Robots Interacting with Style*

Wafa Johal
Univ. Grenoble Alpes - LIG, UMR CNRS
F-38000 Grenoble, France
wafa.johal@imag.fr

June 25, 2015

Abstract

Our research goal is to identify ways to adapt non-verbal behavior and skills of a companion robot for children. We present an experiment considering parents' and children's perception of role changing and behavioral style in an interactive scenario with children. Behavioral styles being nonverbal parameters affect the way a robot expresses itself within a specific task. The results of this ongoing experiment aim to determine the influence of role changing and styles in term of perceived credibility and engagement of the child interacting with the robot.
Style, Personalization, Child-Robot Social Interaction, Companion Robot

1 Introduction

Companion robots are assistant robots aimed to keep users company. We are interested in companion robots for children present in various situations : serious tasks, comforting, playing games, alarming in cases of danger, etc. As mentioned in [6], one of the main challenges in designing a companion robot is to give them social competences in perceiving, reasoning and acting during their interaction with humans. Research in social HRI includes more and more of affect computing in order to conceive more social, and emotionally competent companion robots. Other dimensions, such as trust, legitimacy and credibility of the companion are important for their acceptability. [8] proposed a design of robots able to play several social roles and to adapt according to the user's needs and to the context. The Companion theory presented in [6] raised the problem of individual differences influencing the quality of interaction. [2] proposed to move towards an approach related to *personalization* in order to improve acceptability. Personalization could indeed help in increasing the attachment and to match the expectations of both children and their parents. Previous studies have shown that children's perception of robots might differ from adults [10] hence they could have different expectations. Our work aims to propose and test styles for personalization and better acceptance of companion robots by both parents and children.

*http://dx.doi.org/10.1145/2701973.2702706

2 Previous Works

In this section we define the notion of style and provide reference to prior work on styles and personalization in HRI.

2.1 Styles Theory

Style is a notion in psychology that describes categories of behaviors displayed by people playing specific social roles. A *style* is a way of playing the social role. In a first study [5], we focused on parenting styles to match individual differences in the acceptability of a companion which had the role of a teacher. We used non-verbal and paralinguistic cues of communication to generate gestures that were either Permissive or Authoritative. The Permissive and Authoritative styles are parenting styles distinguished by the level of dominance. This study validated the psychological model of parenting styles for robots with facial or bodily expression, by showing correlations between perceived authoritativeness and dominance. This study also showed individual differences in the preference of styles by parents that was not correlated to their own parenting style. These results are in line with the work of Kramer [6] suggesting not to create a unique perfect persona but to let the user customize its companion by giving it roles and personality. Other studies [9] have now showed the influence of behavioral styles on the perception of trust.

2.2 Personalization in HRI

Personalization has proved in previous researches to be quite effective in terms of improving acceptability and trust towards the robot. By showing personalized behaviors, the users see the robot as more socially competent. Other works have focused on emotional adaptation to the user, such as [7], showing that by adapting to the mood of the user, the robot was found to be more helpful. Personalization has also been found to be determinant in the persuasion process. Fogg in [4] defended the fact that adapted social cues can

significantly improve the persuasive impact of a computer system. This is also supported by the study of Fasola et al. [3] showing how personalization can improve intrinsic motivation of the user. Based on works on Companion Theory, we choose to model the companion behaviors within the social roles and to work on personalization depending on this context. We are interested in non-verbal personalization of robots' behaviors in order to propose different persona for the user to choose from.

3 Current Work

In our current work, we want to investigate the influence of style and versatility of the robot on the perception of performance and trust as well as attachment. The experiment is being conducted in a smart apartment equipped with camera sensors and microphones. The room has a one-way window from where parents can see the interaction of their child with the robots without being seen. We also use a Microsoft Kinect sensor to record the child's behavior during the interactions.

Following are listed our main hypothesis :

- H1 Styles influence children engagement in an interactive task.
- H2 Styles influence perceived competence and credibility of the robot in an interactive task.
- H3 Versatility of a companion increases the attachment and engagement of the children in interaction with it.
- H4 Specialist robots are perceived to be more competent and trustworthy than versatile robots.

3.1 Study Design

The experimental design is within subject; each participant sees 2 conditions, in a random order during 2 sessions of 3 interactions. Each session is 15 minutes long and is organized by the succession of 3 interactions (fig. 1). First the child takes a mathematics evaluation (*Math Quiz*), before being invited to *dance* and finally being a part of a second *Math Quiz*. In order to test the **impact of style**, we generate authoritative and permissive behaviors [5] for a Nao robot from neutral behaviors during the *Math Quiz*. Styles are role dependent, so we test our styles only in the *Math Quiz* interaction. The **versatility** is tested by having either one versatile robot (one robot performs the 3 interactions) or 2 specialists robots (one robot is assigned to the serious task and another to the dance). The figure 1 shows an example of two instances of sessions. In the top session, the child interacts with two robots one after another. The orange robot is a *Math Quiz* specialist showing an *Authoritative* style. The dance is performed by another robot (in blue). The *Math Quiz* specialist takes over again with the same *Authoritative* style in the last interaction. The style being relatively stable in the role and for the individual. On the lower session, the child interacts with one versatile robot taking care of both *Math Quiz* and *dance*. This robot has a *Permissive* style in the *Math Quiz* interactions only.

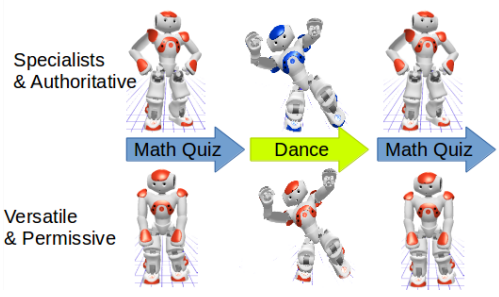

Figure 1: Example of two session flows

3.2 Factors and Measures

Parents and children are interviewed to collect data on acceptability, trust and credibility of all the robots' performances and behaviors after each session. This evaluation allows us to do a comparison between conditions and between parents and children. In addition to these qualitative evaluations at the end of the last session, the participants are asked to reply to a final survey in which they compare the conditions directly. This allows us to obtain the participants' preferences and to see if it is correlated to other measures. Objective measures are also collected to evaluate variations in the performance of children at the math test, and engagement in the different tasks using the Kinect Sensor. The engagement score is computed from multimodal data such as face detection, smile detection, body lean angle, voice activity, etc. We base our quantitative analysis on previous work [1] on detection of intention during interactions.

4 Prospects of Research

This work aims to contribute in defining criteria for plasticity in human-robot interaction. Plasticity is the capacity of an interface to adapt to the context of use, which is defined by the user, the platforms and the environment of use. We believe that role specific styles can be used to adapt to users' social preferences by various robotic platforms [5]. By showing the applicability of behavioral styles to different roles and different platforms, we could build a framework allowing the robot to adapt to the context of use- its own expressive abilities, the users in front of him and the role it has to fulfill.

References

[1] W. Benkaouar and D. Vaufreydaz. Multi-sensors engagement detection with a robot companion in a home environment. In *IEEE IROS'2012*, pages 45–52, 2012.

[2] K. Dautenhahn. Robots we like to live with?! - a developmental perspective on a personalized, life-long robot companion. *RO-MAN 2004*, pages 17–22, 2004.

[3] J. Fasola and M. J. Mataric. Using socially assistive human–robot interaction to motivate physical exercise for older adults. *Proceedings of the IEEE*, 100(8):2512–2526, 2012.

[4] B.J. Fogg. Chapter 5 - computers as persuasive social actors. In *Persuasive Technology*, Interactive Technologies, pages 89 – 120. Morgan Kaufmann, 2003.

[5] W. Johal, S. Pesty, and G. Calvary. Towards companion robots behaving with style. In *RO-MAN 2014*, pages 1063–1068, Aug 2014.

[6] N. C Krämer, S. Eimler, A. Von Der Pütten, and S. Payr. Theory of companions: what can theoretical models contribute to applications and understanding of human-robot interaction? *Applied Artificial Intelligence*, 25(6):474–502, 2011.

[7] Barbara et al. Kühnlenz. Increasing helpfulness towards a robot by emotional adaption to the user. *International Journal of Social Robotics*, 5(4):457–476, 2013.

[8] J.H. Ruckert, Jr. Kahn, P.H., T. Kanda, H. Ishiguro, S. Shen, and H.E. Gary. Designing for sociality in hri by means of multiple personas in robots. In *HRI 2013*, pages 217–218, March 2013.

[9] R. Van Den Brule, R. Dotsch, G. Bijlstra, D.H.J. Wigboldus, and P. Haselager. Do robot performance and behavioral style affect human trust? *International Journal of Social Robotics*, 6(4):519–531, 2014.

[10] S. Woods. Exploring the design space of robots: Children's perspectives. *Interacting with Computers*, 18(6):1390–1418, 2006.