

## Autism and technology

### Research article

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### Title

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### Background

In spite of great improvements in early diagnosis and interventions, most children diagnosed with autism spectrum disorders (ASD) are unlikely to live independently when they reach adulthood.

Research on novel computer-based interventions with the goal of promoting social skills has proven that these can play a crucial role in developing activities aimed at increasing pro-social behaviors such as collaboration and coordination, augmented appreciation for social activities, and providing individuals with novel forms of expression.

The past ten years have seen a great increase in the number of computer-based interventions. For example, Piper et al. [21] designed a tabletop application for children with ASD in the form of a four-player cooperative game. The authors found the game provided students with an engaging experience for group work, something they usually find challenging. Hendrix et al. [13] studied the design of a tangible tabletop application to engage shy or socially withdrawn children in games by giving them roles that encouraged other children to engage with them in a positive manner with promising results. Gal et al. [9] conducted a three-week study with six children diagnosed

with ASD (aged 8-10) using Story Table, software implemented on a DiamondTouch multitouch surface that used enforced collaboration in the context of storytelling. They observed an increase in children's responses to peers, with more positive affect, and greater likelihood to express emotions.

Multitouch tablets have the potential of providing similar advantages to tabletop displays in terms of encouraging pro-social behaviour through sharing an interactive surface, while providing advantages in terms of cost, availability, flexibility of use and mobility. They can also enable additional social behaviors such as passing the device to a partner. Tangible technologies have also been used to encourage social interactions. For example, Farr et al. [7] used Topobo and LEGO toys with groups of children with ASD and noted the differences in playing styles, finding that Topobo led to more social forms of play.

Somewhat related are interventions that use robots to encourage social interactions [8, 22]. Some mobile technologies have been designed to support and encourage communication with others. For example, Madsen et al. [18] use mobile computers loaded with software that automatically classifies emotions on human faces. Tentori and Hayes have also proposed mobile devices to support social activities in school and other controlled environments [24].

Less sophisticated approaches include speech-generating devices (e.g. DynaVox) that use picture communication symbols or text and are very costly but have shown promising results

for some children [2]. There are also technologies that blend into children's everyday environments and support them while not getting in the way of engaging with others. Hayes et al. [12], for example, studied the use of computer-based visual supports for communication, scheduling and recording of images for children with ASD. Hirano et al. [15] expanded on the scheduling system called vSked, which replaces the paper-based visual schedules that are commonly used in classrooms with children with ASD. The goal of the system was to mimic these paper systems while reducing teacher burden and automatically generating records and reports. The system was evaluated in a classroom with nine children with ASD (aged 8-10) and was well received by teachers, students and other stakeholders.

Other research on embedded or pervasive approaches to support children with autism has involved tools that help keep track of children's behavior [1, 11, 17, 25] and that encourage certain behaviors [20]. Finally, there has been a wide set of computer interventions that work with traditional desktop or laptop setups and have led to positive results in areas such as building vocabulary, encouraging vocalizations, and learning about appropriate forms of communication [3, 4, 5, 6, 7, 10, 14, 16, 19, 26]. These desktop or laptop-based technologies are generally intended for individual use, potentially limiting social interactions while they are being used, while in other cases interactions with another person are accomplished through the computer [23].

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