



Impacts of Social Robots in Education and Rehabilitation of Children with Autism in Iran

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ABSTRACT: In this study, our objective (as one of the pioneers in Iran) is to explore the clinical application of interactive humanoid robots as medical assistants in the treatment and education of children with autism in order to improve their social and cognitive skills. To reach this goal, we have designed and implemented a set of therapeutic games with the following topics: a) Investigation of social robots' acceptability and effect on improving the fine/gross movement imitation of Iranian children with autism, b) Exploring the effect of a robot-assisted music-education program on children with autism spectrum disorders' socio-cognitive skills improvement (as an individual clinical intervention program), and c) The impact of humanoid robots on improving the social and cognitive skills of high-functioning autistic children (as a group clinical intervention program). The results indicated that our robots were accepted by 70 percent of the participants as a communication tool from the first interaction. We also observed improvement in joint attention and fine movement imitation skills of both the high-functioning and low-functioning subjects. It was concluded that the high-functioning children's social skills improved due to the robot-assisted group therapy sessions, while the stereotyped behaviors of the low-functioning subjects decreased during the course of this program.

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1- Introduction

Since 2000, it has been widely shown that using social robots in autism treatment can significantly increase the impact of intervention sessions for children with Autism Spectrum Disorders (ASD) [1, 2]. In these type of studies, the impact of the robot-assisted scenarios on participants' performance as well as their behavioral skills is observed and assessed over time using different qualitative/quantitative tools (such as questionnaires, video coding, automatic assessments using machine learning algorithms, etc.) [2-5]. Improvement in joint attention, imitation, social-cognitive and communication skills of the subjects during (even a short number of) robot-assisted interventions are the most frequent findings of previous researches [2-4, 6].

In this paper, our main goal is to explore the clinical application of social robots as interactive assistants in the education/treatment of children with autism. Using and implementing a set of robot-assisted therapeutic games/scenarios, we would like to affect/improve the participants' social and cognitive skills.

2- Methodology

2- 1- Humanoid robots

The humanoid robots used in this research are the NAO H-21 and the Alice robot made by the Aldebaran Company and Robokind Hanson Company, respectively. The capabilities of these robots make them commonly used robots for autism

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research. To be used in the Iranian context, these robots were renamed "Nima" and "Mina", respectively.

2- 2- Participants

Three children with high-functioning and one child with low-functioning autism enrolled in the robot-assisted music-education program, and three pairs of autistic males (including a pair of twins, two siblings, and two classmates) participated in our group clinical intervention study.

2- 3- Experimental Setup

Our case studies were conducted in the Social & Cognitive Robotics Lab at the Sharif University of Technology with the autistic participants in the presence of a human therapist, social robots, and a robot operator. The time duration of each intervention session was about 30 minutes. The room contained observation and examination areas. Additionally, two computers, a video projector, and one/two Microsoft Kinect sensor(s) were also used in the intervention room. The Wizard of Oz style robot control (without having a control group) was selected for our study. Child-Robot interactions were preset and structured.

2- 4- Assessment Tools

In this study, the Gilliam Autism Rating Scale (GARS) and Autism Social Skills Profile (ASSP) questionnaires were used at different times.



3- Results and Discussion

In the music-education study, the GARS questionnaire was filled in by the participants' parents four separate times (Fig. 1). It should be mentioned that higher subscales/total scores indicate a higher autism severity. A decreasing trend in the autism severity of the subjects from pre-test to post-test was observed. The decreasing amount in autism severity, however, seemed to be different and was much higher for the high-functioning children than that for the low-functioning participant. A detailed subscales' assessment of the questionnaires indicated some improvement in the stereotypical behaviors, communication, and social interaction subscales for two of the participants from pre-test to post-test. One subject progressed somewhat in stereotypical behaviors and communication subscales, while the fourth one showed some improvement in communication and social interaction. An interesting point of the results of this questionnaire, which may not have happened accidentally, is the observation of progress for all four children in the subscale communication (in their real life). This observation is in line with the therapists' reports of the communication toward the robot/instruments. Considering the high-functioning subjects in a group, the calculated effect size of the overall scores of the GARS as well as communication and stereotypical behaviors subscales, are large or close to being large (~0.8), which could show that the interventions had a promising effect on the participants' socio-cognitive skills and, as a result, their autism severity.

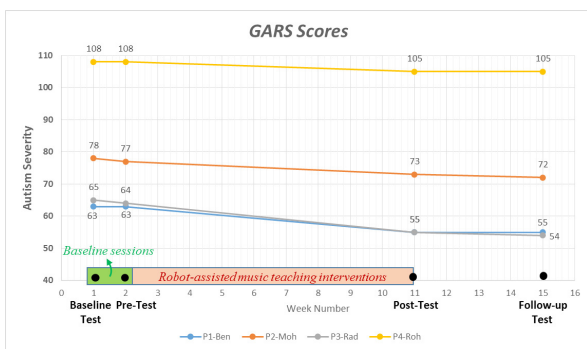


Fig. 1. GARS scores (autism severity) of the participants in the Baseline-Test, Pre-Test, Post-Test, and Follow-up Test in the robot-assisted music-education program.

Moreover, a comparison of the overall scores between the Post-test and Follow-up Test shows the retention of the sessions' impact on each of our subjects.

In the group interventions program, the GARS questionnaire was filled in by the subjects' parents one week before and one week after the clinical sessions. The autism severity of the participants is shown in Fig. 2. Similar to the music-education program's results, a decreasing trend in the autism severity of the participants from Pre-Test to Post-Test was reported for all six participants. The amount of decrease in GARS scores, however, seemed to be different; and was much more for the Siblings group than the other two groups. According to Fig. 2, both siblings showed improvement in stereotyped behaviors, communication, and social interaction subscales of the questionnaire during the course of the program. An interesting

point of the autism severity questionnaire is the observation of progress for all subjects in the communication subscale. This observation is in line with the video coders' reports of the participants' communication. The clinical sessions seemed to have a promising effect on the participants' social/cognitive skills. It is a signal that the presence of the Nima and Mina robots, as attractive communication tools, as well as being involved in group games could be possible ways to affect the communication skills of the children with ASD. The protocol of this program included many imitation/joint attention tasks; and it has been shown that improvement in imitation and joint attention skills can significantly affect social/communication skills of children with ASD [2-4, 7, 8].

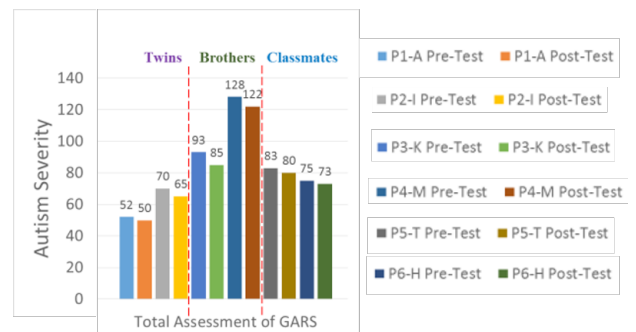


Fig. 2. GARS' overall scores (autism severity) of all six participants in the Pre-Test and Post-Test in the group interventions program.

4- Conclusions

Thanks to our designed scenario, we were able to provide a platform that enabled us to simultaneously influence the diverse social, cognitive, and emotional behaviors of individuals with autism. As an overall finding of the current research, based on the GARS questionnaire, the autism severity decreased for all participants. It is indicated that the robot-assisted programs could positively affect the social and cognitive skills of the subjects; however, in general, the effects of the intervention sessions on subjects' behaviors seem to be different for children from different points on the autism spectrum; even our high-functioning subjects showed different potential behavioral improvement. This may be due to the combinatorial nature of the developed scenarios/games affecting various skills of the children. It should be noted that because of the small number of participants in such case studies, there are no strong claims on generalizing the findings to other children with ASD.

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