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Challenges in child-robot interaction: The cases of two research projects

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Abstract. Evaluating Child-Robot Interaction (CRI) constitutes one of the main challenges among the Human-Robot Interaction (HRI) community. This paper presents the challenges faced by two projects (EMOTE and CoWriter projects) aimed at having a robot that interacts with children. Moreover, the paper presents the metrics used, addresses their challenges and contributes with solutions for the evaluation of CRI.

Keywords: Child-robot interaction; Metrics; Challenges

1 Context

Social robots are becoming widespread as useful tools in a variety of context, such as entertainment [8], assistance [5] and tutoring [2]. As such, depending on their context of use, robots can interact with adults and/or with children. For the interaction to be successful, robots must be designed, developed and evaluated in their real context of use with real end-users. This paper addresses the challenges of measuring and evaluating the performance of a robot that is being developed across two different projects (EMOTE project[1] and CoWriter project[2]) with children as end-users (see Fig. 1). Moreover, this paper presents how we have dealt with the same challenges and proposes possible solutions.

2 EMOTE Project

EMOTE is an EU FP7 project aimed at designing, developing and evaluating a new generation of artificial embodied tutors that have perceptive capabilities to engage in empathic interactions with learners in a shared physical space [2]. The target users of this project are early-secondary students with age ranging 11 and 15 years old. To measure children's perception on the robot's performance, quantitative measures were applied during studies. We have used measures such as the Godspeed series to assess the perception of *anthropomorphism*, *animacy*, *likeability*, *perceived intelligence* and *perceived security* [1]; we have used an adapted

[1] EMOTE project: http://www.emote-project.eu/
[2] CoWriter project: http://chili.epfl.ch/cowriter

version for HRI of the Interpersonal Reactivity Index to measure empathy, specifically *empathic concern* and *perspective taking* dimensions [4]; moreover, we have measured children's attitudes using the Negative Attitudes towards Robots Scale [9]; and finally we have applied a technology acceptance scale [6]. Mostly, our results did not yielded differences across study conditions, revealing almost always positive results towards the evaluation of the robotic tutor by children. After the study, children were also interviewed and expressed their excitement for the interaction with a social robot. Therefore, the novelty effect of interacting with a sci-fi character seemed to have influenced the overall results of a study when the measures rely on quantitative metrics for children.

3 CoWriter Project

The CoWriter is a project aimed at exploring how a robot can help children with the acquisition of handwriting, wherein children are the teachers who help the robot to better write [7], or help correcting other children in their writing [3] (see Fig. 1). The target group are children between 6-7 years old that already learned how to write, but need to master their handwriting skills. To gain insights about how children perceived the robot during the interaction, studies were performed and validated quantitative metrics developed for younger children were used. Therefore, the Smileyometer aimed at measuring how children liked the activity with the robot, wherein the Again-Again Table aimed at measuring how much children 1) would like to perform the activity again only with the robot; 2) only with the iPad; 3) and with both the robot and the iPad [10]. Despite having used metrics specially developed for younger children, results revealed to be extremely positive in all study conditions, with no significant differences, revealing that children are extremely positive assessing a novel type of interactive technology such as a robot.

4 Solutions

Studies conducted with both EMOTE and CoWriter projects translated the challenge of using quantitative metrics in CRI. To better understand how children perceive the interaction with the robot, behavioural analysis were conducted, revealing different reactions of children to the interaction. Moreover, interviews in the EMOTE project also lead to important insights about their perception of the robot. In addition to this, longitudinal studies will be considered. In sum, qualitative measures seem to better translate CRI in comparison with quantitative metrics. However, there is a need to understand behavioural commonalities to enable comparison across studies. To achieve such a high goal, the community of HRI focused on CHRI needs to work together on the creation of such metrics.

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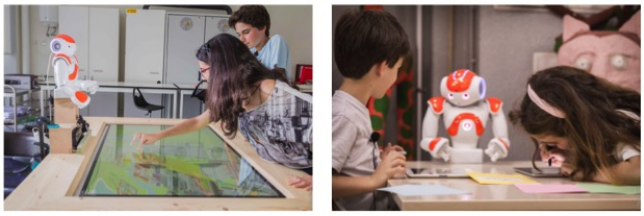

Fig. 1. *From left to right*: Children in EMOTE; Children in CoWriter.

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