Technology-aided Instruction is now classified as one of the 27 intervention practices for children with autism.

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Autism Spectrum Disorders (ASD) are a group of heterogeneous neurodevelopmental disorders that severely compromise the development of social relatedness, reciprocal social behavior, social communication, joint attention and language learning. An estimated one in 68 American children (and 1 in 42 boys) are affected with the disorder. The Centers for Disease Control (CDC) reports that the prevalence of the disorder has increased ten-fold in the past 40 years, with a 10 to 17 percent increase annually in recent years. This statistic indicates that Autism is the fastest-growing developmental disability in the United States. Numbers in such staggering proportions leave researchers and clinicians grappling with innovative methods to manage a growing caseload with highly specialized needs.

The past decade has seen a surge in the use of technology to accelerate progress and support professionals and caregivers of children with ASD. Technology-Aided Instruction is now classified as one of the 27 intervention practices that have sound scientific evidence for increasing social skills in children with ASD.

Recently, humanoid robots have been developed to fulfill a variety of human-like functions, creating the possibility of being a co-therapist to improve social skills in children with ASD. While research into robot-assisted intervention is in its infancy, early findings suggest social robotics to be a promising intervention practice for teaching social skills to children with ASD.

Theoretical Foundations of ASD Therapy

Children with ASD have a preference for objects over people and often demonstrate superior nonsocial skills constructing and analyzing systems (e.g., math, physics, engineering, computers and robots) in the presence of impaired social intelligence. This preference for the nonsocial, mechanical world makes robot-assisted therapy a plausible means to facilitate the core social challenges faced by children with autism.

Baron-Cohen explains the social challenges in persons with ASD as being problems developing the cognitive and affective elements of empathy relative to mental age. The cognitive element is the development of a Theory of Mind (TOM) or the ability to attribute mental states (i.e., desires, beliefs, thoughts, imagination and emotions) to oneself and others. The affective element of empathy refers to having an appropriate emotional reaction to another person’s mental states. Challenges with empathy found in persons with ASD have been referred to as “the mind blindness theory of autism.”

Accessing another person’s mind begins around 12 months of age when the child is capable of the joint attention skills of showing, pointing and following another’s eye gaze, which is delayed in children with ASD. As children get older, failures in the development of empathy manifest as difficulties understanding others’ intentions, understanding others’ emotions, taking another’s perspective, and understanding the appropriate amount of information needed to avoid ambiguities, to be informative, to be relevant and to maintain the listener’s interest.
Another aspect that impacts social skills is the drive for “coherence”. Coherence allows us to give meaning to our experiences by understanding them within a broader context.9 Individuals with ASD often have a bias towards Weak Central Coherence (WCC) or the tendency to focus on the details, processing incoming information in a piecemeal fashion.9 WCC makes it difficult to integrate information to achieve meaning about the world. Persons with WCC “can’t see the forest through the trees.” A bias towards WCC makes it difficult for persons with ASD to understand a central “theme” and causal connections within a social situation.7 WCC may also underlie problems understanding ambiguous language such as figurative language, idioms, metaphors and jokes.7,8

Research in Social Robots for ASD Therapy

With technological advances, humanoid robots are more affordable than ever. This improved accessibility and technology makes viable the possibility of robots being used as a co-therapist to improve social intelligence in children with ASD. Preliminary research suggests that the use of social robots is promising. Children with ASD show more engagement and are better able to recognize facial expressions with social robots than with humans.10-13 While there are individual differences in performance, many children with ASD respond better to humanoid robots as compared to humans or other devices.3,10 In addition, many children with ASD speak more to an adult partner when the co-therapist is a robot as compared to another human or a tablet.14 Finally, robot intervention has been found to promote the initiation of questions in children with ASD at a similar level to an ABA therapist.15

Clinical Applications

The research on the clinical use of robots to elicit behaviors is still preliminary.3 Because children with ASD are more responsive to robots than humans, implementing more conventional evidence-based interventions in combination with humanoid robot technology may have advantages over human-to-human communication. That is, by harnessing the power of an intrinsically motivating object in the form of a human-like robot, clinicians may have the potential to better reach and motivate clients that might otherwise be difficult to engage or who might have anxiety and discomfort practicing social skills with other humans. By marrying a curriculum, utilizing well-known and widely utilized evidence-based practices to “unpack” social skills in a developmental framework, with humanoid robot technology, clinicians may have not only a new tool for improving client attention during service delivery, but also a means of empowering children with ASD socially.

The Robots4Autism project by RoboKind utilizes cutting edge humanoid robotics and tablet technology to deliver a curriculum addressing relevant social skills for school-aged children with autism. This curriculum employs the evidence-based practices of visual supports, social narratives and video modeling. It emphasizes improving theory of mind to help with the understanding of emotions, relevant social cues, perspectives and appropriate responses. In addition, the curriculum facilitates coherence by providing multiple ways for the child to gain meaning about the social situation. The curriculum uses a consistent core vocabulary both within and across the lessons and utilizes visual supports in the form of graphic symbols.

As impressive as these advances may be, a child’s therapy program cannot be composed solely of sessions with a robot, regardless of the sophistication or the design of the system. Once the child has shown mastery of a skill within the robot-delivered curriculum, skills must be generalized to human interactions, both in structured and real-life activities. The Facilitator Manual in the Robot4Autism package outlines suggested extension activities to support therapists’, teachers’ and parents’ interactions with the child subsequent to completion of each Robots4Autism module.

The Robots4Autism program, and similar projects that are sure to follow, should be viewed not as a replacement for interaction with a therapist, teacher or parent but as another tool in our intervention toolbox.

Existing research suggests that humanoid robots are promising tools for aiding teachers and therapists in social and communicative intervention for children with ASD. Innovative programs like the Robots4Autism project build on evidence-based practices by utilizing an intrinsically motivating robot to target more advanced theories of mind and facilitate understanding of higher level social cues. Although more research is necessary to establish clinical effectiveness, humanoid-robot initiatives are promising tools in mediating social interaction, as well as acting as supplements to a human interventionist.

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References


