) and experimental setup (right-side)

## 4.4 Experimental Setup

The right side of Fig. 3 describes experimental setup in Group 1. The experiment room was surrounded by white partitions. Two cameras were arranged in the room such that all subjects could be seen and the conversation could be recorded clearly. The participants were seated at a roundtable approximately two meters in diameter. The participants were free to choose their seats at the table.

# 5 Case Study

We hold a result of Group 1 up as an example. A result of personality testing is indicated in Table 1. According to Table 1, a value of extraversion of subject A3 indicates extremely high. Subject A3 seems the most contribute participant in this group. A value of openness of subject A5 indicates remarkably low. Subject A5 seems an less-contribute participant to express/spread his ideas.

## 5.1 Analysis of Video-Recorded Conversation

A minute and a half after the start of the Desert Survival Problem task, Neut suddenly approached subject A5, and subject A4 said, “This robot can move,”

**Table 1.** Results of personality testing (Group 1)

Subject	Extraversion	Neuroticism	Openness	Conscientiousness	Agreeableness
A1	53	54	53	42	64
A2	51	68	35	38	53
A3	<u>75</u>	44	41	30	63
A4	52	63	62	37	67
A5	37	56	<u>27</u>	40	36
A6	51	60	51	37	52

and subjects A1, A2, and A6 laughed. Two seconds after this remark by subject A4, subject A5 said, “Hi!” while bringing a hand up to the robot, and said “It is cute!” twice. Subject A5 also remarked about Neut’s appearance after 8 s. Next, subject A4 said to subject A5, “You will be interviewed by the robot” to which subject A5 replied “Seriously?” and after 2 s said, “The robot does not seem to have a speak function” twice. The same subject, subject A5, said, “Leave the robot alone” after 6 s, which was followed by the laughter of all participants. Then, the Desert Survival Problem task resumed with focus on subject A3.

We summarize the above conversation in three points. (1) The robot (Neut) encouraged a participant (i.e., subject A5, whose expected openness was remarkably low, as indicated in Table 1) to speak. (2) It promoted to allowing others to speak, e.g., subject A4 persuaded subject A5 to speak by saying “You will be interviewed by the robot.” (3) In Group 1, subject A3, who was expected to contribute the most to a conversation as indicated in Table 1, led the Desert Survival Problem task. However, when subject A4 and subject A5 started a topic related to the robot, subject A3 remained silent and observed their interactions. When the topic related to the robot ended, the Desert Survival Problem task resumed, with the focus back on subject A3. Thus, the robot enabled the reconstruction of the Participation Framework [1].

## 6 Conclusion and Future Work

In this paper, we designed and implemented a persuasive robot (Neut) that intervenes during a brain-storming session to encourage participants to speak out while maintaining neutrality by remaining silent itself. Basic effect of the ice breaker that eases the tension between the first met participants was founded. In future research, we plan to further analyze the interaction between conversational participants and Neut.

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