Robots4Autism Leverages Evidence Based Practices to Teach Learners with Autism Social Skills

Introduction

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 1 in 68 American children (and 1 in 42 boys) are affected with the disorder. The Center for Disease Control (CDC) reports that the prevalence of the disorder has increased ten-fold in the past 40 years, with a 10-17% increase annually in recent years (Centers for Disease Control and Prevention, 2013). These statistics indicate that Autism is the fastest-growing serious 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.

Robots and Autism

The past decade has seen a surge in the use of technology to accelerate progress and to 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 (NPDC, nd). Recently, humanoid robots have been developed to fulfill a variety of human-like functions, opening up the possibility of being used as co-therapist to improve social skills in children with ASD (Diehl, Crowell, Villano, Wier, Tang, & Riek, 2014). Preliminary research suggests that the use of social robots is promising. Children with ASD show more engagement (Bekele, Lahiri, Swanson, Crittendon, Warren, & Sarkar, 2013; Shamsuddin, Yussof, Miskam, Che Hamid, Malik, & Hashim, 2013; Feng, Gutierrez, Zhang, & Mahoor, 2013) and are better able to recognize facial expressions with social robots than with humans (Costa, 2014). While there are individual differences in performance, many children with ASD respond better to humanoid robots as compared to humans or other devices (Diehl et al., 2014; Bekele et al., 2013). 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 (Kim, Berkovits, Bernier, Leyzberg, Shic, Paul, & Scassellati, 2013). Finally, robot intervention has been found to promote the initiation of questions in children with ASD similarly to level to an ABA therapist (Huskens, Verschuur, Gillesen, Didden, & Barakova, 2013)

Theoretical Foundations

Children with ASD have a preference for objects over people (Lombroso, Ogren, Jones, & Klin, 2009) and often demonstrate superior nonsocial skills constructing and analyzing systems (i.e., math, physics, engineering, computers, and robots) in the presence of impaired social intelligence (Baron-Cohen, 2005; Baron-Cohen, 2009). This preference for the nonsocial, mechanical world makes robot-assisted therapy a reasonable means to facilitate the core social challenges faced by children with autism.

Baron-Cohen (2005) 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 (Baron- Cohen, 2005; Baron-Cohen, 2009). The affective element of empathy refers to having an appropriate emotional reaction to another person's mental states (Baron-Cohen, 2005; Baron- Cohen, 2009). Challenges with empathy found in persons with ASD have been referred to as "the mind blindness theory of autism" (Baron-Cohen, 2005). 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 (Norbury, 2013, Rollins, 2014), 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, understanding the appropriate amount of information needed to avoid ambiguities, to be informative, to be relevant and to maintain the listener's interest (Norbury, 2013; Paul, Landa, & Simmons, 2014).

Another aspect of cognition that impacts social skills is the drive for "coherence". Coherence allows us to give meaning to our experiences by understanding our experiences within a broader context (Happè & Frith, 2006). 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 (Happè & Frith, 2006). WCC makes it difficult to integrate information to achieve meaning about the world. In essence, 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 (Norbury, 2013). In addition, WCC may underlie problems understanding ambiguous language such as figurative language, idioms, metaphors and jokes (Norbury, 2013; Paul, et al., 2014).

Clinical and Educational Application of Robots

Because children with ASD are more responsive to robots than humans, implementing more conventional evidence-based interventions in combination with humanoid robot technology has become plausible and may have advantages over human-to-human communication. That is, harnessing the power of an intrinsically motivating object in the form of a human-like robot, teachers and therapists may have the potential to better reach and motivate children that might otherwise be difficult to engage or who might have anxiety and discomfort practicing social skills with other humans. By marrying a humanoid robot with a curriculum that utilizes well-known and widely applied evidence-based practices to "unpack" social skills, teachers and therapists may have not only a new tool for improving the child's attention during service delivery, but also a means of empowering children with ASD socially.

In Robots4Autism, RoboKind harnesses the learning style of most children with ASD by utilizing 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, video modeling, and the principles of Applied Behavioral Analysis (ABA). These practices have scientific evidence for increasing social and communication behavior in children with ASD at **all grade levels**. In addition, we used a core functional vocabulary to teach a wide variety of social concepts. In building the Robots4Autism social skills curriculum, we integrated these practices to facilitate coherence and to provide multiple ways for the child to gain meaning about the social situation. Utilizing these techniques, our lessons aim to improve theory of mind skills in order to help with the understanding of emotions, relevant social cues, perspectives and appropriate responses.

Robots4Autism uses Evidence-based Practices

Utilizing appropriate evidence-based practices (EBP) must be a priority in designing treatment. Many interventions for autism exist, but only some have been shown to be effective through scientific research. The National Professional Development Center (NPDC) on ASD uses rigorous criteria to determine whether a practice has adequate scientific evidence to be considered effective. In essence, "scientific evidence" means that a particular therapy approach has been supported as being effective by several research studies from several different researchers. To date, the NPDC has identified 27 interventions as meeting the criteria for scientific evidence. Not all practices have been found to be effective for all skills or all grade levels. It is noteworthy that true evidenced-based practice requires scientific evidence to be viewed through the lens of professional expertise/experience and child characteristics, such as learning style and developmental level (Dollaghan, 2007; Odom, Collet-Klingenberg, Rogers, & Hatton, 2010).