

## ***Proposal Research Traineeships 2020***

### ***1. Title of the Project***

The education practice of social robots in preschools for children with a diverse background: Long-term engagement and linguistic development through storytelling

### ***2. Coordinators***

Dr. Paul Vogt (DCA)

Dr. Rian Aarts (DCU)

### ***3. Project Summary***

In recent years, there has been an increased effort in developing robot tutors to educate both children and adults (Belpaeme et al., 2018). One application domain for robot tutors is second language tutoring to preschool children (Belpaeme et al., 2015; Vogt et al., 2019). This could either be tutoring a popular second language such as English to native speakers of, for instance, Dutch or tutoring the official school language to children from immigrant families. One of the advantages of using a robot is that it may converse with the child in both her first language (L1) and second language (L2).

Previously, we have focused on the engagement of preschool children while interacting with a social robot in a L2 vocabulary learning experiment (Baxter et al., 2017). In a next step, we have investigated the effect of L1 use in teaching L2 vocabulary of 4-6 year old Turkish children (Leeuwestein et al., submitted). Next to vocabulary development, we have focused on narrative competence in an experiment where a social robot performed a storytelling task with preschool children (Goossens, Aarts & Vogt, 2019). Children's intrinsic motivation was explored by implementing the conditions of autonomy, relationship and competence in a social robot. It turned out that the common decline of engagement could be diminished by using this kind of robot (van Minkelen et al., 2020).

While most studies using social robots were carried out at schools, they were typically held in a separate room where children engaged with the robot in a one-on-one experimental setting, and under the guidance of a researcher – not their own teacher. We want to bring the robots into the classroom as part of the teachers' daily program. Moreover, many studies only involve a single session, but in most long-term studies children's engagement tends to wear off over time (Vogt et al., 2019). Increasing children's motivation (van Minkelen et al., 2020) and adding new activities, however, could diminish that (Tanaka et al., 2007).

In this project, we will investigate the implementation of a social robot in a preschool environment with a diverse population of children who are mostly learning Dutch as L2. We will deploy a social robot in a preschool classroom for several weeks, containing various activities to stimulate storytelling. To evaluate the effect of the robot, we will assess two key factors in L2 development (Aarts et al., 2016): vocabulary and narrative development. Additionally, we will investigate how we can monitor children's frequency and degree of engagement automatically using proximity sensors.

#### *Research questions*

1. How can social robots be implemented in a preschool classroom with the aim of stimulating the L2 development of preschool children?
2. What is the frequency and the degree of engagement of children's interaction with the social robot in the daily classroom practice?
3. What are the effects of the implementation of social robots on vocabulary and narrative development in L2 of preschool children?

## *Methods*

The research questions will be answered in co-creation with educational practice. A preschool in Eindhoven has already agreed to participate and preparations have been done in setting up the materials of the program.

The project will have two phases, and for both phases, we will program a NAO humanoid robot to perform a range of activities aiming at the linguistic development of the children. The robot will be present in the classroom for several weeks in a row, where it will operate autonomously without the intervention of a researcher or teacher (though the teacher may initiate activities and will supervise children using the robot). Each week the robot will receive new activities to maintain children's engagement and interest in communicating with the robot. During the experiments, one researcher will monitor the events from a nearby location outside the classroom to intervene if necessary.

The first phase of the project will consist of a three week program aimed at stimulating vocabulary development of the children. Next to that, we will monitor children's engagement with the robot over time using proximity sensors that children wear on their clothes. Preparations of the activities have started already and – if conditions allow - the activities will be piloted in June 2020. (We had planned to conduct this experiment last April, but due to the corona crisis, we were unable to proceed.)

In the second phase of the project, we will develop a six week program aiming at stimulating narrative development of children. On the basis of the foregoing study involving a storytelling program for preschool children (Goossens et al., 2019), activities for stimulating narrative development will be co-created with the teachers and piloted. In addition, we will develop and test automatic methods to monitor and maintain children's engagement with the robot over time.

In both phases, the interactions between robot and children will be monitored using proximity sensors, which allow us to measure the frequencies and duration of interactions between children and robot as a proxy of measuring engagement. Video observations will be made and analyzed in a qualitative manner, to supplement the quantitative data derived from the sensors. Vocabulary and narrative development will be measured using standardized tests (Toets Tveetaligheid), a language production test (picture storytelling task) and thematic word lists of the preschool program in a pretest-posttest design.

## *Collaboration and project results*

The research trainees will closely collaborate in data collection and analysis, but each with their own focus. One trainee will focus on the linguistic and educational part of the study and will put most effort in designing the program. The other student will focus on the technical aspects of this project and will put most effort in the automated measuring of engagement and in programming the social robot. This collaboration also nicely integrates research approaches from the two departments involved. The project incorporates language acquisition research of both departments: educational aspects from DCU, and the research on second language learning using social robots from DCA. The project will result in an initial draft for a publication to be submitted to a journal on child language development or educational robotics.

#### 4. Project timeline

Month	Trainee DCU	Trainee DCA
Sept 2020		Literature study
Oct 2020	Set up of vocabulary program	Implementation in robot Set up of automated measuring of engagement
Nov 2020		Experiment 1 in preschool
Dec 2020-Jan 2021	Set up of narrative program	Implementation in robot
Febr-March 2021		Experiment 2 in preschool
April-May 2021		Data analysis
June 2021		Drafting the paper

#### 5. Research Trainee Profile

Both trainees will be involved in the literature study, design, data collection and analysis. The program will be developed in close cooperation, but one trainee will focus primarily on the linguistic part, while the other is more concerned with the task of incorporating the program into the robot tutor. However, the trainees will be working together and sharing responsibility for both parts of the project.

We are seeking two enthusiastic students, preferably at the Research Master or Master levels (though excellent Bachelor students are also considered), who have excellent communication skills and preferably some background in language acquisition and -at least- affinity with human-robot interaction. For at least one of the trainees, basic programming skills (or the willingness to acquire these) are required. Also, for at least one of the trainees, competency in Dutch is required.

Applications, including a motivation letter and a resume, should be sent to both Rian Aarts ([A.M.L.Aarts@uvt.nl](mailto:A.M.L.Aarts@uvt.nl)) and Paul Vogt ([P.A.Vogt@uvt.nl](mailto:P.A.Vogt@uvt.nl)).

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