



# The use of Robotics for the Development of Social Skills for Children with ASD

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## Abstract

This paper researches an innovative technology in the field of ICT (robotics) to support the cultivation of social skills in children with ASD (Autistic Spectrum Disorder), as these have been documented internationally in recent years.

**Keywords:** Autism, ICT, innovative technology, Robotics

## 1. Introduction

Before beginning the analysis for this new and innovative technology designed to help and support the induction of people with ASD into social situations, it seems necessary to describe autism and the different aspects of life in which people who have it have been reported to have deficiencies. It is, therefore, useful to refer to areas in which people with ASD show a lack of efficiency in their social skills.

Children with ASD present significant inadequacies in social communication and need to contend with various difficulties in social interaction. According to the DSM-5 (2013) they exhibit:

- ✓ Deficiencies in socio-emotional mutuality, which can vary from a deviant social approach and failing in conversational involvement, to reduced expression of interests or emotion, often expressed as failure to begin or respond to social interactions.
- ✓ Deficiencies in non-verbal communication behavior which are used in social interaction, examples of which can be poor inclusion of verbal and non-verbal communication, the absence of eye contact, deficiencies in understanding the use of body language or gestures, or even complete absence of facial expression and non-verbal communication.
- ✓ Deficiencies which can vary widely in developing, maintaining and understanding relationships. Some examples include difficulties in adapting behavior in accordance to different social structures and/or engaging in imaginary play, making friends, or even complete lack of interest in their peers.

Social situations in which children with ASD are involved can often have unexpected consequences. Different social circumstances can cause unforeseen stress, and confusion leading to isolation and even refusal to take part in activities. In sharp contrast to socially developed children, those with ASD have difficulty acquiring social skills through the passage of time since their interaction with their environment constitutes a complicated process for them (Gena, 2002).



It is for these reasons that many different therapeutic methods and approaches have been developed with the sole aim of cultivating these children's social skills to provide them with support in the development of these skills. This in turn would allow them more functionality and better management of social situations which they find challenging.

This paper probes the effectiveness of an innovative therapeutic approach which can be utilized in the development of social skills in children with ASD. The focus will be on robotics. This specific method aim at helping children with ASD establish social competences with which they can accommodate the ever growing needs for social interaction and reinforce their inclusion in the community.

## 2. Robotics

Among the many tools that therapists utilize in the development of communication skills and social interaction for children with ASD is the field of robotics, a method in which interest seems to be rising in recent years. Much research has been conducted in an effort to achieve specific therapeutic goals in children with ASD, such as autonomous interaction, the undertaking of activities, mimicry, the recognition of emotions, joint attention and triadic interaction (Ricks & Colton, 2010). Research on the interaction between man and robots has shown that robots, specifically social robots, as they are called, can greatly improve the level of response, inclusion and interest in children with ASD and also help promote new and enriched social behavior (Barakova, Lourens 2010; Feil-Seifer et al., 2009; Ricks and Colton, 2010; Scassellati et al., 2012).

The reason this happens is because while children with ASD show little interest in other people, they tend to communicate better with robots, even in situations when the robot has a relatively simple appearance (Kim et. al., 2012). According to Miyamoto et al. (2005) children with ASD accepted Muu (a talking robot), more as a social factor rather than an object of play, even though the robot had very simple functions. These results were based on an extensive period of observation of two children with ASD during which the children quickly began to interact with the robot. Kozima et al. (2009) invented a robotic creature they named Keepon which was able to convey attention (through the direction of the eyes) and emotion (happiness and excitement) and studied its interaction with children with ASD (Kozima et al., 2009). This robot could react emotionally every time a child displayed a specific social interaction (i.e. when the child would look at the same object the robot was looking at, Keepon would jump up and down and move around displaying its excitement). The researchers were therefore able to conclude that the robot peaked the interests of the children and provoked emotions and interaction between them.

Such a reaction can encourage a child with ASD to continue to interact and improve its communicational and social skills. In addition, the repeated behavior of the robot invokes the interest of children with ASD and challenges them to mimic it. This helps them in understanding socially significant information (Robins et al., 2012). Wainer et al. (2014) in a related study used an anthropomorphic robot (KASPAR) in order to evaluate the use of robotics in the encouragement and support of partnered play between children with ASD in triadic form (two children and a robot). KASPAR functioned completely autonomously and utilized information in accordance to the circumstances of game play and the behavior of the children so as to prompt them to participate, encourage them and provoke them into playing a game of mimicry together. These children were then evaluated as to what extent they could play the same game without the robot. The results showed that different pairs of children with ASD portrayed improved social behavior in dual play, in comparison to the behavior they had exhibited prior to their inclusion in the specific program. The results were quite promising for the use of autonomous robots in cooperative games between children with ASD.

According to Scassellati et al. (2012) even though these robots may provide new sensory stimuli, in educational situations such as when a child is waiting for their turn when playing a game with another child, or when expressing compassion, or even when the child begins to have physical contact with the therapist, it proved more effective than conventional toys (which

do not invoke new social behavior) and cartoon figures which can create stress and anxiety in these children.

### **3. Characteristics of Social Robots**

The design and function of the robot has a significant effect on its efficiency in the therapeutic process. Children with ASD may display greater acceptance toward specific characteristics of a robot, while others may express discomfort (Giullian, 2010). It should, however, be pointed out that although there may be similarities in the way the children react to certain attributes of the robots, due to the inconsistent nature of the disorder, not all children react in the same way. For this reason, when designing robots for the purpose of treating children with autism, there are many questions which demand answers concerning the proper appearance a robot needs to have so that its therapeutic effectiveness can be maximized, depending on the specific goal which has been set by the therapist (Cabibihan et al., 2013; Giullian, 2010).

From the research that has been conducted by Cabibihan et al., (2013) and Giullian, (2010), by studying a variety of robots used in therapy sessions with children with ASD it seems that they can be categorized based on their appearance, functionality, safety demands, autonomy, modular construction, and adaptability. Specifically:

- The robots must not possess many lights or colors
- Since children with ASD tend to avoid interaction with other people, the robots can resemble human beings but should not contain much detail in the facial characteristics
- Their size should approximate that of a child's
- Their structure should be safe and modular
- They should possess a controllable level of autonomy
- The robot user interface which controls the robot should be easily understandable by the therapists

### **4. Role of social robots in the therapy of children with ASD**

Social robots are designed to take on a wide span of roles in the therapy of children with ASD. Based on the aforementioned references, the roles of these robots can be categorized as follows:

- *Friendly Playmate*: the robots can engage in pleasurable activities and stimulating play with children with ASD. Activity games with a robot can provide a safe and pleasant environment by giving the child the opportunity to interact freely and without fear (Wainer et al., 2014).
- *Behavioral Inducing Factor*: the robots can stimulate significant behavior such as mimicry, eye contact, self-initiated movement. For example, a robot can teach a child with ASD to wave hello, to wait for its turn to throw the ball, to follow the robot's eyes to an object, to replicate its moves as it dances (Ferrari et al., 2009; Kozima et al., 2007).
- *Social Mediator*: the robot can act as a mediator between the child and the therapist, teaching the child social skills with the goal of expanding the behaviors learned during treatment into the child's interaction with other people (i.e. its classmates) (Wainer et al., 2014; Costa et al., 2010).
- *Mimic Role Model*: the robots can function as "actors", by acting out proper behavior in specific social situations. In this way the child has the alternative of learning these behaviors through the robot via predictable but ultimately progressively diverse actions (Dautenhahn, 2003).
- *Personal Therapist*: therapeutic sessions in which the interaction is between the child and the robot allow the robot to focus its attention on only one child (individualized therapy) while utilizing activities which rely on play, and accommodate the specific needs and preferences of each child (Wainer et al., 2014).

In conclusion, robots have evolved into invaluable tools in the therapy of children with ASD.



## 5. Conclusions

The incorporation of digital technologies in education domain is very productive and successful, facilitates and improves the educational procedures via Mobiles [29-42], various ICTs applications [43-79], AI & STEM [80-91], and games [92-101]. Additionally the combination of ICTs with theories and models of metacognition, mindfulness, meditation and emotional intelligence cultivation [102-144] as well as with environmental factors and nutrition [25-28], accelerates and improves more over the educational practices and results.

More specifically, from the aforementioned analysis it can be inferred that therapeutic approaches through the various uses of technological mediums have provided valuable tools to apply in situations which affect people with ASD. Although this field is still in developing states, it has already shown much promise in many aspects of treating people with autism.

More precisely, due to the fact that robots have a much more simplified appearance, are more easily controlled, and are much more predictable than people, it is by far easier for children with ASD to follow instructions from such parties rather than simply listening to verbal signals uttered by people. An important reason for this is that interactions with robots do not depend on verbal or non-verbal communication. It is this factor that makes the entire communication process much easier (Ferrari et al., 2009, Ricks and Colton, 2010). Also, it is important to note that robots appear less threatening to the children, thereby ensuring that they feel more comfortable during the entire duration of the interaction (Ricks and Colton, 2010).

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