Influence of child-robot spacial arrangement in a learning by teaching task

A1[1] and A2[2]

Abstract— **In this paper we present a study in which we test the influence of child-robot spatial arrangement on child's focus of attention, child's perception of robot's performance in the CoWriter learning by teaching activity. In this activity the child teaches a Nao robot how to handwrite. In our study, we explore two spatial condition from Kendon's F formation, the side-by-side and the face-t-face formations.**

We have 2 conditions following Kendon's F formation:

- **side by side**
- **face to face**

I. INTRODUCTION

Interaction settings are crucial for

Robots to enhance childhood education

The Co-Writer projects aims to help children with difficulties in handwriting [1]. It is based on the idea of learning by teaching. By teaching a Nao robot how to write, children learn and improve their handwriting. The activity also plays with the protg effect that make children more motivated in practising for the robot than for themselves.

Previous studies in the Co-Writer project helped us to develop a system that generates handwriting for the robot based on demonstrations from the child[1]. Case studies presented in [3] showed that children were able to stay engaged in long term interaction with repeated session within the Co-Writer activity in real pedagogical/therapeutic contexts. These works proved to have a positive effect on extrinsic motivation of children when practising their handwriting thanks to the protg effect.

[5] had a similar approach than learning by teaching with their Care Receiving Robot that was being taken cared off and taugh by a child with physical interaction.

Proxemics : explain how spatial arrangement could influence the interaction

Role attribution

Kendon F Formation in HRI: explain how spatial arrangement had influences in the past

Spatial arrangement is also a social signal that tells about the relationship between the persons.

[2]

We propose to study the impact of spatial arrangement on engagement of children a handwriting task

II. RELATED WORKS

Perspective taking: speaker with partners tend yo use more egocentric perspective rather than solo speakers [**?**]

Handwriting linked to spatial-sequential ability of the child. This is also linked to perspective taking ability of the child.

The 3 spatial perspective taking rules state that :

1) any object will present the same visual appearance to the self and to another person if the two observer view from the same point of view.
2) An object with different sides will be seen different if the viewers are form different side views
3) An object homogeneous in all sides will be the same from different view.

[6] shows that children around the age of 5 are able to complete perspective taking tasks and to imagine what others point of you might look like.

III. APPROACH

In this study, each child saw interacted with the robot in the two conditions in a random order.

within subjects Repeated measures

Hypothesis

- Child feels more in a teacher student relationship when facing the robot
- child feels more in a peer to peer when the robot is in L or side by side
- how does it influence the engagement -¿ with-me-ness
- does the child looks more at the experimenter when the robot is badly behaving
- how does the child rates the robots performances according to the arrangement

IV. METHOD

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Number of child Expe settings Condition within subject but with

Experimental Hypothesis

- withmeness is higher in f2f
- targets looked at in f2f would be more the head of the robot, in sbs it would be more the tablets
- UF is more positive when in f2f rather than sbs
- UF
- how does it influence the engagement -¿ with-me-ness
- does the child looks more at the experimenter when the robot is badly behaving
- how does the child rates the robots performances according to the arrangement

[1]A1 is with Faculty of A1, University of A1, country A1 email
[2]A2 is with Faculty of A2, University of A2, country A2 email

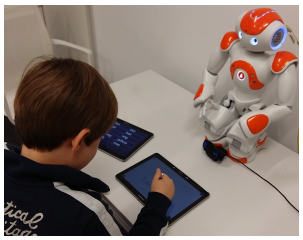

Fig. 1. Face to face spatial formation

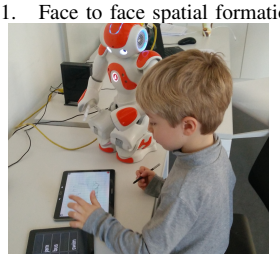

Fig. 2. Side by Side spatial formation

A. Reward Mechanism

The table interface on which the child and the robot practice their handwriting contains also two buttons that allow the child to give positive (green thumb-up) or negative (red thumb-down) feedback to the robot's handwriting.

We noticed that children were expecting the robot to react. Now that the usage of these buttons have been proven, we will consider for future experiment to allow the robot to react. For instance, if the child gives a positive feedback when the robot is actually improving, the robot should display a positive emotion. If he is given a positive feedback but doesnt not actually make any progress, he might express doubt to force the child to be more exigent.

B. With-me-ness

The with-me-ness measure applied in HRI in [4], helps to set specific targets during each state of the interaction and to determine rather the user is looking at one of these targets or not. The algorithm is based on the d-lib library that helps to estimate the head pose of the user using a video from webcam device for instance.

This measure allow us to see if the child is engage in the interaction and is looking at the tablet or the robot's head when he/she should.

For this experiment, the targets where: "the observer"(a teacher or a teacher assistant), "the selection tablet"(the tablet used to pick a word),

Present it as a measure of synchrony,

Get time when robot looking where and see if similar pattern with child

C. Performances

1) Response Time and Writing Time:

2) Writing Score for the robot: Regularity of writing in time

Score as a distance to a baseline from adult sample

V. RESULTS

A. Reward Mechanism

B. With-me-ness

C. Performances

VI. CONCLUSIONS

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REFERENCES

[1] D. Hood, S. Lemaignan, and P. Dillenbourg. When children teach a robot to write: An autonomous teachable humanoid which uses simulated handwriting. In *Proceedings of the 2015 ACM/IEEE Human-Robot Interaction Conference*, 2015.

[2] H. Hüttenrauch, K. S. Eklundh, A. Green, E. Topp, et al. Investigating spatial relationships in human-robot interaction. In *Intelligent Robots and Systems, 2006 IEEE/RSJ International Conference on*, pages 5052–5059. IEEE, 2006.

[3] A. Jacq, S. Lemaignan, F. Garcia, P. Dillenbourg, and A. Paiva. Building successful long child-robot interactions in a learning context. In *Proceedings of the 2016 ACM/IEEE Human-Robot Interaction Conference*, 2016.

[4] S. Lemaignan, F. Garcia, A. Jacq, and P. Dillenbourg. From real-time attention assessment to with-me-ness in human-robot interaction. In *Proceedings of the 2016 ACM/IEEE Human-Robot Interaction Conference*, 2016.

[5] S. Matsuzoe and F. Tanaka. How smartly should robots behave?: Comparative investigation on the learning ability of a care-receiving robot. *Proceedings - IEEE International Workshop on Robot and Human Interactive Communication*, pages 339–344, 2012.

[6] N. Newcombe and J. Huttenlocher. Children's early ability to solve perspective-taking problems. *Developmental Psychology*, 28(4):635–643, 1992.