

Using Robots for Increasing Social Interactions and Engagement

In Children with Autism Spectrum Disorder

A Review of the Literature

Stephanie Talalai

New Jersey City University

## INCREASING SOCIAL INTERACTIONS

### **Introduction**

Technologies dedicated to the treatment and education of children with Autism Spectrum Disorder (ASD) have been present in educational institutions and therapeutic practices for decades. The study of the use of robots with persons with ASD dates from 1999 and has gradually increased to date (Aresti-Bartolome & Gracia-Zapirain, 2014). Children with ASD are characterized by having difficulty interacting socially, exhibiting repetitive behaviors and communicating both verbally and non-verbally ([www.autismspeaks.org](http://www.autismspeaks.org)). The predictable behavior, controlled social situations, and simplistic interactions of robots make them a useful treatment option for children with ASD (Aresti-Bartolome & Garcia-Zapirain, 2014). Thus, this review of the literature will address the current role of robotics in the treatment of students with autism and its implications for application to other individuals with low incidence disabilities.

Many of the studies presented in this literature review focus on Human-Robot Interaction (HRI), Robot-Assisted Therapy (RAT) and the use of socially assistive robots to alleviate or lessen the characteristics of ASD. Few studies have been conducted that focus on using robots to increase communication and language acquisition for students with ASD or other cognitive disabilities, especially in preschool-aged children.

### **Human-Robot Interactions**

“Children with Autism have been known to respond more to machines than they do to normal people” (Shamsuddin et al., 2012). Researchers believe that a robot with human characteristics

## INCREASING SOCIAL INTERACTIONS

including the ability to verbalize, blink its eyes and exhibit human-like movements would be more likely to elicit communication and reduce autistic-like behaviors. Human-Robot Interactions have the possibility of increasing the bonds between the child and the robot potentially enhancing their social skills (Yussof et al., 2012). A study conducted by Tapus et al. (2012), investigated whether autistic children exhibited increased initiation and social engagement behaviors when their actions were being mirrored by a NAO robot compared to a human partner. Of the four children participating in this study, all showed an increase in eye contact and social behaviors in the initial interaction with the Nao robot but only two of them sustained those behaviors throughout the session. The small size of this study provides questions to its validity but suggests that the potential is there for its applications. These findings are consistent with the longitudinal study conducted by Robins, Dautenhahn, Koekhorst and Billard in 2005 who concluded that

exposure of the children to the robot over a long period, in a stress free environment, with a high degree of freedom, allowed the children, as hoped, to have unconstrained interactions, which facilitated the emergence of spontaneous, proactive, and playful interactions (pg. 116).

### **Socially Assistive Robots in Robot-Assisted Therapy**

The social deficits inherent in children with ASD and the varied technological interventions developed to treat these deficits contributed to the introduction of socially assistive robots in treatment sessions. A study conducted by Kim et al. (2013), examined the social behaviors of 24 children with ASD who were asked to interact with an adult human, a touch screen computer,

## INCREASING SOCIAL INTERACTIONS

and a robot. It was concluded that there was an increase in the general utterances of the children and that direct interactions with adults also increased after interaction with Pleo, a socially expressive robot dinosaur. Further studies into the long-term effects of continued interactions between social robots and children with ASD needs to be addressed. An analysis of student interactions, when presented with a choice between the Pleo and the Nao robots, would add to the discussion.

A similar study conducted by Lee, Takehashi, Nagai, Obinata & Stefanov (2012) explored the responses of 6 children diagnosed with autism to the facial expressions and verbal commands of both a human subject and an ifbot robot. Their study found an increase in eye contact, response to verbal cues and facial expressions after interactions with a robot that had distinct facial features and verbal capabilities. Further investigation with a larger number of participants was suggested at the conclusion of this study.

### **Robot Support for Children with Profound and Multiple Disabilities**

Through this literature review, it has been observed that there are numerous studies that demonstrate the benefits of using robots to facilitate social interactions for students with ASD. However, there is a lack of studies where robots are used to facilitate learning in students with low incidence and multiple disabilities, especially in the United States. One study conducted in the United Kingdom attempts to identify ways to use a NAO to attain learning objectives and increase engagement in such students as well as methods to measure their success (Hedgecock, Standen, Beer, Brown and Stewart, 2014).

## INCREASING SOCIAL INTERACTIONS

For their study, Hedgecock et al. recruited five teachers and five students as participants after giving a demonstration of the NAO robot to the school. Of the five students, three had cerebral palsy, three had epilepsy, three exhibited global developmental delay, and two were on the autism spectrum. All participants displayed severe learning and communication difficulties.

After specific learning objectives were identified (cause and effect, directionality, number recognition, and sequencing) and ways to achieve the objectives were established, the five students were videotaped during five half hours sessions interacting with the NAO robot. It was concluded that the use of the Nao robot increased engagement in all of the students with two of the students showing a significant increase in engagement. The high percentages of teacher assistance may have accounted for the increase in goal achievement.

### **Conclusions**

Through the research, it is evident that the use of social robots has a place in the intervention and treatment of children with ASD. Many of these studies, although successful need further investigation. Children with ASD often exhibit varying degrees of severity and sensitivity that makes their participation in a study unpredictable and challenging. Furthermore, future studies need to include a larger number of participants, an increased number of sessions and studies conducted over a longer period with repeated exposure to the robot. (Pop et al., 2013)

Other considerations for future studies would be to include not only the whole spectrum from low-functioning to high-functioning autism as well as to study further the effect of robots with other special needs populations. Additionally, as many of these studies were conducted in other countries the need for studies in the United States is evident.

## INCREASING SOCIAL INTERACTIONS

**References**

- Aresti-Bartolome, N., & Garcia-Zapirain, B. (2014). Technologies as support tools for persons with autistic spectrum disorder: A systematic review. *International Journal of Environmental Research and Public Health*, *11*(8), 7767-802.
- Hedgecock, J., Standen, P. J., Beer, C., Brown, D., & S. Stewart, D. (2014). Evaluating the role of a humanoid robot to support learning in children with profound and multiple disabilities. *Journal of Assistive Technologies*, *8*(3), 111.
- Kim, E. S., Berkovits, L. D., Bernier, E. P., Leyzberg, D., Shic, F., Paul, R., & Scassellati, B. (2013). Social robots as embedded reinforcers of social behavior in children with autism. *Journal of Autism and Developmental Disorders*, *43*(5), 1038-1049. doi:10.1007/s10803-012-1645-2
- Lee, J., Takehashi, H., Nagai, C., Obinata, G., & Stefanov, D. (2012). Which robot features can stimulate better responses from children with autism in robot-assisted therapy? *International Journal of Advanced Robotic Systems*, *9*, 72.
- Pop, C. A. 1., Simut, R. E. 1., Pintea, S., Saldien, J., Rusu, A. S. 1., Vanderfaeillie, J., . . . Vanderborght, B. (2013). Social robots vs. computer display: Does the way social stories are delivered make a difference for their effectiveness on ASD children? *Journal of Educational Computing Research*, *49*(3), 381-401. doi:10.2190/EC.49.3.f

## INCREASING SOCIAL INTERACTIONS

Robins, B., Dautenhahn, K., Boekhorst, R. T., & Billard, A. (2005). Robotic assistants in therapy and education of children with autism: Can a small humanoid robot help encourage social interaction skills? *Universal Access in the Information Society*, 4(2), 105-120.

doi:10.1007/s10209-005-0116-3

Shamsuddin, S., Yussof, H., Ismail, L. I., Mohamed, S., Hanapiah, F. A., & Zahari, N. I. (2012). Humanoid robot NAO interacting with autistic children of moderately impaired intelligence to augment communication skills. *Procedia Engineering*, 41, 1533-1538.

doi:10.1016/j.proeng.2012.07.346

Tapus, A., Peca, A., Aly, A., Pop, C., Jisa, L., Pintea, S., David, D. O. (2012). Children with autism social engagement in interaction with nao, an imitative robot: A series of single case experiments. *Interaction Studies*, 13(3), 315-347. doi:10.1075/is.13.3.01tap

What Are the Symptoms of Autism. (n.d.). Retrieved August 03, 2015, from

<https://www.autismspeaks.org/what-autism/symptoms#communication>

Yussof, H., Ismail, L. I., Shamsuddin, S., Hanapiah, F. A., Mohamed, S., Piah, H. A., Zahari, N. I. (2012). Human-robot interaction intervention therapy procedure for initial response of

autism children with humanoid robot. Retrieved from

[https://asknao.aldebaran.com/sites/default/files/publications/yussofismailshamsuddin\\_2013\\_humanrobotinteractioninterventiontherapy.pdf](https://asknao.aldebaran.com/sites/default/files/publications/yussofismailshamsuddin_2013_humanrobotinteractioninterventiontherapy.pdf)