Child-Robot Interactions for Second Language Tutoring to Preschool Children

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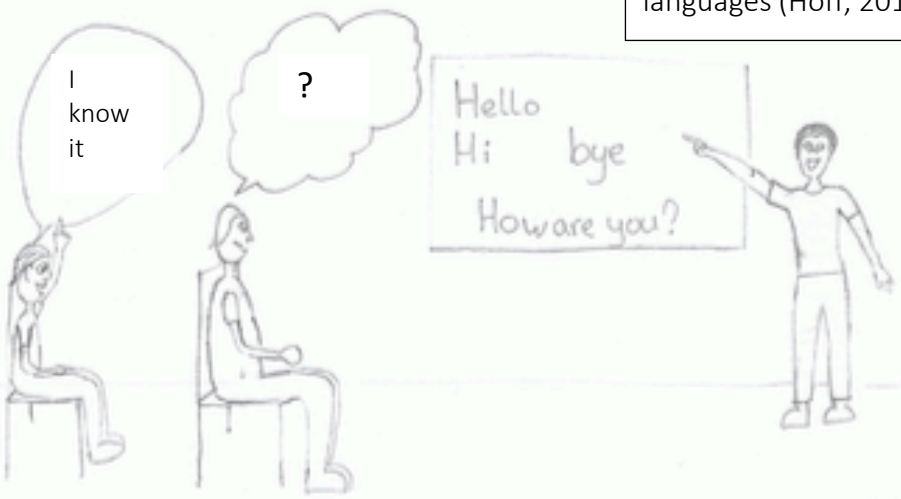
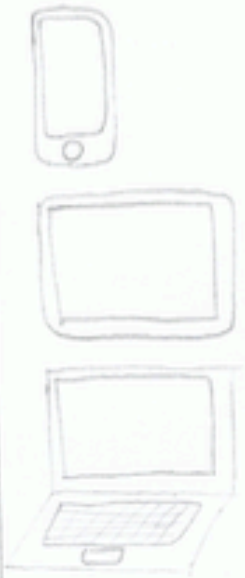
Given the globalization of our society, it is becoming increasingly important for people to speak multiple languages (Hoff, 2013)

Young children are most flexible at learning languages (Hoff, 2013)



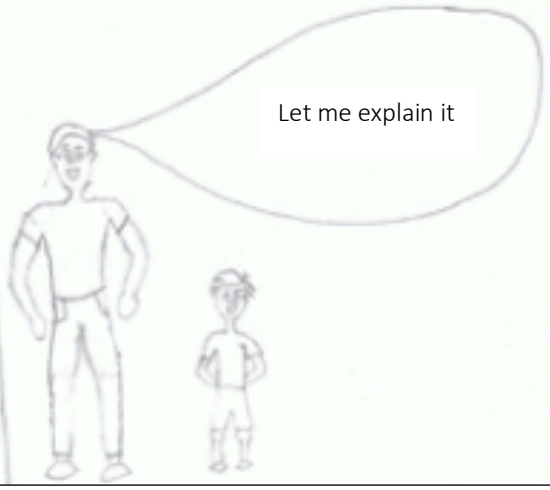
Starting second language (L2) learning in preschool would provide them a good opportunity to acquire the second language more fluently at a later age



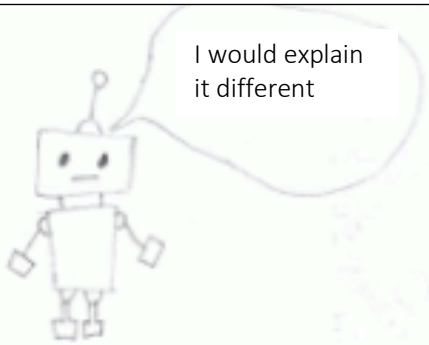
Technologies are being developed for educational purposes, although there is little evidence about their efficacy. Children can benefit from playing with technologies and interacting with a social robot can optimize the child's language learning (Glenberg, 2010; leyzberg et al., 2012)

This project aims to design a digital learning environment in which preschool children interact one-on-one with a social robot that support learning a second language

Children can learn more effectively from an adult who can use well-defined pedagogical methods for teaching children (Matthews et al., 2007)

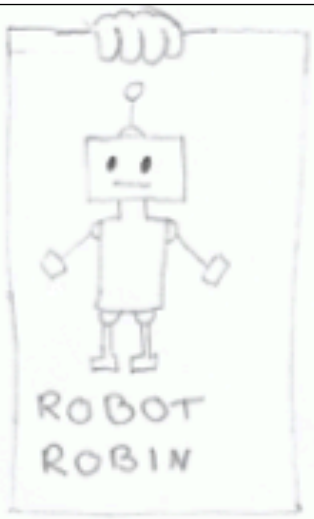


Designing a robot as an adult tutor has disadvantages. Children will form expectations about the robot's behavior which cannot be met with current technology

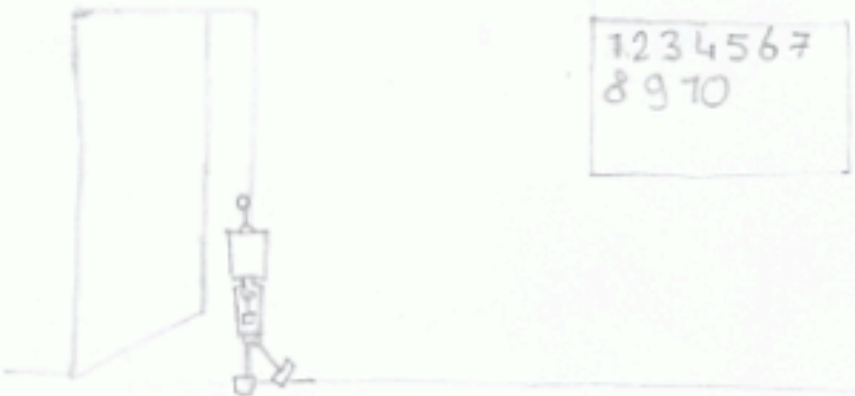


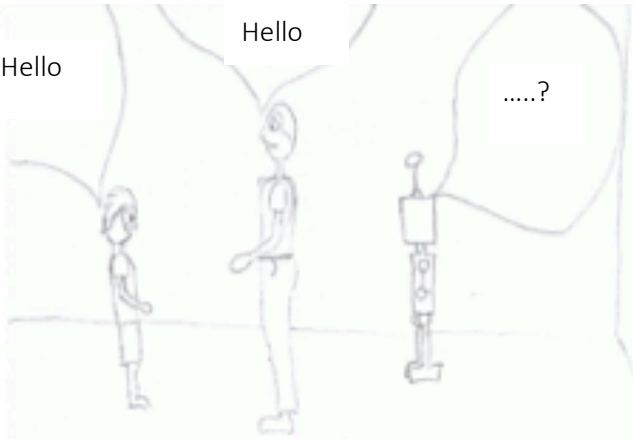
Interacting with robots acting as peers is conceived as more fun for children (Kanda et al., 2004), which allows for learning-by-teaching (Tanaka and Matsuzoe, 2012). A robot needs to interact with children in multiple sessions, but first impressions to establish trust and rapport are crucial (Hancock et al., 2011)

To familiarize children prior to their first encounter with the robot, it is therefore advisable to prepare them well (Westlund et al., 2016). About 1 week before the experimental trials the robot will be introduced. One experimenter will explain the differences and similarities between the robot and children, while a picture of the robot will be shown.

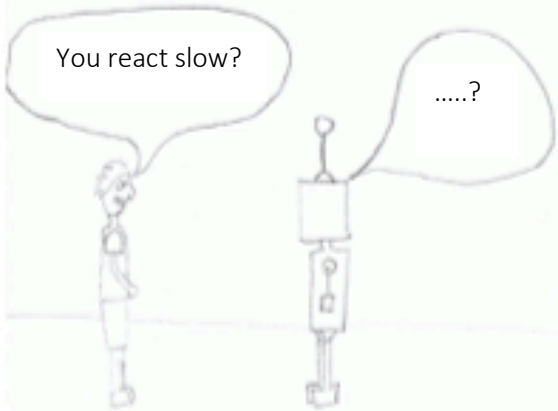


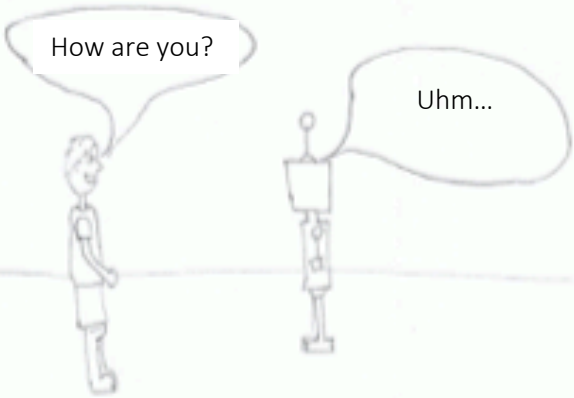
Another experimenter will enter the room with the robot. The robot will introduce itself with a small story about itself and by performing a dance in which the children were encouraged to participate.





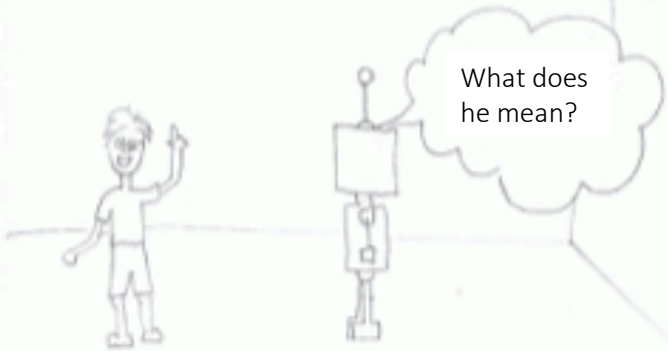
It is crucial for children's language development that their communication bids are responded to. Adults tend to take over turns very rapidly

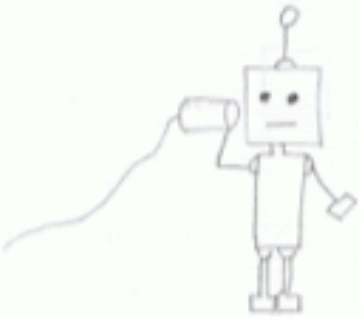




Robot require relatively long processing time to produce a respond. In our first experiment (de Haas et al., 2016) children were ar first surprised by the delayed responses, but quickly adapted tot the robot and waited patiently for a response

The lag in temporal contingency may not harm the interaction with the children but it may harm learning. This can be solved white providing a backchannel signal, indicating that the robot is still thinking (Clark, 1996)

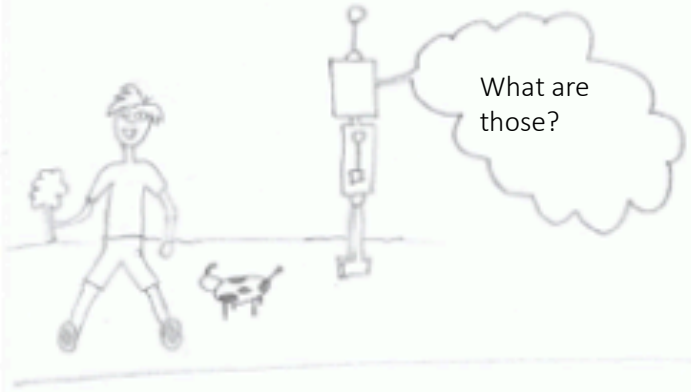




A robot should respond in a semantically continent time to the children. Therefore, it is important for the robot to understand the child's communications bids

The robot needs to be equipped with well-functioning automatic speech recognition (ASR). But not many researches have been carried out on ASR, in this research we therefore cannot rely on ASR. In our project, we explore various strategies to achieve an alternative of ASR.

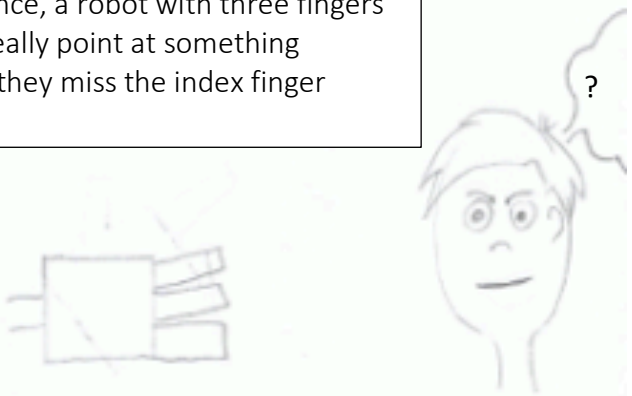
Strategies are based on monitoring non-verbal behavior of children. The first strategy relies on providing children tasks, such as placing “a toy cow behind a tree”. This, however, requires the visual object recognition on the robot to work well



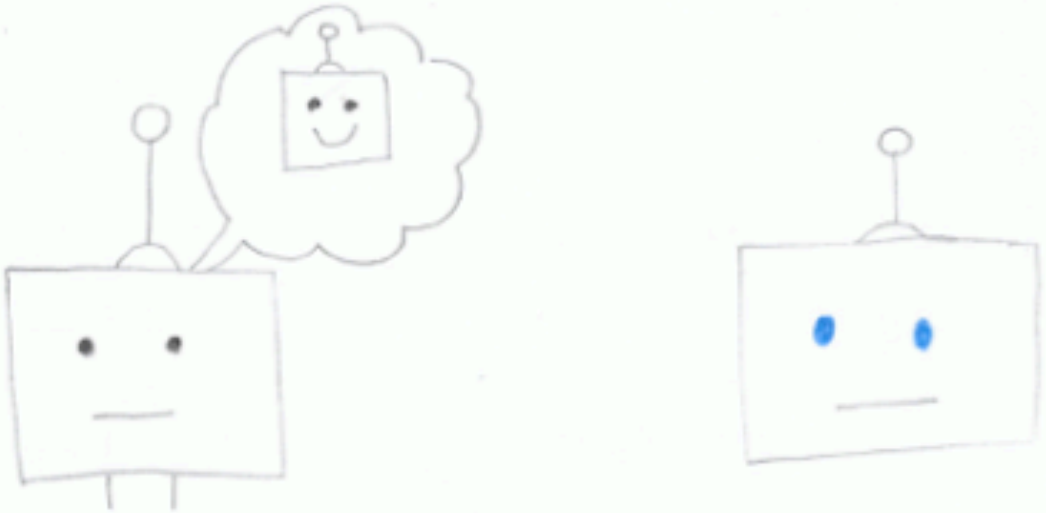
A second strategy is using a touchscreen that displays scenes the child can manipulate. This avoids the problem of object recognition and the robot’s responses can be controlled

Joint attention supports children learning a second language. One way to establish that is to guide their attention to a referent using gestures, such as pointing

Hence, many human gestures cannot be translated directly to robot gestures. For instance, a robot with three fingers cannot really point at something because they miss the index finger

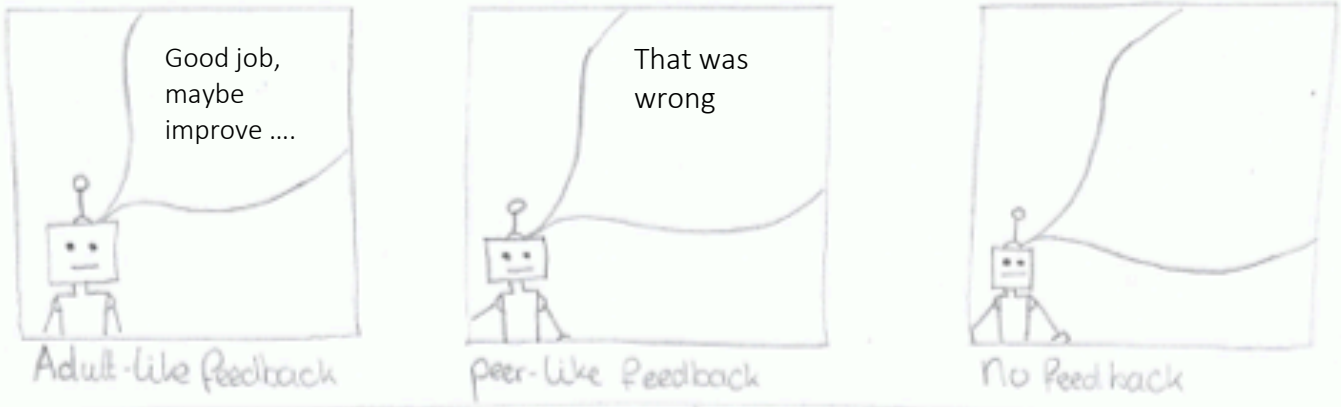


A robot cannot smile with its mouth. Therefore, coloring of the eyes is another non-verbal behavior we can use. When changing the color of the eyes the robot can indicate happiness as a form of feedback



Feedback is another interactional feature known to help language learning (Mathews et al., 2007). Adults give feedback in another way than children would do.

An experiment has been carried out to find out how children experience feedback (de Haas et al., 2016, 2017). There were no significant differences between the conditions, but there was less interaction with the robot when it did not give any feedback.
There were three condition:



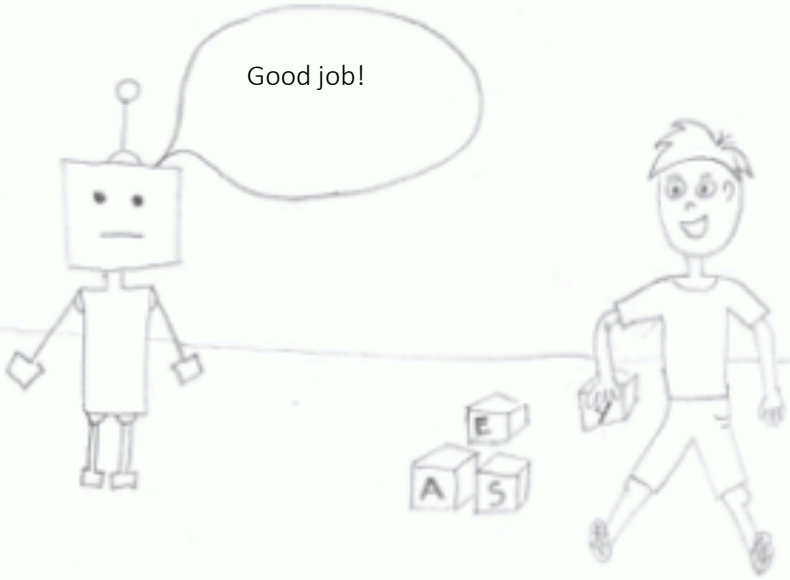
Interaction between the child and the robot should be challenging but not too hard. The child can lose its interest in the robot

The robot should be able to keep track of the children's advancements in language learning during the sessions and adapt to these

Conclusion: This article presented some design features that we consider crucial for developing a social robot as an effective second language tutor.

Firstly, the robot must be framed as a peer and designed to use adult-like interactions

Secondly, the robot should be introduced with appropriate care on the first encounter



Thirdly, the interactions between robot and child should be contingent and multimodal, and provide appropriate forms of feedback

The present list of design features covers many aspects that need to be considered when developing a robot tutor, but it is not yet comprehensive. For instance, there are no designs of robot's for children form different cultures.

This offers a perspective on first steps towards a list of design features but it is needed to be complete and optimize