# Exploring Different Types of Feedback in Preschooler and Robot Interaction

Mirjam de Haas, Peta Baxter, Chiara de Jong, Emiel Krahmer, Paul Vogt Tilburg center for Cognition and Communication, Tilburg School of Humanities, Tilburg University Tilburg, the Netherlands mirjam.dehaas@tilburguniversity.edu

## ABSTRACT

This study considered the feedback of a robot during second language tutoring. Traditionally, robots are programmed to provide feedback as teacher; we propose a robot that acts as a peer to motivate preschoolers during the tutoring. We conducted an experiment with 65 preschoolers (M = 3.6 years) in which the robot varied feedback in three conditions: peer-like (explicit negative), adult-like (explicit positive and implicit negative) and no feedback. The results suggest that feedback did not influence children's engagement (measured via eye-gaze), although children who received peer-like feedback seemed to perform more independently during the learning task (requiring less interventions from the experimenter).

#### **Keywords**

Social robots; second language tutoring; child-robot interaction

#### **1. INTRODUCTION**

Recently, more attention has been given to robots in education, for example to teach children a second language [1], [2]. In such settings the robot is used as an adult teacher, and the ensuing childrobot interactions are based on interactions between children and their teachers. However, in long-term interactions, children may treat the robot as a peer, not as a teacher [3]. Moreover, peer interactions have been shown to have a positive effect on language development [3]. We therefore develop a tutor robot as a more knowledgeable peer, who can adjust the difficulty of the task, give personalized feedback and provide new information, but can also make mistakes, and allows for learning-by-teaching [2].

One of the questions that arises is how should the robot provide adequate feedback during language tutoring, such that is it both pleasant and effective for learning? Adult caregivers normally praise children to encourage them and recast utterances to provide corrective feedback implicitly, but peers may also use explicit negative feedback [5]. Research has shown that explicit negative feedback can have more impact on learning, although positive feedback gives some reassurance to the learner [6].

In this study, our aim is not to investigate the effect of feedback on learning, but instead to investigate how children react to these different types of feedback. We implemented three types of feedback in a NAO-based robot tutor: adult-like feedback, peer-like feedback and no feedback. The adult-like behavior of the robot used reformulations to correct the children ("*Three* means three", the

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text said in English is indicated in Italics, the rest was said in Dutch) and positive feedback ("Well done!") when they responded correctly. The positive feedback was accompanied by colored eye-LEDs to indicate happiness. The second peer-like condition, only provided explicit negative feedback ("That's wrong!"). In the no feedback condition, the robot did not give any corrections or feedback. We examined how children responded to these different feedback conditions in terms of how engaged they were during the interactions as measured through eye-gaze.

## 2. EXPERIMENTAL SETTING

We conducted an experiment with 65 three-year old children (30 boys, 35 girls; M = 3.6 years, SD = 0.29) at different preschools in the Netherlands. Six children stopped with the experiment before it was finished and were excluded from the data. The remaining participants were randomly assigned to the three conditions: adult-like feedback (N=20), peer-like feedback (N=19) and no feedback (N=19). In all conditions the experimenter was seated nearby and provided reassurance for the children if necessary. While the experimenter instructed the children to perform a task, or occasionally provided help if required, she was careful not to provide feedback. Figure 1 shows a participant interacting with the robot and the blocks.



Figure 1. Experimental Setup.

In the week before to the experiment, all children took part in a group introduction to familiarize them with the NAO robot. During the actual experiment, children were taught the first four count words in English. The interaction consisted of an introductory phase followed by the tutoring session. In the tutoring session, each target word was repeated only once, so the task was repeated four times. However, the children were already exposed to the target words in the introduction phase. The interaction was in Dutch and only the target words were in English. During the experiment, the robot requested the child to collect a certain number of blocks using an English target word. After the child collected the blocks, the robot provided feedback to the child according to the condition. For example, in the adult feedback condition, a correct answer would invoke a happy expression, together with a positive verbal feedback, while in the other conditions the robot would continue to the next step. In the case of a mistake, the child would receive negative feedback and then could try again. The duration of the experiment was between 10 and 15 minutes.

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## 3. RESULTS

#### 3.1 Eye-gaze

The experiment was recorded in order to analyze the participants' interaction with the robot, and in particular their eye-gaze in reaction to the different feedback. We annotated the gaze towards the robot, human experimenter, to the blocks and elsewhere and conducted a repeated measures ANOVA to explore the differences within the groups. In general, the children looked significantly longer at the blocks and the robot than at the experimenter (see Figure 2).



Robot Experimenter Blocks Elsewhere

Figure 2. Time spent on gaze direction shown for all conditions combined.

Note. \*p<0.05, \*\*p<0.01.

Immediately after the moment that the robot gave instructions, the children looked more often at the robot and the blocks in the adult feedback and the peer feedback conditions, but looked more often at the experimenter in the no feedback condition (see Table 1). Moreover, children received less help from the experimenter in the peer condition than in the adult feedback condition and most in the no feedback condition (22 times, 36 times and 43 times respectively).

However, we did not see any significant differences in the duration of the gaze towards the experimenter, the robot and the blocks across the three conditions.

 Table 1. Total number of gaze occurrences towards the experimenter, robot or blocks immediately after the robot gave the instructions

Gaze	Adult feedback	Peer feedback	No feedback
Robot	32	50	35
Experimenter	10	11	50
Blocks	50	38	45

# 4. **DISCUSSION**

In this experiment we explored how preschoolers interact with a robot tutor and how they respond to the robot's different types of feedback. Children in the adult feedback condition received most feedback from the robot. Moreover, children in the peer feedback condition received less help from the experimenter, and looked less at the experimenter after receiving the instructions from the robot. According to Spilton and Lee [7] children respond more often to explicit, specific questions than to implicit nonverbal and verbal feedback from peers. This might explain our results, as the children received explicit negative feedback in the peer condition, and required less help from the experimenter.

While the gaze duration results did not show significant differences between the three conditions, the children looked less often at the experimenter in the two feedback conditions. This suggests that children respond well to the robot's feedback. In all conditions, the children looked most at the blocks and the robot. It is possible that the non-significant differences in gaze duration between the conditions are due to individual differences between the children. In general, we saw substantial differences between children in how they responded to the robot, and further exploring these differences is an interesting line for future research.

Importantly, we believe that the implicit and explicit feedback can be useful in a tutoring session, and it would be beneficial for the robot to be able to adapt to the child and the setting with regard to feedback. The implicit negative feedback together with the positive feedback can, for example, be used in cases where the child is demotivated by previous mistakes. The explicit negative feedback may, on the other hand, be used to increase the learning gain of the child.

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