On the recording and measurements of social robotics experiments in education

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There is a breath of new experiments recently being carried out on the introduction of robotics in many educational and therapeutic related activities, ranging from children with the autistic spectrum condition (ASC) relation to anthropomorphic robots to the effect of robotic programming in the cognitive capabilities of healthy and diagnosed children. Here we review the way these experiments measured the effects of robotics insertion in education.

Key Words: social robot intervention, measurements

1 Introduction

There is a growing expectation that computer aided and robotic assistants will help to improve the life and learning process of children with special educational needs. Specifically, children with autism spectrum condition (ASC) are receiving most of the attention in formal studies and experiences, though autonomous care is far from feasible in the near future [11]. For instance, specific augmented reality games [1], virtual reality environments [7], robot imitation games [3, 8, 19], programming the Nao robot [4], and robotics classes base on the LEGO platform [2] have been proposed with diverse but convergent aims for ASC children. The way that the effects of the intervention are measured is of particular importance because it can somehow condition the conclusions and the outcome of the experiments. In this paper we focus on these measurements instead of the precise details of the intervention realized.

2 Human observer measurement

The observation of the response of the children is often done by a human observer that encodes some specific reactions or behaviors according to a predefined code table. In a specific comparison between two LEGO based interventions with ASC children [2, 16] the code system employed in the two sites where slightly but maybe significantly different. One study has a set of "social skills" while the other has similar events in a "social interaction" category of events, where the encoded events are similar but quite different, reflecting also ideosyncratic differences between site populations and researchers. In some studies this measurement is purely qualitative based on reports by the staff conducting the experience [4], sometimes including the parent/guardian [5]. In some preliminary experiences, conclusions can be drawn on the basis of very soft qualitative observations [9].

In many studies [8, 15, 17, 20], video recording of the experimental session is analysed by a human observer encoding the events. As usual, human observation is prone to error and fatigue, but also it is able to detect events that are quite difficult to measure automatically, i.e. gaze directed to the robot. Some specific tools are proposed to help the manual counting of events [21]. Measurement can be quantitative, such as the time elapsed reading with and without the help of the robot for children with ADHD [12]. These kind of concentration time measuremens have been used to validate a commercial proposal of robotic assistant in the school [14].

3 Self assessment

Many experiences rely on self assessment of the participants via questionaries [4, 2, 13], where children are expected to grade their satisfaction with the experience and some aspects of it. The main inconveniences of such questionaries is that they may be biased in their very construction, and that they may be not well understood by the subjects. However, such approach might have some value when the goal is to acquire some new concepts by the subject [7].

4 Automated measurement methods

Automated analysis of images taken during the experiences has been used in diverse ways. In an experience with a parrot like robot [6] the degree of satisfaction and progress of the ASC children was measure by positive emotion recognition on a set of captures by an automated expression recognition system. It must be taken into account that image sampling must be fair across the experiment in order not to introduce bias, and that automated emotion recognition may be sensitive to image capture parameters. In some studies, the authors propose automated gesture recognition from video recording [19] in some quite restricted environmental conditions. Some more invasive methods, such as physiological measurements (pulse rate) have been reported to measure stress responses to very specific tests [10, 13]. In some cases, the measure of the impact is indirect, such as the number of downloads of an assistive app [18].

5 Conclusions

Nowadays, most of the studies rely on qualitative assessments and/or manual accounting of events carried out by a human observer. The need for automated measurement methods that provide robust and repeatble measurements is a methodological need to ensure unbiased conclusions from the experiments.

References

[1] A. Akbulut. Computer aided autism threapy system design. In *2015 Medical Technologies National Conference (TIPTEKNO)*, pages 1–4, Oct 2015.

[2] J. Albo-Canals, M. Heerink, M. Diaz, V. Padillo, M. Maristany, A. Barco, C. Angulo, A. Riccio, L. Brodsky, S. Dufresne, S. Heilbron, E. Milto, R. Choueiri, D. Hannon, and C. Rogers. Comparing two lego robotics-based interventions for social skills training with children with asd. In *2013 IEEE RO-MAN*, pages 638–643, Aug 2013.

[3] A. Amanatiadis, V. G. Kaburlasos, C. Dardani, and S. A. Chatzichristofis. Interactive social robots in special education. In *2017 IEEE 7th International Conference on Consumer Electronics - Berlin (ICCE-Berlin)*, pages 126–129, Sept 2017.

[4] D. Arias and E. Madrid. A way to promote the development of autistic teenagers through programming of a humanoid robot platform. In *2017 IEEE Frontiers in Education Conference (FIE)*, pages 1–6, Oct 2017.

[5] J. Bharatharaj, L. Huang, A. M. Al-Jumaily, C. Krageloh, and M. R. Elara. Effects of adapted model-rival method and parrot-inspired robot in improving learning and social interaction among children with autism. In *2016 International Conference on Robotics and Automation for Humanitarian Applications (RAHA)*, pages 1–5, Dec 2016.

[6] J. Bharatharaj, L. Huang, A. M. Al-Jumaily, C. Krageloh, and M. R. Elara. Experimental evaluation of parrot-inspired robot and adapted model-rival method for teaching children with autism. In *2016 14th International Conference on Control, Automation, Robotics and Vision (ICARCV)*, pages 1–6, Nov 2016.

[7] J. Cecil, M. Sweet-Darter, and A. Cecil-Xavier. Exploring the use of virtual learning environments to support science learning in autistic students. In *2017 IEEE Frontiers in Education Conference (FIE)*, pages 1–8, Oct 2017.

[8] D. Conti, S. Di Nuovo, S. Buono, G. Trubia, and A. Di Nuovo. Use of robotics to stimulate imitation in children with autism spectrum disorder: A pilot study in a clinical setting. In *2015 24th IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN)*, pages 1–6, Aug 2015.

[9] L. Dickstein-Fischer and G. S. Fischer. Combining psychological and engineering approaches to utilizing social robots with children with autism. In *2014 36th Annual International Conference of the IEEE Engineering in Medicine and Biology Society*, pages 792–795, Aug 2014.

[10] S. G. T. Haokip, G. Shah, and U. Lahiri. Psycho-physiological implications of computer based social and non-social interactive tasks for children with autism. In *2017 8th International Conference on Computing, Communication and Networking Technologies (ICCCNT)*, pages 1–7, July 2017.

[11] R. Hashim and H. Yussof. Feasibility of care robots for children with special needs: A review. In *2017 IEEE International Symposium on Robotics and Intelligent Sensors (IRIS)*, pages 379–382, Oct 2017.

[12] F. Jimenez, T. Yoshikawa, T. Furuhashi, M. Kanoh, and T. Nakamura. Effects of collaborative learning between educational-support robots and children who potential symptoms of a development disability. In *2016 Joint 8th International Conference on Soft Computing and Intelligent Systems (SCIS) and 17th International Symposium on Advanced Intelligent Systems (ISIS)*, pages 266–270, Aug 2016.

[13] F. Jimenez, T. Yoshikawa, T. Furuhashi, M. Kanoh, and T. Nakamura. Collaborative learning between robots and children with potential symptoms of a developmental disability. In *2017 IEEE Symposium Series on Computational Intelligence (SSCI)*, pages 1–5, Nov 2017.

[14] F. Kirstein and R. V. Risager. Social robots in educational institutions they came to stay: Introducing, evaluating, and securing social robots in daily education. In *2016 11th ACM/IEEE International Conference on Human-Robot Interaction (HRI)*, pages 453–454, March 2016.

[15] J. Lee, H. Aoki, D. Stefanov, T. Yamamoto, and G. Obinata. A study on the relationship between robotic movement with animacy and visual attention of young children. In *2016 25th IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN)*, pages 682–687, Aug 2016.

[16] J. Lee and G. Obinata. Interactive educational material for children with asd. In *2015 International Symposium on Micro-NanoMechatronics and Human Science (MHS)*, pages 1–6, Nov 2015.

[17] L. Lewis, N. Charron, C. Clamp, and M. Craig. Soft systems methodology as a tool to aid a pilot study in robot-assisted therapy. In *2016 11th ACM/IEEE International Conference on Human-Robot Interaction (HRI)*, pages 467–468, March 2016.

[18] R. Munoz-Soto, C. Becerra, R. Noël, T. Barcelos, R. Villarroel, S. Kreisel, and M. Camblor. Proyect@ matematicas: A learning object for supporting the practitioners in autism spectrum disorders. In *2016 XI Latin American Conference on Learning Objects and Technology (LACLO)*, pages 1–6, Oct 2016.

[19] F. Petric, D. Miklić, M. Cepanec, P. Cvitanović, and Z. Kovačić. Functional imitation task in the context of robot-assisted autism spectrum disorder diagnostics: Preliminary investigations. In *2017 26th IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN)*, pages 1471–1478, Aug 2017.

[20] M. Puyon and I. Giannopulu. Emergent emotional and verbal strategies in autism are based on multimodal interactions with toy robots in free spontaneous game play. In *2013 IEEE RO-MAN*, pages 593–597, Aug 2013.

[21] S. Shamsuddin, H. Yussof, F. A. Hanapiah, and S. Mohamed. A content validated tool to observe autism behavior in child-robot interaction. In *2015 24th IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN)*, pages 43–47, Aug 2015.