Robot Polyglot

Design Document for MSc Socially Intelligent Robotics

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Abstract

This document describes all the relevant information regarding the Robot Polyglot project. Robot Polyglot is a Nao robot able to teach the children of English-speaking expats the Dutch language. This document explains the current situation, existing problem and people who are affected by this problem. Moreover, the document explains how and why the Nao robot can act like a suitable solution. In the evaluation and results chapters, the data collected is summarised, evaluated and the results obtained are explained.

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Foundation

In this part of the document we outline the problem, people who are affected by this problem and their needs. In addition, we discuss how a socially intelligent robot can provide a solution to the problem.

Problem statement

Problem scenario

The Netherlands is a desired destination for expats. In the coming decades an enormous increase in the number of expats is expected. Furthermore, the average length of stay in the Netherlands is also expected to increase. There will also be a higher demand for their children to attend regular Dutch schools instead of international schools [1].

Albert is a highly skilled expat working in the Netherlands. After he was done settling down in Amsterdam he decided to bring his wife and child from his home country England. His child, Lucy, is four years old and is supposed to go to primary school in Amsterdam soon. However, Lucy doesn't speak or understand the Dutch language and is only able to speak English. Before she goes to primary school there is no suitable location where Lucy can start with practicing the Dutch language. This means Lucy has to go to her new school without knowing any basic Dutch words and without being able to express herself in Dutch.

Stakeholders

The main direct stakeholders of this project are English-speaking children between 3 and 6 years-old, in need to learn and practice the Dutch language. This project is targeting kids for various reasons. Mostly due to the fact that Nao would be easily accepted by kids, since previous research has already proven the Nao robot to be successful in teaching children [2][3][4][5].

Continuing with the aforementioned, the novelty of receiving language training from a social robot is probably well received by children. "Child curiosity" as it is commonly called, is a rather well documented, albeit strongly discussed [6] phenomenon. As early as 1899, Williams James argues [6] that curiosity can exist in different forms (*sensational, theoretical, scientific and philosophical among others*) and that children in particular exhibit strong sensational curiosity behavior. William James further explains [7]: *"Young children are possessed by curiosity about every new impression that assails them."*

Next to considerations in terms of desirability (i.e. "*would the target demographic be interested in learning English from a social robot?*"), having children who are between 3 and 6 years-old as the target demographic also has its advantages in terms of feasibility. While no academic or other authoritative source could be found that specifically describes the level of Dutch expected from children up to 6 years-old at primary schools, personal anecdotal evidence of *"how it used to be"* and information found at other online sources [8][9] give the

impression that the Dutch taught at primary schools is already at a relatively basic level. In other words, this also means that the lessons which are given to our target demographic can be rather simple and yet still be sufficient. All these considerations come together to support the decision of having children between the ages 3 and 6 years-old as the main stakeholders.

Other direct stakeholders are the parents/guardians, as they are directly related to this problem. They want to provide their children with fun, education as well as consistent lessons. Therefore they are included in the process, as they will help their children to work with the provided robot. Another group of indirect stakeholders are the language teaching centers. In our vision the language teaching centers are responsible for providing the robots and offering the language course itself. On a financial level they will invest in robots, store them safely and make sure they can be rented by parents or used in their own lessons. In addition to that they could provide us with important information on how to create useful and consistent lessons, as they are experts in that field.

Personas

As is stated above, the target audience is children in the range of 3-6 years, who are children from migrants and are non-Dutch. As this audience is already very specified, there is no division of two or more different persona's in this project; our persona we created is Lucy. Below we provide an example of the her needs and characteristics.

Demographics
Name: Lucy
Age: Four
Origin: England

Situation
- Just moved to Amsterdam with her parents from England.
- Will join the primary school in September.
- Her parents have the desire that she improves her basics of Dutch, as she will experience the least difficulties in the beginning at school.

Personality
- She is very shy and timid, but is curious and willing to learn.

Human-factors knowledge

In order to analyze the human factors relevant to our solution, our team has investigated a research conducted by Tilburg center for Cognition and Communication (TiCC) at Tilburg University[3]. This paper is about developing a social robot that is designed to interact naturally with young children and to help them learn English or Dutch. The main research goal of the paper is about "changing relation between child and robot over the course of multiple one-on-one tutoring sessions"[3]. To measure the changes in the relationship two parameters were used: engagement and performance. As this is a very similar project, the

contents of this paper are very relevant for our research, for instance the experimental setup and the used metrics to assess the relationship.

Results of the experiments performed in the research showed a positive relation between the time the child spends with the robot and the performance on the provided tasks. The more children spend time with the robot the bigger the achievements were in learning the language. This reveals that children need time to feel comfortable having a robot as their mentor. Also the decrease of engagement that was observed at some point is explained by familiarization with the robot.

Technological principles

Social robot

Social robots are designed to interact with people in a natural, interpersonal manner – often to achieve positive outcomes in diverse applications including education [10]. The Nao robot has already been successfully used to educate children [2][3][4][5]. Therefore the Nao robot will be used in our project. Furthermore, as mentioned in the previous section on the stakeholders, the decision to focus on 3 to 6 year-old non-Dutch speaking children also was a practical one. The expected simplicity of Dutch lessons for children of the aforementioned age range allows a higher likelihood of the application to be feasible.

Conversational principles

In our design and implementation we follow the framework for conversational UX design as proposed by Moore [11] that is grounded in conversation analysis. This means we are using adjacency pair sequences for dialog management and context.
Furthermore, it's important that the children will be engaged in the conversation and keep attention. To design such an engaging dialog:

- The robot says the right things in the right context:
  At the start of the first lesson there is some introductory conversation initiated by the Nao robot to make the child feel comfortable and to facilitate the bonding process between child and robot.
- We use appropriate responses in this context of children learning a language when defining intent and responses, for instance avoiding complex words and long sentences.
- Cooperative principle: The robot gives compliments and encourages the children. In order to do this the robot must use speech recognition to process the voice-based input from the user. This input must be stored in the memory of the robot.

Non-verbal behavior

Children are more likely to remember words if the robot uses gestures. This was concluded in a study where authors looked at using a Nao robot to teach Dutch children (from 4 to 6 years old) some English words [10]. By itself, adaptation did not make much difference, but combining it with gestures had the greatest increase in learning. For this reason, in our project the Nao robot should use appropriate gestures to indicate correct/incorrect answers

in order to enhance the learning experience. However, our group didn't go beyond using standard implemented gestures, as gestures were not the main focus of this project. However, it should be noted that the basic conversational gestures that come standard with the software of the Nao already contribute positively to the engagement in conversations.

Personalization

Research has shown that personalization promotes child learning [12]. In our implementation of the NAO robot, interaction with the children is personalized by the use of names and distinguishing between different users and their progress. The robot also gives the child a free choice of topic he desires to learn the Dutch words for. So there is no fixed programme and every child is free to follow his own flow. In the future this personalization method could be extended by asking the child about hobbies or interests, and proposing the topic to be learned next by the Nao itself based on the information gained.

Robot perception

In our project the robot interacts with children to teach them the basics of the Dutch language. Visual perception is not used in this project, because there is no physical interaction between the child and the robot. All the input the robot receives in this project is sound-based. Therefore the robot must use speech recognition to process the voice-based input from the user. This is achieved by adding Google dialog flow. Since the robot uses both Dutch and English the speech recognition is implemented for both languages. This is covered in more detail in the implementation part.

Specification

Design scenario

Albert is a highly skilled expat working in the Netherlands. After he was done settling down in Amsterdam he decides to bring his wife and child from England, his home country. His child, Lucy, is four years old and is supposed to go to primary school in Amsterdam soon. However, Lucy doesn't speak or understand the Dutch language and is only able to speak English. Her parents have applied Lucy for Dutch lessons with a Nao robot at the nearest language center. They received a Nao robot to practice with Lucy at home. The Nao robot provides Lucy with fun and interactive lessons. He introduces several basic words in a fun, interactive way. After several words been practiced, he tries to show Lucy how to combine them and create simple sentences or questions. Using word recognition the robot is able to communicate with her. Furthermore, the imperfect nature of even state-of-the-art word recognition could actually benefit this purpose of getting Lucy to make sure of the correct pronunciation of a target word/sentence. In addition to the former, the ability of the Nao robot to perform simple sounds (e.g. beeps which indicate a listening state) or gestures makes it much more admired by Lucy and makes her feel more engaged in the learning process. After the lesson is finished, Lucy's progress is saved. Next lesson will start with the previously learned topic in order to practice the words learned and after that the studied topic

will be removed from the options on what to study next. She feels more secure about her Dutch language skills and therefore more ready to go to a Dutch school soon.

Application context

Physical environment

Physical environment is important as this projects is focused on speech. The lessons are prefered to be held in quiet place so there are no interferences for the conversation. Also the distance should be taken into account, as the interaction will be better with a shorter distance between children and the robot.

Social environment

As the main target audience is children, the social environment is child-friendly. When the child and the robot meet for the first time, it must be in a safe and known or familiar place for the child. Therefore, the introduction lesson (and all next lessons) will take place at home.
The language centre provides the robot to the parents, including an important and strict explanation how to use. It's the role of the parents to tell their child what's the purpose of the robot and why it's there, to let the child understand what will be going on.

Organizational environment

When the child is interacting with the robot, the parent/guardian (or other adult who's responsible for the child at that moment) is in the same place, i.e. at home, and will act as a controller. Responsibility of the controller is to check if everything is going well with the child and the robot. They will be responsible to help, whenever some error occurs, for example if the batteries run out or the robot falls.

Technical environment

For the successful interaction between the child and the Nao robot, internet connection is required. Power outlet presence in the room is also required, however if the robot is fully charged before the lesson, it's able to complete the lesson on its loaded battery.

Use cases

Title	UC01: Introduction
Objective	Objective 1: Initiate a meeting between the child and Nao robot; Objective 2: Brief introduction to the foreign language
Actors	Child; Robot; Controller;
Pre-condition	The child hasn't met the robot before and wants to learn Dutch words.

Post-condition	The child is familiar with the Nao robot and the Nao “remembers” the child's name by having its name stored in the database.

Happy Flow	1. The controller enters the room with the robot.
	2. The controller places the robot on the floor and asks the child to sit directly in front of the robot.
	3. The robot asks the name of the child.
	4. The robot greets the child with the given name and introduces itself by telling its name and its functional role.
	5. The robot says that it would like to greet the child in Dutch and asks the child to repeat after the robot.
	  a. The child repeats ‘Goedemiddag’ correctly.
	  b. The child has trouble pronouncing ‘Goedemiddag’. See the alternative flow.
	6. More introductory q&a (not implemented)
	7. The introduction lesson is done. The robot asks if the child wants to continue to the next lesson.
	  a. In the case that the child wants to continue to the next lesson see Use case 2
	  b. If the child does not want to continue. The robot says ‘See you next time! I hope you enjoyed our time together’.

Alternative Flow	Every time the robot asks a question it tries to recognise the answer of the child. If the answer is not understood, the flow is as follows:
	
	1. Robot repeats question.
	2. The child answers.
	3. The robot tries to recognize answer.
	  a. If success → return to happy flow.
	  b. If failure and the question has not been asked more than 3 times → return to a1.
	  c. If failure and the question has been asked 3 times already → continue to the next question.

Title	UC02: A regular lesson
Objective	Objective 1: Assess what the child learned from the previous lesson; Objective 2: Teach the child a new lesson; Objective 3: Bond with the child
Actors	Child; Robot; Controller.

Pre-condition	The child has completed the introductory lesson.
Post-condition	The child has learned more about the Dutch language and wants to keep learning together with the Nao robot.

Happy Flow	1. The controller enters the room with the robot, places it on the floor and asks the child to sit directly in front of the robot.
	2. The robot asks for the name of the child.
	3. The child answers, the robot recognizes the name and load the progress of the child.
	4. The robot checks the progress of the child
	  a. If the child has only completed the introductory lesson, continue to step 5.
	  b. If the child has completed another lesson, the robot asks the Dutch translation of 3 randomly sampled words from the previous lesson. There are no multiple tries, so the child either answers correctly or incorrectly. When the child answers correctly, the robot answers enthusiastic. With an incorrect answer, the robot gives the correct answer. Continue to step 5.
	5. The robot gives the child 3 options for lessons from which the child can choose. The answer is recognized, the robot confirms the choice, and the robot loads the lesson.
	6. The lessons consists of ~6 words. For each word the following steps are done
	  a. The robot says 'The next word means (english word). (dutch word)'.
	  b. The child tries to repeat the Dutch word. If done incorrectly, move to the alternative flow. Else continue.
	  c. With a probability of 20% the robot shows the child a sentence in which the current word is used. It says 'Let's use (English word) in a sentence. (English sentence). (Dutch sentence). The robot also says that the child does not have to repeat the sentence, as it is just used to show how the word can be used.
	7. The robot says that the progress of the child is saved.
	8. The robot asks the child if he wants to continue to the next lesson.
	  a. The child wants to continue → restart use case 2
	  b. If the child wants to stop, the robot says 'See you next time! I hope you enjoyed our time together.'

Alternative Flow	Every time the robot asks a question it tries to recognise the answer of the child. If the answer is not understood, the flow is as follows: 1. Robot repeats question.

	2. The child answers. 3. The robot tries to recognize answer. a. If success → return to happy flow. b. If failure and the question has not been asked more than 3 times → return to a1. c. If failure and the question has been asked 3 times already → continue to the next question.

Requirements and Claims

		Claims	
UC Step	**Requirement**	**Upside**	**Downside**
UC01 4 & 5	The robot should be friendly and open in conversation	The child likes the intonation of the robot and interacts positively with the robot	The child doesn't like the behavior and does not want to keep the conversation going
UC01 5	The robot should be able to speak multiple languages	The child recognises that the robot is able to speak multiple languages and admires the skills of the robot	The child feels worried about robot speaking a different language
UC02 3	The robot should memorize answers that are given by the child in previous lessons	The child bonds with the robot and sees him more as a conversation-partner then as just a teaching device	Child expects the robot to remember all the details they share. When this isn't the case, it will damage the long-term bond
UC02 4	The robot should be able to enthuse the child and react enthusiastic on the child's answers	The child likes the way the robot speaks and is motivated to finish the lessons	Child expects only fun lessons and wants everything to be fun

Interaction diagram

The interaction diagrams below displays the use cases relevant for the successful workflow of the robot.

Diagram 1: The diagram below illustrates the flow for the situation when a participant starts an interaction with the Nao robot.

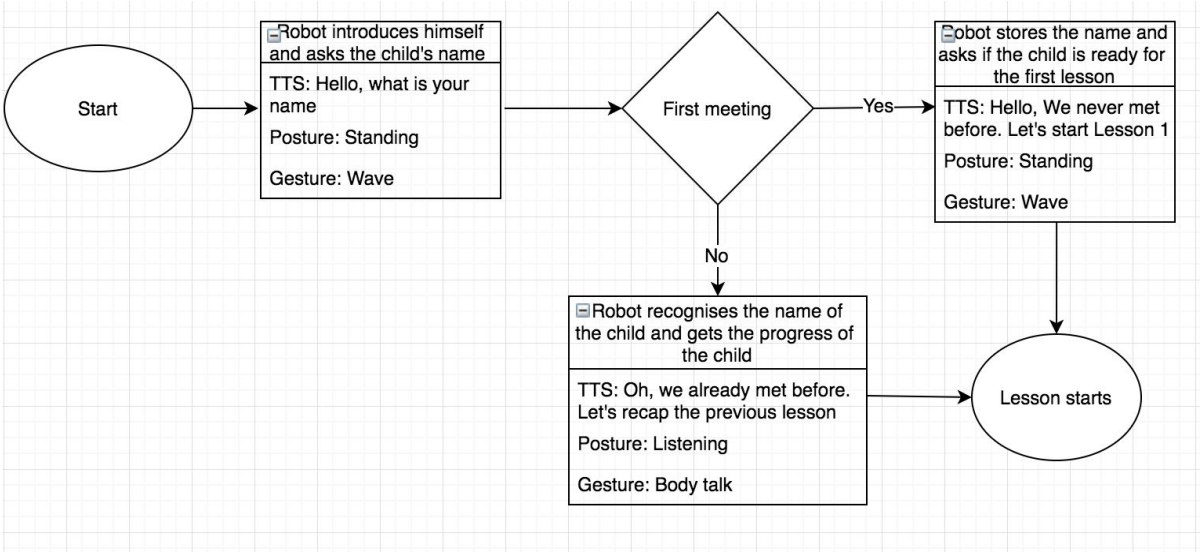


Diagram 2 below gives an generic overview of the interaction itself, from the lesson start to the end of the session.

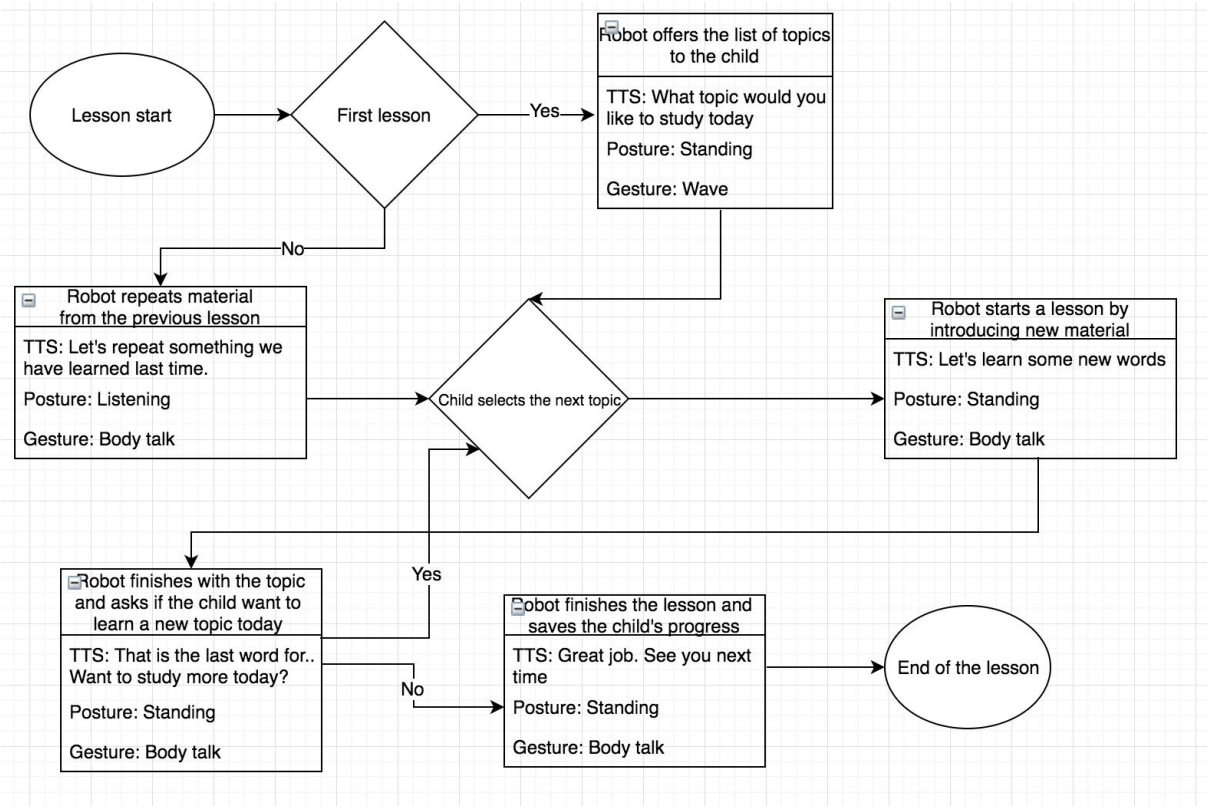
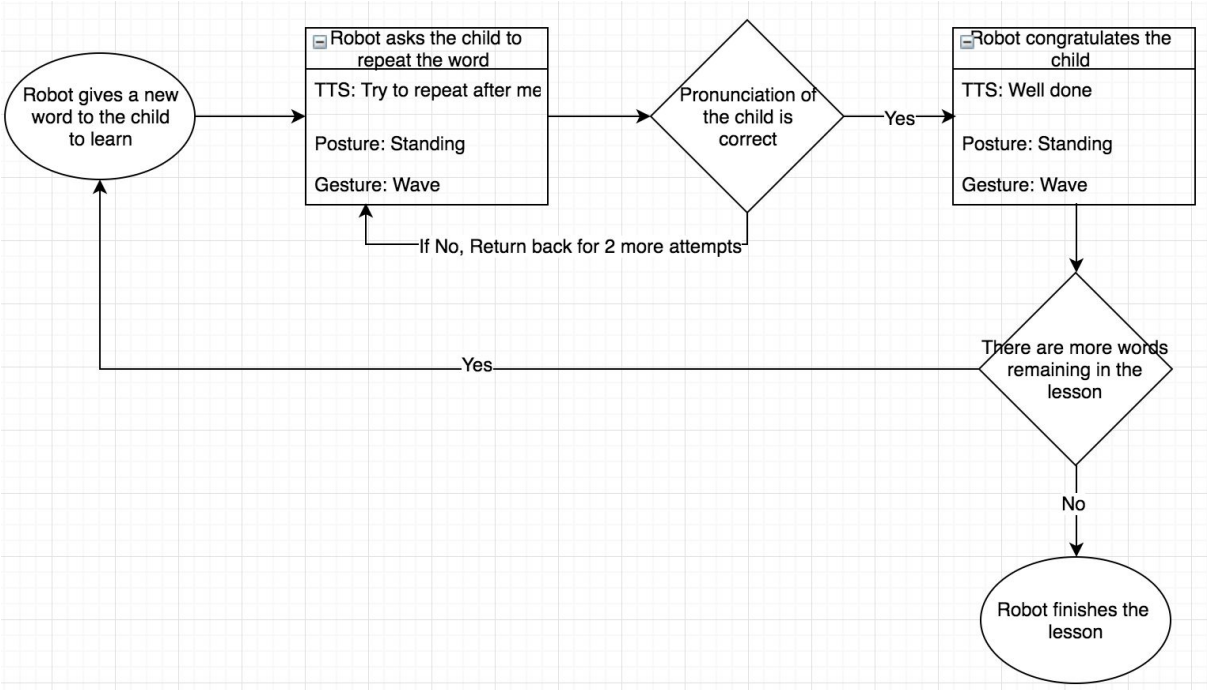


Diagram 3 demonstrates the flow for the actual learning step, where participant learns new words. In case the participant won't be able to pronounce a required word correctly, the Nao robot will ask to repeat it two more times. If the participant still is not successful with this particular word, Nao skips this word.



Implementation

This project is implemented using Python, PyCharm was used as the IDE. The code consists of some custom classes for the lessons, words, and persons. In order to successfully maintain the role as the language teacher the robot should be able to freely change between languages and listen to the replies in the desired language. The code is written in a generic way, meaning that it is easily scalable. Adding new topics for the lesson is a matter of adding them to our database of lessons. The robot provides each user with personalized lessons as it lets the participant select the desired topic for the lesson from the topics left. So each participant is following his own schedule. This is possible due to the generic structure of the lessons. Besides the words, the robot also sometimes provides examples of how the word could potentially be used in a sentence. The sentences are chosen in a way that the English sentence can be literally translated into Dutch, so there are no constructs used in the sentences that are not directly translatable to the other language.

All the progress is currently saved in a text file. Each participant has a field with name as a userID. All the words and topics learned are stored in the same file. Nao is able to successfully access the progress of each user, meaning that the topics which are finished won't appear again.

Another important part of the implementation is Google Dialog Flow. The agent created in the Dialog Flow is able to recognize words in both English and Dutch. Required words for the lessons were added as intents in both languages if needed. One of the challenges here

was the fact that training phrases are meant to be more than just a word which is rare in our lesson use cases.

Here is the link to implementation code described above.

Evaluation

Research question

This study is set up to test whether a Nao robot is able to teach a child a limited number of basic Dutch words in three different domains (animals, family and transportation). However, due to limited time (especially with regard to ethics), we were not able to test this specific target audience. We therefore chose to evaluate the system on young non-Dutch speaking adults instead. While not the intended target demographic, some formative evaluation is still possible. Through participant interaction with the Nao robot, we aim to answer the following main questions:

1. Is it possible to create a Nao robot that teaches Dutch to non-Dutch speakers?
2. How efficient and engaging is the interaction between the Nao robot and the user?

Method

Experimental design

In order to answer our aforementioned research questions, we perform a formative and explorative pilot-study on our young non-Dutch speaking adult participants. Results obtained from the questionnaires as well as observations made should assist us in the evaluation and answer both aforementioned research questions as seen in the previous section.

Participants

Nine people participated in the current experiment. The average age was 22.7 years old and 6 of the participants did practice the Dutch language before. The 9 participants are non-Dutch students, 7 of which were recruited from the Master of Artificial Intelligence. Two young adults were acquaintances of one of the authors, neither of the two had ever interacted with a social robot before. The remaining 7 AI Master students also followed the course Socially Intelligent Robotics as well and therefore, all 7 have interacted with a social robot before.

Set-up and materials

This project was set up on the floor in the hallway next to the Intertain Lab of the VU. In the Intertain Lab, multiple projects were ongoing as well and hence it was too noisy. The hallway allowed us to keep a strong connection to the local network and a power outlet was present as well. The participants were seated in front of the Nao robot, no other devices were used.

On occasion during the experiment people passed by in the hallway, which could have some distracting influence on the participants.

Procedure

1. **Experimenter:** Gives briefing to participant. Provides an outline of the tasks the participant will have to do and what the participant can expect from the experimenter.
2. **Experimenter:** Describes the purpose of the experiment. Briefly explains the purpose of the social robot in general as well.
3. **Experimenter:** Requests consent to record the trial. Further emphasizes that the participant is free to quit at any time.
4. **Experimenter:** Initializes the trial by starting with the introduction interaction of the robot
5. **Robot:** Introduces itself and asks for the name of the participant (can be any name)
6. **Participant:** Greets the robot and tells it their name.
7. **Robot:** Finishes the introduction and proceeds to the first lecture. It asks the participant to pick from any of the following subjects: *animals*, *family* and *transportation*.
8. **Participant:** Chooses a subject for the lesson.
9. **Robot + Participant:** Goes through the lesson on a selected subject.
10. **Robot:** Marks the selected subject as done.
11. **Experimenter:** Restarts interaction where the robot has come to know and remember the participant.
12. **Robot:** Greets participant and evaluates participant on word memorization using words covered in the prior lecture.
13. **Robot:** Offers updated selection (after step 9) of subjects to participant
14. **Robot + Participant:** Goes through the lesson on a newly selected subject.
15. **Experimenter:** Concludes the experiment. Requests to fill in a questionnaire/evaluation (Google form).
16. **Participant:** Fills in the questionnaire/evaluation (Google form).

Measures and instruments

Two different aspects are measured in our study; 1) the performance of remembering Dutch words and 2) the appreciation of learning Dutch in interaction with a Nao robot.
For the first aspect a database is preserved in which all remembered words per person are stored and counted. As the robot asks test questions from the previous lesson when you start a new lesson, the answers to these questions will be stored. This is done by reviewing the video and list which words that were (not) remembered and which words were wrongly pronounced. The database will provide us with the average of remembered words from each lesson per person and the average of words which are wrongly pronounced. For the second aspect, the measure of appreciation, we use a questionnaire for evaluation. This questionnaire can be found in appendix A. The results of this questionnaire will be evaluated. All the participants were recorded with their permission. All the interactions could be found here.

Results

The experiment was evaluated on multiple aspects. Firstly, the results of the evaluation of the previous lesson was used. Since the experimenters were present during every experiment information was gathered about the conversational efficiency. Lastly, the results of the questionnaire are also evaluated in this section.

Every participant completed the introductory lesson, an actual lesson, and the evaluation of the actual lesson. As stated in the previous sections, the evaluation checked if the participant remembered 3 randomly sampled words from the previous lesson. Figure 1 shows the results of the evaluation for all participants. In total more than half (52%) of the words were remembered correctly. When the answer was not correct it was due to wrong pronunciation most of the time (44%). Only a few words were not remembered at all by the participants (4%).

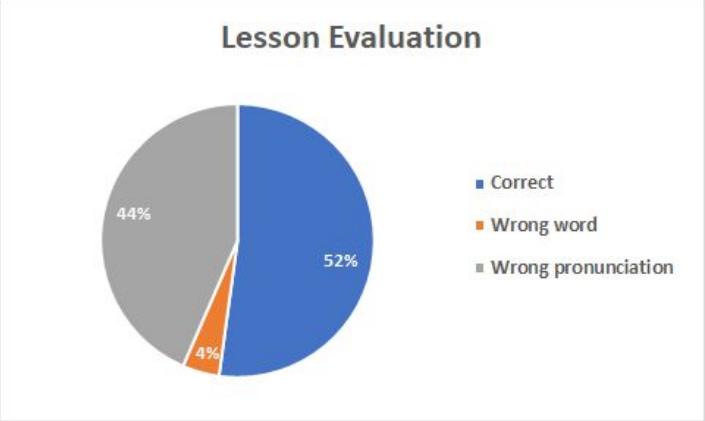


Figure 1. Results percentage correct words, wrong words and wrongly pronounced words after practicing with the Nao robot.

During the experiments issues were noted and the robot was adapted based on these issues. One issue was that the robot kept asking the same question if the participant had trouble pronouncing a word. This was immediately solved by adding a maximum number of times a question gets asked. Another issue was that during the evaluation the question 'Do you remember the Dutch translation for (English word)?' was asked which is a closed question. So after a participant answered with 'yes' it was an unexpected result. Therefore the question was adapted so it wasn't closed anymore. These kinds of issues were observed and solved during the experiment.

The results of the questionnaire indicated that participants were quite satisfied and engaged with the robot. Every participant either either liked (56%) or really liked (44%) the interaction with the NAO robot. A small part (22%) of the participants were neutral as opposed to the engagement of the interaction, 44% thought the interaction was engaging and 33% found the interaction really engaging. Lastly, all of the participants thought that children would be able to learn basic Dutch words when interacting with the Nao robot, where ⅔ of the participants answered 'a lot'. At the end of the questionnaire participants were asked if they had any suggestions for optimizing the interaction. Most of the feedback was positive,

although some suggestions were useful for the future development. Some of these suggestions were gamification, asking for feedback on difficulty at the end of the lesson, and a slower rate of speech when saying the example sentences.

Discussion

Interpretation of results

The results of the follow-up lesson:
The words that were detected as incorrect in the follow-up lesson were mainly caused by bad pronunciation. In particular, Dutch words as ‘zus’ or ‘muis’ appeared to be hard to pronounce properly for a lot of participants speaking a totally different native language. This could be potentially caused by techniques of DialogFlow not sufficient enough to distinguish between correct pronunciation options in the DialogFlow. However, offering too many ways to pronounce a ‘simple’ word would be too easy and is just not correct many times. A goal of our project is not only to teach Dutch words, but also to teach the correct pronunciation. Nevertheless, as can be seen in the video’s, all of the participants remembered the words in their follow-up lesson, which shows that the robot is able to teach the users Dutch basic words. Thereby it must be said that the time between this lesson and the follow-up lesson had an intense short time in between, this because of the limited time that was given.

The results of the questionnaire:
As can be seen in the results, most of the participants (really) liked the interaction with the robot and all the participants answered the question about engagement quite positively. These positively answered questions could be due to the fact that the participants don’t interact with robots on a daily basis, which makes it new and exciting already. The last question in the questionnaire had as a result that all participants were really positive about the idea of learning the basic Dutch words to children, interacting with the Nao robot. This is very hopeful outcome, as this is the plan for the future.

Limitations

As our target population consists of children from three to six year old, the participants this research is done on (young-adults) is a limitation of this study. Although we had promising results, we cannot relate this to our actual target audience. Second, our test environment wasn’t ideal. A more controlled environment (quiet and without distractions) will benefit the study. Last, our sample size was rather small. With more participants more statistical power can be achieved.

Recommendations & lessons learned:

Given the limited time for the implementation of this project we have a lot of future plans to improve the Nao Robot. In our project we tested the amount of learning at the end of each lesson. It would make sense to extend performance measurement with more long-term memory. We would also like to extend the language course with more lessons, more question types and an increased number of supported languages. Other ideas include adding images illustrating the words and supporting gamification for a better experience.

Extending the used gestures and intonation could also attribute to a more engaging experience.
Reflecting on our project we think that it was a good idea to choose for a well-defined problem with a clear scope and a specific target group. We also liked to work in cycles as based on the SR-IDM methodology, in this way iteratively refining our design as well as our product. Starting as soon as possible testing our first implementation resulted in modifying our product based on shortcomings. Furthermore, our group members have different backgrounds and competences and this mixture appeared to be of added value. We were able to divide tasks and to ask critical questions to another in this way improving the outcome and learning from each other.

Conclusion

By working on this project it was proven that it is possible to create software for Nao in order for it to teach non-Dutch speaking children Dutch language. The experiments were conducted successfully using Nao and real non-Dutch speaking participants. Based on those interactions we tried to evaluate our design, how efficient and how engaging the interaction is. Using the feedback obtained, multiple changes to the initial design were made. By analyzing the recordings of the interactions of the participants it was observed that even after initial lessons people were able to memorise more than half of the words covered during the lessons.

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Appendix A - Questionnaire

What is your age? *

Мой ответ

What is your gender? *

- ○ Female
- ○ Male
- ○ Prefer not to say
- ○ Другое:

Did you ever practice the Dutch language before? *

Мой ответ

Did you like the interaction with the NAO robot? *

	1	2	3	4	5	
No, not at all	○	○	○	○	○	Yes, a lot

How engaging was the interaction? *

	1	2	3	4	5	
Not at all	○	○	○	○	○	A lot

Do you think a child would learn the basic Dutch words when interacting with the Nao robot? *

	1	2	3	4	5	
No, not at all	○	○	○	○	○	Yes, a lot

Do you think a child would learn the basic Dutch words when interacting with the Nao robot? *

	1	2	3	4	5	
No, not at all	○	○	○	○	○	Yes, a lot

Do you have any suggestions for optimizing the interaction between the Nao robot and the user? *

Мой ответ