The Use of Technology in Social Skills Training for Individuals with Autism Spectrum Disorder

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Superheroes social skills training, Rethink Autism internet interventions, parent training, EBP classroom training, functional behavior assessment: An autism spectrum disorder, evidence based (EBP) training track for school psychologists.

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INTRODUCTION

Among individuals with autism spectrum disorder (ASD), social communication skills are one of the core skill deficits. It was these social deficits that led Eugene Bleuler to coin the term '*autism'* in 1911, stemming from '*autos*,' the Greek word for '*self*.' Bleuler worked with a group of children thought to have severe schizophrenia who all presented with similar behaviors. He states that these children "…lose contact with reality to varying degrees" (as cited in Frith, 1991). Bleuler asserted that individuals with autism had an 'autistic thinking style' that differs from their typically developing peers. Rather than finding motivation in their external world, he stated that individuals with ASD are driven by internal desires. Examples of internally motivated behaviors include stereotyped, repetitive motion or speech; poor eye contact and play skills; and noncompliance.

Despite this earlier use of the term, it was Hans Asperger (1944) and Leo Kanner (1943) who used 'autism' to refer to individuals who were not believed to have schizophrenia. Kanner described children whose primary symptom was an inability to relate to others, rather than psychosis. The cases outlined in Kanner's famous paper were children who were considered 'feeble-minded,' Hans Asperger described a group of youth who displayed similar social impairments, but who also demonstrated less impairment in their language ability. These two descriptions of autistic individuals set the framework for autism diagnoses, though not immediately. Autism was not distinguished from childhood schizophrenia until the release of the Diagnostic and Statistical Manual, Third Edition (DSM-III) in 1980. Asperger's syndrome was added as a distinct diagnosis in the DSM-IV in 1994. In the current DSM-5 (American Psychiatric Association, 2013) individuals previously considered to have Asperger's are now considered on the less severe end of the autism spectrum.

One of the two criteria necessary for an autism diagnosis is a “persistent deficit in deficit in social communication and social interaction (American Psychiatric Association, 2013). A number of discrete abilities compose ‘socially communicative’ behaviors. One of these behaviors is social competence, which refers to both understanding and using the basic rules of social engagement (the degree to which one participates in a community or society) and social interaction (sharing emotions and experiences with others) (Goldberg et al., 2005). Social competence is unrelated to an individual’s cognitive abilities; however, people often make unrealistic assumptions about an individual’s grasp of the rules of social engagement and interaction based on their level of verbal and cognitive functioning. This is particularly relevant for individuals with high-functioning autism (HFA). Because these individuals tend to have average or better verbal and cognitive skills, it is assumed that they understand what is expected of them in social situations. Nonetheless, due to either a lack of knowledge of social skills or a lack of opportunities to practice those skills, individuals with HFA often do not live up to these expectations and can suffer consequences.

Another ability that is necessary for typical social communication is Theory of Mind (ToM). Sometimes referred to as ‘mindreading,’ ToM refers to one’s “capacity to infer what is in other people’s minds” (Slaughter, 2015). ToM allows an individual to attribute mental states to others and understand that the people around them have beliefs, thoughts, emotions, and desires that differ from their own. Typically developing children as young as 12 months demonstrate some ability to infer the thoughts and desires of others (Liszkowski, Carpenter, Striano, & Tomasello, 2006). For individuals with autism, however, this skill is often difficult across the lifespan.

In children with autism, Theory of Mind deficits manifest early on in areas such as symbolic play. An example of this is an inability to use a placeholder to stand in for another object or action during a play sequence (e.g., having a wooden block fly around as if it were an airplane). This deficit mirrors the rigid cognitive patterns often noted in individuals with autism. As children with autism age, ToM deficits also impact their pragmatic conversation skills, or their ability to use language for social purposes. Much of the meaning encoded in speech is not represented in speakers' words; rather, the listener must observe the context of the conversation and make inferences about the speaker's true intentions (Parsons & Mitchell, 2002). Individuals with autism are more likely to interpret speech literally and ignore contextual cues that hint at the speaker's true intentions.

Another common social skill deficit in individuals with ASD is emotion recognition, or the ability to decode others' facial expression into their underlying emotion. Individuals with ASDs have difficulty filtering sensory input, meaning that they often disregard relevant information and instead attend to irrelevant stimuli in the environment. Because of this, transient stimuli are often not interpreted by individuals with ASD. The ability to recognize emotions in others is a critical skill for social development. Reciprocal social interactions often pose a problem for individuals with ASD because they fail to interpret transient nonverbal communicative behaviors that are frequently present for less than a second, such as facial expressions, gestures, and eye contact. This nonverbal deficit limits the individual's ability to monitor the effect of the conversation on communicative partners and gauge their level of interest (Hopkins et al., 2011).

One final skill deficit that limits the social ability in individuals with ASD is empathy. When taken in combination, deficits in social interaction ability, Theory of Mind, and emotion recognition result in an overall difficulty for individuals with ASD in connecting with and understanding the experiences of those around them. Empathy differs from Theory of Mind in that Theory of Mind refers to an individual's ability to recognize emotions in others, while empathy involves a corresponding change in the emotional state of the individual (Bird & Viding, 2014). In social situations, this difficulty with empathic skills manifests itself as a lack of awareness of others as conversation partners. Individuals with ASD, particularly higher functioning individuals with highly restricted interests, frequently enjoy talking about certain topics with little regard for their conversation partners. Often, these individuals do not monitor or attend to the emotional state and social cues of the conversation partner indicating lack of interest, and they often do not change their behavior to better accommodate their partner. Difficulty developing friendships is common among these individuals. Repeated negative social interaction attempts can lead to feelings of inadequacy and loneliness among youth with ASD. A study conducted by White & Roberson-Nay (2009) found a correlation between the social ability of individuals with ASD and their scores on the self-report Loneliness Questionnaire. Children with ASD are often targets of bullying and social rejection (Otero, Schatz, Merrill, & Bellini, 2015). In sum, youth with ASD suffer significant social and emotional consequences due to social skill impairments.

SOCIAL SKILLS TRAINING

As of 2014, the National Professional Development Center on Autism Spectrum Disorder and the National Autism Center considers Social Skills Training (SST) to be an evidence-based practice. This distinction signifies that there is sufficient research evidence to support the use of SST packages with youth on the spectrum. SST seeks to enhance the social behaviors of individuals with social deficits. The most common SST format is a small group setting. Didactic instruction, modeling, role plays, performance feedback, reinforcement, and homework assignments are common components of SST packages (Bellini & Akullian, 2007; Cappadocia & Weiss, 2011; Laugeson & Park, 2014).

Despite being deemed ‘evidence-based practice,’ many researchers and professionals have concerns about the use of social skills training programs. The primary concern with SST is that, even when participants demonstrate skill acquisition in treatment sessions, parents often do not report significant changes in their social abilities in real-world situations (Cappadocia & Weiss, 2011; Bellini & Peters, 2008). To alleviate this generalization problem, many social skills programs contain components designed to promote generalization, such as homework assignments, to practice skills in naturalistic settings and repeated practice.

TECHNOLOGY AND SOCIAL SKILLS TRAINING

According to The Autism Society, the costs associated with diagnosis and treatment of ASD in the United States are nearly $90 billion each year. The use of technology in SST would result in financial savings due to the need for fewer highly trained practitioners. In addition, technology offers the opportunity to create highly reinforcing environments that provide high levels of sensory engagement, which is crucial for gaining and maintaining participant attention. Technology also provides a controlled, structured environment in which participants can repeatedly practice target skills in the same setting. This aspect is beneficial for two reasons. First, repeated practice of social skills aids in maintenance of treatment outcomes following treatment termination; and second, identical repetition appeals to many people with autism who have an interest in sameness and repetition (Reed, Hyman, & Hurst, 2011).

Another advantage of integrating technology into social skills training is that the programs can often be individualized easily for new participants. For example, photographs of the participant can be substituted into many programs in order to maximize personalization and aid with skill acquisition (CITE). The final reason that technology should be used for SST is that children with autism tend to find technology highly motivating. In 1993, Chen & Bernard-Opitz compared computer-based and human mediated instruction methods with four children with autism. Three out of the four students were more motivated to learn when using computer-based instruction rather than in-person instruction. Even during leisure time, when children can choose their activity, children with autism tend to choose electronic media over other activities (Shane & Albert, 2008). For these reasons, integrating new technologies into social skills training programs is not only convenient for professionals implementing the programs, but may also facilitate skill acquisition and maintenance.

There are a variety of technologies with support in the research literature for use in social skills training. The current review will examine the use of five different types of technology: video modeling, virtual reality programs, robots, interactive computer software, and mobile technology. Variations of each type of technology will be discussed, as well as evidence of effectiveness and generalization of skills when used with youth on the autism spectrum. Finally, limitations of the current research and recommendations for future research will be presented.

VIDEO MODELING

Video modeling consists of the presentation of a video portraying a model who is performing a desired behavior to participants. Video modeling programs are based on the concept of observational learning, a theory first proposed by Alfred Bandura. In 1961, Bandura conducted the well-known Bobo doll experiments, in which typical children were recorded interacting with an inflatable doll. Children who observed adults interacting with the doll in a violent manner (e.g., hitting, kicking, throwing) were more likely to perform those behaviors on the doll. Additionally, Bandura demonstrated that observers will emulate an observed behavior even without the presence of a reinforcer and generalize to other violent behaviors and other environments (Bandura, 1977).

Child hitting a Bobo doll with a hammer after watching an aggressive adult model (Bandura, 1961)

In 2007, Bellini & Akullian conducted a meta-analysis of video modeling programs for individuals with autism. Overall, video modeling was found to be an effective treatment approach for a variety of presenting problems, including behavioral, self-help, and social communication skills. They found that, across studies, the most important features of a model are that the model is 1) interesting, so that children attend to the model; 2) perceived as competent; and 3) similar to themselves in some way (e.g., age, ethnicity, group, physical characteristics). In video modeling programs, a video portraying the model engaging in the target behavior is recorded. The video is then edited to omit any inappropriate behaviors and focus only on desired behaviors. After watching the model, participants are given the opportunity to practice the target. This cycle is repeated until the child consistently and independently demonstrates the target behavior.

Three different types of models have been shown to be effective for video modeling social skills programs: adult models (MacDonald, Clark, Garrigan, & Vangala, 2005; Scheflen, Freeman, & Paparella, 2012), peer models (Dauphin et al., 2004; Lowy Apple et al., 2005; Reagon et al., 2006), and self-models (Bellini & Akullian, 2007; Buggey, 2005; Buggey & Ogle, 2012). In self-modeling programs, the participant was filmed in the natural environment; then, the video was edited to eliminate inappropriate behaviors and focus solely on desired behaviors. The results of a literature review conducted by McCoy & Hermansen (2007) indicate that all three types of models produce positive results in individuals with autism.

Video modeling programs have been demonstrated to effectively increase a range of appropriate behaviors. Charlop, Dennis, Carpenter, & Greenberg (2010) used adult video models to increase socially expressive behaviors in three boys with autism. Results indicated that the intervention led to improvements in participant use of intonation, gestures, verbal comments, and facial expressions following the intervention. Several studies have demonstrated that video modeling can effectively increase the use of play-related verbalizations in individuals with ASD. In 2009, MacDonald et al. used adult video models with substitutable loops to target play-related speech in three children with autism. Substitutable loops are individual utterances that can be modified to address different characters. These loops were included to increase the number of situations in which the participants could utilize the play scripts and enhance generalization of skills to the natural environment. Results of this study indicate that watching the adult video models consistently increased participants’ use of scripted verbalizations. However, incorporation of characters not modeled in the videos varied across participants.

Other verbal behaviors, such as compliments, have been targeted in video modeling programs. Using a portable video modeling intervention during an interactive athletic group game, Macpherson, Charlop, & Miltenberger (2014) demonstrated an increase in the frequency of giving verbal compliments within 5 intervention sessions. Despite showing the model in a chaotic recreational activity, the intervention was still effective. Grosberg (2014) also used a portable video modeling intervention to target social initiation bids with peers. All participants demonstrated an increase in persistence when initiating social interactions, and these results were maintained at a 2-month follow-up.

Simpson, Langone, & Ayres (2004) used peer models in a computer based social skills instruction program. Results of the study found an increase in unprompted social behaviors following exposure to the model. Dupere et al. (2009) used adult models in scripted play settings to target reciprocal pretend play. Following the intervention, children acquired and maintained the scripted verbalizations from the videos and an also increased their level of unscripted verbalizations. Scheflen, Freeman, and Paparella (2012) examined the use of typical peer video models of appropriate play and language behaviors presented in a developmental sequence. All four participants in the study demonstrated improvements in play and language skills, as well as the average utterance length of the participants.

Video modeling has not only been demonstrated to be an effective treatment modality, but there is evidence to support the claim that it is a superior method of instruction (Wang, 2011) to in-vivo modeling. In a 1989 study, Charlop & Milstein used adult models to teach conversational speech to three young boys with autism. All three participants demonstrated rapid increases in conversational speech that generalized to other settings. Video modeling may result in more rapid skill acquisition than in-vivo modeling procedures because they eliminate the social context and minimize the focus area, thereby filtering extraneous stimuli. Since individuals on the spectrum have difficulty doing this independently, presenting only relevant stimuli in video models reduces the pressure for the participants to choose what to attend to. Additionally, social interactions are often punishing for children with ASD and it is difficult to get a child to attend to an adult in the room with them. However, the audio-visual displays of video model programs are intrinsically reinforcing for individuals with autism. It is not difficult to get the participants to attend to the video models. Furthermore, watching the same video during each session fits the restrictive, repetitive interests and insistence on sameness seen in individuals with autism. Presenting the same model and the same, carefully crafted script each time increases treatment integrity and significantly limits deviation from the treatment protocol. Lastly, video modeling programs can be cost and time effective. When adults or peers serve as the models, the videos can be reused for large numbers of children.

A 2005 review of video modeling intervention use with children with autism (Corbett & Abdullah) examined the specific characteristics of autism that contribute to the effectiveness of presenting audio-visual models. The authors state that video modeling capitalizes on over-selective attention, restricted focus, preference for visual stimuli, and avoidance of face-to-face attention found in children with ASD. In these children, visual processing is often a relative strength; programs that take advantage of that strength are more likely to be effective. Furthermore, video modeling programs only require one-third of the time and one-half of the cost of traditional in-vivo modeling procedures.

Video modeling programs are not effective for all children with autism. According to a 2011 meta-analysis (Wang, Cui, & Parrila), age moderates the effects of video modeling programs. Between age 10 and age 15, there is a significant drop in treatment effectiveness. So, although VM programs are effective for younger children with autism, the effects taper off after age 10. However, only one of the 13 articles included in the meta-analysis included participants over the age of 10. Therefore, further research on the topic is necessary before making more definite conclusions.

Video modeling SST programs provide several opportunities for generalization that are not possible with in-vivo modeling. First, video modeling allows for the use of multiple models. It is difficult to arrange for multiple models to be present for in-vivo modeling programs. Adult, peer, and self-models are all effective methods for generalization (Corbett & Abdullah, 2005). Video modeling programs can also show the target skills being performed in a variety of naturalistic settings, including home, school, and community settings in which it would be impractical to model in-vivo.

Video modeling SST procedures may be used in conjunction with other interventions in order to enhance generalization. In 2005, Apple, Billingsley, & Schwartz employed a video modeling intervention both with and without a self-management component targeting social reciprocity in children with high-functioning ASD. The authors demonstrated that including the self-management intervention along with video modeling increased compliment giving initiation. When video modeling alone was used, only compliment giving responses increased.

There are a variety of video modeling programs available online for use with children with ASD. Most of these programs are designed to be delivered alone, so parents can show the videos to their children without the assistance of a therapist. One such program is Model Me Kids, which is a peer video modeling SST program in which a peer reads a social story related to a social skill, explains the skill, then demonstrates the use of the skill. Watch Me Learn is another online VM program. Videos in this program present peer models utilizing social skills in home, outdoor, and school settings. These programs are considered evidence-based practice, since they are a form of video modeling. However, most of the specific programs (Model Me Kids and Watch Me Learn included) have not been researched in clinical populations.

One research-validated modeling program is the Transporters series (Golan et al., 2010). Transporters is a series of short, animated episodes in which models act out social scenarios, emotional reactions, and explanations. What sets Transporters apart from other video modeling programs is that the models are trains with human faces added digitally. Researchers used trains as models due to enhanced systematizing skills in individuals with autism. This means that they often have a greater drive to build and analyze systems, allowing them to predict the behaviors of the system in order to control it. Individuals with ASD often use these skills to make up for empathy difficulties. Using trains, which are complex systems that are captivating for individuals with ASD, provides the opportunity to study emotional expressions in faces and voices while still presenting them in context. Research indicates a significant improvement in emotion comprehension and recognition that generalized to other videos of humans not attached to vehicles after watching the series.

Examples from Transporters

VIRTUAL REALITY

Virtual reality refers to computer-based technology that offers three-dimensional real-time virtual environments that can be used to simulate real or imaginary environments. Virtual reality provides an interactive space in which users can learn about and practice social skills in a highly controlled environment. There are two primary types of virtual reality technology that are used in social skills training: 3D virtual learning environments (VLE) and immersive virtual environments. Virtual learning environments are three-dimensional spaces presented on the computer in which participants operate characters and interact with the virtual environment. Immersive virtual environments are more commonly presented when examples of virtual reality are given. Such programs commonly use a head-mounted virtual reality display, such as the Oculus Rift. When participants wear these helmet-like devices, they enter the virtual environment and can use their body to interact with the virtual space around them.

Virtual reality programs can be run individually or collaboratively. In a collaborative 3D virtual learning environment (3D CVLE), several different users can simultaneously share the virtual space and interact with each other. These types of programs can be useful for remote peer interactions. Stichter, Laffey, & Galyen (2013) described a SST program that uses a non-immersive 3D CVLE as a form of distance education. In the program, students designed an avatar that represented them in the virtual classroom facilitated by a single clinician. In their early review of the use of virtual reality technology in SST for individuals with ASD, Parsons & Mitchell (2002), gave a set of recommendations for intervention design. According to the authors, virtual reality programs should: 1) look realistic, 2) be user friendly, 3) be affordable, 4) allow for repetition and rote learning, and 5) allow for fading and generalization (Parsons & Mitchell, 2002).

There is a relatively large research base supporting the use of virtual reality programs targeting several social behaviors in youth with ASD. Kandalaft et al. (2012) examined the use of an individual 3D virtual learning environment to implement social cognition training. Social cognition refers to an individual's ability to recognize, decode, and respond to social cues. Treatment consisted of virtual scenarios mimicking social situations common for youth in the transition age group (age 17-22). Eight participants went through the scenario once with a coach avatar, operated by a therapist. Following this preliminary attempt, the participant receives performance feedback and repeats the same scenario with an unfamiliar therapist avatar. Results of the study found significant increases in verbal and non-verbal measures of emotion recognition as well as Theory of Mind.

Client, coach, and confederate therapists in virtual reality Social Cognition Training program

Cheng, Chiang, Ye, & Cheng (2010) reported on the effects of a 3D CVLE set in a café. The goal of the intervention was to improve the participants' understanding of empathy and perspective taking in social situations. Participants worked through empathy-evoking scenarios with a partner and answered emotion based questions centered on the scenarios. Following the intervention, participants demonstrated markedly improved empathy that generalized to their daily lives. The virtual environment is highly reinforcing for participants, and positively influenced their learning ability. Results of the study found significant differences in participants' understanding of empathy both in the virtual environment and in their daily lives.

A sample scenario from the 3D empathy system utilized by Cheng, Chiang, Ye, & Cheng (2010). In this scenario, a patron slips and falls near the participant's avatar. The participant must choose the correct response that demonstrates empathetic understanding from a set of four possible answers.

There are several reasons why virtual reality programs are particularly effective for social skills training with ASD individuals. First, the virtual environment's programming is highly predictable. When interacting with the environment, the participant has the comfort of knowing exactly what to expect. However, therapists can incorporate more flexible, unpredictable events into the session in order to prevent obsessiveness in the routine and encourage a more flexible response style. It is important to remember that virtual programs are not meant to circumvent real world social interaction. Rather, these programs should be used as a teaching aid in which the participant can view demonstrations and practice alongside a therapist.

There are several benefits to using virtual treatment programs in place of in-vivo programs. First, the participant is actively controlling their avatar in the virtual environment. This requires a higher level of engagement and closer attending to the program, as opposed to real life models. Another benefit is the ability to swap out the background and present safe yet naturalistic settings in which participants can practice the target skills. Clinicians are able to realistically represent real-world situations in order to enhance generalization.

There are studies that indicate that children can learn information from virtual reality, and some are able to transfer their knowledge to the real world (Cheng, Chiang, Ye, & Cheng, 2010; Kandalaft et al., 2012). In general, skills that are more procedural and require less nuanced understanding of social information demonstrate greater levels of generalization. However, skills requiring a more in-depth understanding of the rules of social interactions need more support in order for the skill to generalize. Future research should incorporate other evidence-based practices in order to enhance the use of skills acquired during treatment in the participants' daily lives.

ROBOTS

Social robotics is an emerging field in which autonomous robots and humans interact and perform social behaviors. Robots can be used as a remedial tool to encourage children to become engaged in a variety of different interactions important to human social behavior. The robots used in these interactions serve as social mediators that encourage children to engage in appropriate social behaviors and teach appropriate social communication behaviors (Boccanfuso & O'Kane, 2011). Robots have both structured and unstructured therapeutic applications. Unstructured approaches, also referred to as constructionist approaches, encourage active exploration of the environment. Participants engage in self-directed play activities with the robot. In structured approaches, therapists actively engage with the participant and robot in the therapeutic activities (Cabibihan, Javed, Ang, & Aljunied, 2013).

Robots can be helpful with children with severe social deficits who have trouble with any interaction with other humans. Children with ASD have relative strengths in understanding the physical world and relative weakness in understanding the nuances of the social world. The use of robots in place of people is an example of adapting treatment to the strength area of the participant. Interactions with robots resemble naturalistic human interaction, but there are much fewer socially communicative signals to interpret. Robots limit social information overload from excessive body movement, facial expressions, and eye movements in the interaction partner. Robots can be utilized as a small step towards interaction with actual humans.

The use of robots in social skills training is particularly important because they capitalize on the therapeutic effects of human touch. The tactile sensation of being touched by another person is a way of breaking through isolation. It acts as a bridge to relating to others. Robots with tactile applications can allow ASD children to explore touch in a way that could be completely under their control. In addition, robots provide a predictable environment in which children can practice social interaction skills. In many ways, therapeutic social robots are very similar to some dolls, so participants think of them as 'toys.' This helps with participant buy-in.

Robins & Dautenhahn (2014) created a humanoid robot named KASPAR to use in therapy for children with ASD. Kaspar was unique because, unlike most robots, which are made of hard plastics, he was designed to look like a human. KASPAR's outer layer is made with a silicon-rubber combination that resembles human skin. The authors examined the effect of the tactile feedback provided by this novel ROBOSKIN design. Participants engaged with the robot in tactile play scenarios targeting educational and therapeutic objectives. The results indicated that repeated play sessions with KASPAR promoted the level of spontaneous play in children with developmental disorders.

Young girl playing with KASPAR

Another robot used in autism therapy is named CHARLIE, which stands for CHild-centered Adaptive Robot for Learning in an Interactive Environment (Boccanfuso & O'Kane, 2011). In previous research, robots have been used to effectively engage children with autism in an interactive game. Additionally, robot assisted therapy has demonstrated gains in speech and child-initiated interactions following therapy. In a 2011 study, participants engaged with CHARLIE in two different games targeting turn-taking and imitation skills. CHARLIE was equipped with face and hand tracking software that was used to track the participants' movements for games in which the robot imitates the participants' movements. The study indicated that CHARLIE was able to effectively track the participant movement, with 86% accuracy for face tracking and 92% accuracy for hand-tracking. However, there is no research on the effectiveness of skill acquisition following therapy with CHARLIE.

Robots have been demonstrated in the research to have significant effects on response time (Dautenhahn & Werry, 2004), joint attention (Robins, Dickerson, Stribling, & Dautenhahn, 2004), and body awareness (Costa et al., 2014). As with other technologies incorporated in autism therapy, the participants display a high level of interest in interacting with the robots, increasing their level of attention and the effectiveness of the treatment.

There is some conflicting information regarding the generalizability of gains made during robot-facilitated SST programs. It is unclear whether or not therapy involving robots actually increases the amount of time the participant spends interacting with the robot. In 2009, Feil-Seifer & Mataric had robots contingently and non-contingently respond to interactions with a set of three participants. Results indicated that contingent robot responses increased the amount of participant-robot interaction time. However, results from a 2008 study (Pioggia et al.) found that the participant with ASD was hesitant to interact with the robot. Future large-scale research is required to obtain more consistent data regarding the willingness of children with ASD to interact with social robots.

Regardless of the effectiveness of robots for increasing social abilities in individuals with autism, the ease of use continues to be a significant limitation in their clinical utility. Until the social robots become more intuitive and user friendly, it is unlikely that there will be widespread use in treatment (Barakova et al., 2012). In this way, therapists play a critical role in the uptake of therapeutic robot use. When therapists have specific knowledge on the use of these social robots, they will be able to create comprehensive and efficient training programs incorporating social robots.

INTERACTIVE SOFTWARE

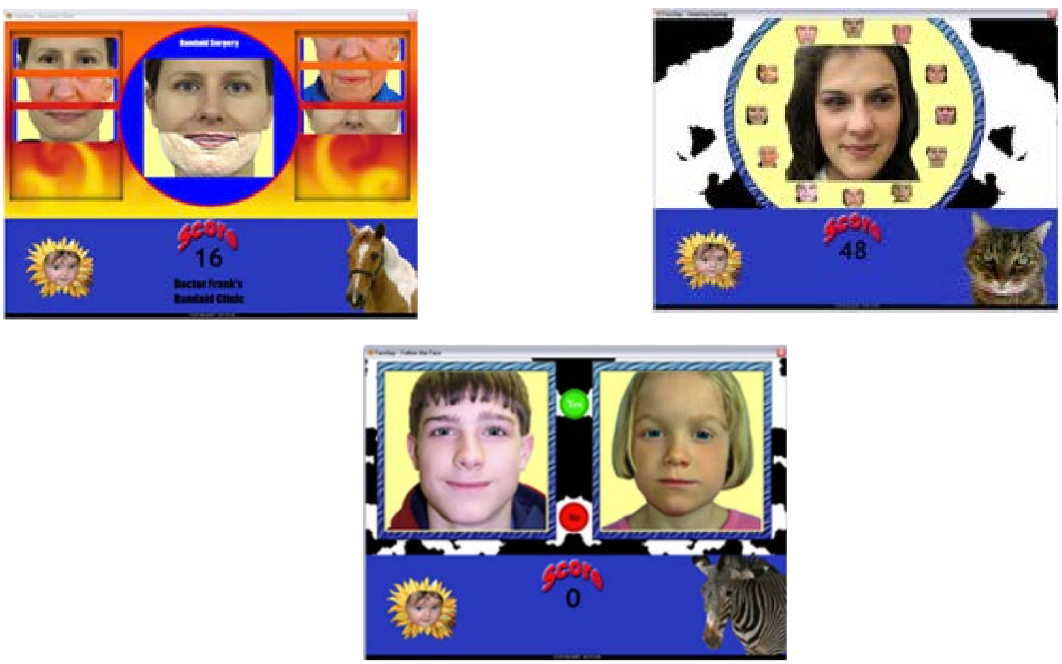
A wide variety of social skills software exists for use with children with ASD. The available software targets a range of behaviors, including joint attention (Hopkins et al., 2011), emotion/facial recognition (Hopkins et al., 2011; Baron-Cohen et al., 2004), language (Hetzroni & Tannous, 2004; Bauminger-Zviely et al., 2013), collaboration (Bauminger-Zviely et al., 2013), and social problem solving (Bernard-Opitz, Sriram, & Nakhosa-Sapuan, 2001). Results from specific studies will be discussed below.

Bernard-Opitz, Sriram, & Nakhoda-Sapuan (2001) employed a computer program, called I Can Problem Solve, with a group of 16 participants, 8 typically developing and 8 with ASD. In the program, social scenarios are presented in which participants encounter a problem with a peer. Participants were required to choose a response to the problem from a list of possible solutions. Results of the study indicated that computer-presented, animated models of problem solutions are effective at teaching social problem solving to children with ASD.

Hetzroni & Tannous (2004) used a computer program called I Can Word It Too that was created especially for their study. The program was designed to target the form, use, and content of participants' spoken language. In the software, situations depicting daily activities were presented in order to provide opportunities to use questions and answers formulated by significant people. These situations were taken from the daily routines of the participants in order to make the therapeutic setting as naturalistic as possible. After an opening statement, participants were expected to initiate or respond to a question using a variety of possible choices, presented as buttons on the bottom of the computer screen. Results of the study demonstrated that completion of the software reduced both immediate and delayed echolalia, as well as irrelevant speech. There was also a corresponding increase in relevant speech, present mostly in food and play activities rather than hygiene activities.

Hopkins et al. (2011) reported on FaceSay, a comprehensive social skills computer program in which participants complete games with realistic avatars designed to teach specific social skills. The overall goal of the program is to promote awareness of movements and features of the face. There are three games included in the FaceSay program. The first is

Amazing Gazing, in which participants follow the gaze of an on-screen avatar and select the item they are looking at, which targets joint attention ability. The second is Band-aid Clinic, in which participants must chose the correct ‘face band-aid’ that corresponds to a missing portion of a presented face. The third game is Follow the Leader, in which participants must manipulate an avatar’s face to copy the emotion expressed on a given peer model. Participants of this study were split into high-functioning (IQ > 70) and low-functioning (IQ < 70) groups. Results indicated significant improved facial recognition, emotion recognition, and naturalistic social interactions in the high-functioning group, while the low functioning group improved only in facial and emotion recognition.

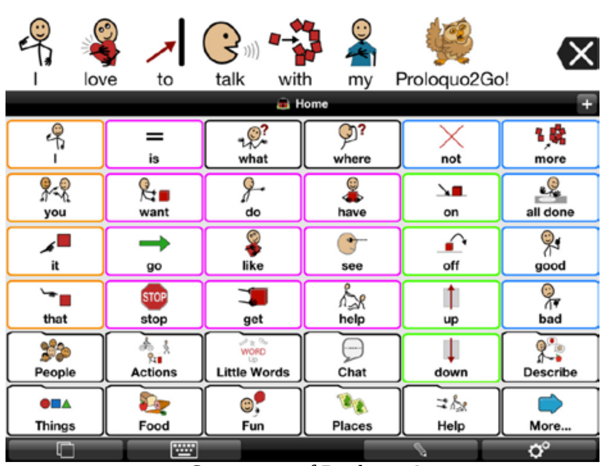


Activities from FaceSay - top left: Band-aid Clinic; top right: Amazing Gazing; bottom: Follow the Leader. (Hopkins et al., 2011)

MOBILE TECHNOLOGY

Mobile technology has become an integral part of daily life for many people in Western society. iPads have been used in general education classrooms to promote higher level thinking and problem solving through engaging, captivating apps. These apps make drills and practice more interesting for students, and offer immediate and consistent feedback. Furthermore, the presentation of the apps on smartphones and tablets, which are associated with positive emotions for many children, increases participant buy-in. Fogg & Eckels (2007) found a relationship between repeated positive interactions with smartphone functions unrelated to therapeutic programs and response to specific behavioral modification messages.

Social Skills Traning programs delivered through tablets and smartphones address a range of behaviors, although many of the interventions are communication related. Perhaps the most commonly used communication app is Proloquo2go, which is an Augmentative and Alternative Communication (AAC) speech generation application with a library of 12,000 labeled icons. The icons contain an image and the word for what is depicted in the image. When the individual using the app selects an icon, the iPad reads the corresponding word aloud. The individual can select a single icon for one-word utterances such as choices, or they can select a string of icons to form longer phrases. Despite the popularity of the app, there is little research on the app's effectiveness. Searching for "Proloquo2go" on PsycInfo, a database of psychology research articles, returns no peer reviewed articles.



Screencap of Proloquo2go

There is some research examining apps that are similar to Proloquo2go. Xin & Leonard (2014) used an app called SonoFlex on an iPad to teach communication skills to three children with autism. SonoFlex is an AAC speech-generating app very similar to Proloquo2go. In the study, teachers asked the participants a series of questions to which students were expected to respond by selecting an icon on the app. If participants failed to respond or responded incorrectly, the teacher pointed to the correct icon. Correct responses to teacher questions were recorded. Results indicated that children with autism were able to acquire communication skills with the use of a speech-generating application.

In addition to functional communication, iPad apps have also been used to target play dialogue. Murdock, Ganz, & Crittendon (2013) showed a play story to four children with ASD to increase scripted and unscripted play-related speech. The stories were presented in a book-like format on the iPad and contained pictures of toy figures interacting with accompanying audio recordings. Child-initiated interactions during play scenarios with an adult were recorded. Three of the four participants demonstrated increases in play dialogue, with medium to strong treatment effects.

In addition to communication-related apps, there are many apps that target other social skills. Alves, Marques, Queiros, & Orvalho (2013) piloted an app prototype called LIFEisGAME. The app is specifically designed for children with ASD and targets emotion recognition skills. Several tasks are included in the app, and they all aim to build the connection between facial expression and emotion. The researchers observed participants engaging with the app in a 15-minute session. Information regarding motivation and usability was gathered. Participants appeared to be motivated to play the game, and exhibited excited behavior while playing (e.g. smiles, laughter, some stereotypy). Although further research is required to determine the effectiveness of the app at increasing emotion recognition ability, the results of this study show that LIFEisGAME could be an entertaining way for children to learn social skills.

CONCLUSION

The vast amount of research referenced in this monograph illustrates the myriad of possible uses of technology in social skills training. From communication to play skills, technology can help to increase many positive behaviors in children with ASD. Despite the large existing research base, there is a need for further investigation in these areas. Moreover, there needs to be consistency between the programs that are utilized in the field and those that have been demonstrated to be effective in the research literature.

One major limitation of much of the existing research regarding technology and SST is that, like SST without the use of technology, skills often do not transfer well to real-world situations. This may be due to the gap between the safe therapeutic environment and the dynamic, unpredictable social behavior found in the real world. Another limitation is often the cost of the interventions. Unless participating for research purposes, access to virtual reality programs and robots can often be quite expensive. However, some video modeling programs, mobile apps, and computer software is relatively inexpensive and can be purchased for use at home. Although robotics and virtual reality as costly and difficult to access, creating self-modeling videos and peer modeling videos is relatively easy with the availability of technology (e.g., iPads) and can be incorporated in home, therapy or school settings to target a myriad of skills including speech, communication, and social skills.

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