Chapter 14:

Innovative technology-based interventions for people with autism spectrum disorders

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Introduction

During the last decade, there has been a shift in emphasis from language-based instruction to more visual instructional supports as a catalyst for learning in individuals with multiple disabilities and autism spectrum disorder (ASD) (eg. Bondy & Frost, 2001; Quill, 2000). This is due to extensive reports that individuals with ASD demonstrate enhanced performance in comparison to matched controls on simple visual search tasks that require detecting a target set among distracters (eg. Dawson *et al*, 2007; Mottron, 2011; Simmons *et al*, 2009). For instance, individuals with ASD generally perform well on the Wechsler Intelligence Scale for Children (WISC) Block Design test, the embedded figures test, visual search, and copying impossible figures as well as on the Raven's matrices (eg. Fugard *et al*, 2011; Soulieres *et al*, 2009).

Given the visual superiority of people with ASD, it is perhaps not surprising that the majority of current educational programmes for these individuals frequently employ visual supports. Picture prompts, photographic activity schedules, visual schedules, or videos appear to be appropriate and particularly motivating for these individuals (eg. Dawson *et al*, 2000; Kamio & Toichi, 2000; Rao & Gagie, 2006; Shane & Albert, 2008).

Advances in information and communication technology (ICT) have led to a number of innovative applications (Doughty *et al*, 2007), in which many of the above visual supports have been integrated, forming the design of technology-based interventions for this population. A non-exhaustive list of examples includes the use of the internet, online communities, robotics, assistive and prompting devices, iPods, computer-aided instructions, video modelling, virtual reality, voice output communication devices, computer-training (affect, social cognition, language), telehealth, telemedicine, smart housing, home automation, computer-play and others (eg. Goodwin, 2008; Verdonck *et al*, 2011).

Technology-based interventions have been used to accommodate a wide range of different skills and deficits in individuals with ASD. Recent studies have attributed this to a number of factors.

- Among typically developing individuals, technology-based applications are widely used for leisure and educational purposes, as a result, they are perceived as social interaction interventions.
- Technology-based interventions enable the individual with ASD to participate in a meaningful way in the wider community life by facilitating new communication, socialising, learning, leisure and employment opportunities (Bolte *et al*, 2010).
- Technology-based interventions can serve as efficient and cost-effective tools as they remove, for example, the requirement to create and re-produce paper-based training aids (eg. Nikopoulos & Nikopoulou-Smyrni, 2008).
- It is common for people with ASD to respond to a restricted set of cues within an environment; a phenomenon known as stimulus over-selectivity (eg. Lovaas & Koegel, 1979; Rincover & Ducharme, 1987). Technology-based interventions can be utilised to bring relevant cues closer together, which can help people with ASD to follow respective cues and to discriminate between them. This is important to develop skills in imitative responding (eg. Morgan & Salzberg, 1992).
- Technology-based interventions can efficiently take advantage of the attention skills of individuals with ASD, which tend to be more sensitive to graphical presentations. Technology can be used to display and record a wide range of examples of visual stimuli and response variations (eg. Nally *et al*, 2000; Williams *et al*, 2002).
- Usually, interventions based on technology do not require high levels of social skills. This is particularly important for individuals with ASD, who typically present with a deficit of social skills (Reichow & Volkmar, 2010) and often experience discomfort within non-controlled social environments (Charlop-Christy *et al*, 2000).

- Individuals with ASD exhibit difficulties in situations involving environmental change, typically referred to as deficits in disruptive transition behaviour (APA, 2000). Technology-based interventions can be used to provide controlled responses and therefore serve as an efficient medium to present optimal, adaptive learning contexts while supporting the option to slowly and systematically increase the levels of complexity (Bolte *et al*, 2010; Golan & Baron-Cohen, 2006).
- Finally, the use of technology-based interventions can strengthen the internal consistency and reliability of research evidence since behavioural measurement in training (such as recording of sequences, correct responses or assessment of complex behaviours) can be easily standardised. This allows for more confident comparison of data sampled across learners and sessions (Morgan & Salzberg, 1992).

Video modelling

Video modelling has been suggested as an effective and technologically advanced method for developing a variety of skills in individuals with ASD (eg. Bellini & Akullian, 2007; Corbett & Abdullah, 2005; Delano, 2007; Kagohara, 2010; Nikopoulos & Keenan, 2006; Schreibman *et al*, 2000; Tereshko *et al*, 2010; Wang *et al*, 2011). It can be defined as the occurrence of a behaviour by an observer that is the same or similar to the behaviour shown by a model on a videotape (eg. Grant & Evans, 1994). The 'model' can be a peer, a sibling, an adult, or even oneself (Bellini & Akullian, 2007). The list of video modelling achievements is growing fast and includes, for example, teaching of generalised purchasing skills (Alcantara, 1994; Haring *et al*, 1987; Haring *et al*, 1995), daily living skills (Shipley-Benamou *et al*, 2002), conversational skills (Charlop & Milstein, 1989; Charlop-Christy *et al*, 2000; Sherer *et al*, 2001), social language (expressive) skills (Baharav & Darling, 2008; Charlop *et al*, 2010; Maione & Mirenda, 2006), generative spelling (Kinney *et al*, 2003), perspective taking (Charlop-Christy & Daneshvar, 2003; LeBlanc & Coates, 2003), socially relevant behaviours and play skills (Baharav & Darling, 2008; Blum-Dimaya *et al*, 2010; Boudreau & D'Entremont, 2010; D'Ateno *et al*, 2003; Dauphin *et al*, 2004; Gena *et al*, 2005; Hine & Wolery, 2006; MacDonald *et al*, 2005; MacDonald *et al*, 2009; Nikopoulos & Keenan, 2003, 2004a, 2004b, 2007; Parsons, 2006; Reagon *et al*, 2006; Simpson *et al*, 2004; Sturmey, 2003; Taylor *et al*, 1999), iPod use (Hammond *et al*, 2010), generalised imitation skills (Kleeberger & Mirenda, 2010), or transitional behaviours (Cihak *et al*, 2010).

Further, with a particular focus on adolescents and adults with ASD, research has shown that video modelling can be an effective and promising method for teaching self-help, daily living and laundry skills (Horn *et al*, 2008; Lasater & Brady, 1995; Van Laarhoven *et al*, 2010), employment-related social skills (Morgan & Salzberg, 1992) or vocational skills (Allen *et al*, 2010). In this last study, Allen and colleagues used video modelling to teach four young men with ASD to use a mascot (ie. WalkAround®) and entertain customers in a large discount retail warehouse. All participants had either limited or no previous employment history. Appropriate use of the mascot comprised of waving, shaking hands, giving high-fives, moving the tongue, tail, ears or eyes, and jumping or shaking its body. Initially, participants watched two versions of a video model twice – scripted and naturalistic – and then returned to the main aisle of the store. In the scripted version (1.5 minutes long), the mascot was shown engaging in each of the targeted skills in isolation. Target skills were demonstrated both from the perspective of someone outside the costume and from the point-of-view of someone inside the costume. In the naturalistic version (4.5 minutes long), the mascot was shown using each of the targeted skills in a large retail warehouse on a busy weekend afternoon in a variety of combinations and sequences. Results demonstrated that video modelling was an effective way to teach young adults with ASD to perform a vocational task in a social setting. Each participant learned to shake hands, wave and interact with customers by waving their eyes, ears, and tail in ways that customers and managers found pleasing.

Critically, apart from video modelling being reported in the literature as an effective method for teaching a variety of skills to individuals with ASD, emerging evidence has suggested its effective use for eliminating challenging/problematic behaviours in children (eg. Nikopoulos *et al*, 2009; Schreibman *et al*, 2000). However, it has never been investigated as an approach for reducing challenging behaviours in adults with atypical development. This could possibly be achieved when potential reasons for the manifestation of challenging behaviours are identified and carefully considered and included in the construction of the videotapes. Thus, a functional behavioural assessment (FBA) procedure (eg. Bachmeyer *et al*, 2009; Delfs & Campbell, 2010; Dwyer-Moore & Dixon, 2007; Hanley *et al*, 2003; Manente *et al*, 2010; Matson & Wilkins, 2009; Matson & Minshawi, 2007) is initially conducted and the findings from it are used for the design of the videotaped scenarios. In a hypothetical example, functional behavioural assessment has suggested that the function of an individual's verbal aggression is to get attention from a member of staff during lunch. Based on this suggestion, in the video the model will be shown performing an appropriate behaviour (verbal or gestural) in order to get the attention from the member of staff. A functional behavioural assessment is a precise description of a behaviour, its context, and its consequences, with the intent of better understanding the behaviour and those factors influencing it. It includes three approaches to assessment:

1. **Indirect assessment** consisting of structured interviews and checklists which have been developed to solicit information about situations in which problem behaviour occurs.
2. **Direct descriptive assessment**, involving direct observation of behaviour and the environmental situations in which it occurs. Opportunities are scheduled to observe and describe the target behaviour across a broad sample of environments and occasions with a focus on identifying functional relations between the target behaviour and the environment based on the A-B-C recording form (A: antecedent, B: behaviour, C: consequence). That is, an observer enters data whenever problem behaviour occurs: time and setting, problem behaviour, and events occurring immediately prior to and following the target behaviour. The data collected from these observations are analysed and one should look for trends in the occurrences of that behaviour, for stimuli that may be evoking it or the needs that the individual is attempting to fill by exhibiting this behaviour.
3. Finally, **experimental functional analysis** involves the systematic manipulation of environmental conditions in an artificial setting, to identify the variables that control and maintain challenging behaviours. Experimental control is deemed to be evident when a change in condition brings an associated change in behaviour (eg. Harvey *et al*, 2009). Although generally considered superior to other functional assessment methods, experimental functional analysis has known practical limitations and therefore it may be used only when data from the other two approaches are insufficient for the creation reliable hypotheses.

Computer-based training for individuals with ASD

According to a number of findings reported in the literature, the design of any computer-based device and program would involve a task analysis whereby the complex sequence of behaviours (tasks) in any given scenario are broken down into constituent elements in an effort to tailor the demands of the task to the individual needs of each child. This systematic manipulation of the tasks would follow the rules of the scientifically validated strategy of Task Analysis (Baily & Wolery, 1984; Stokes *et al*, 2004). That is, a rather difficult scenario will be made easier by allowing children to experience selected parts of it (cf. *prompting*). Once the required behaviours in these parts are identified they can be taught to that child and the task of reconstructing the entire scenario for the child can begin. Undoubtedly, such training will also empower the treatment providers and/or parents of each child by learning how difficult behaviours can be effectively taught to their children with ASD (Keenan *et al*, 2000).

Computer-based programs and devices can allow the presentation of a simplified social environment and then a gradual increase in the complexity of social interactions. These are significant elements for the design of successful therapeutic programmes for children with ASD (Duquette *et al*, 2008; Goldsmith & LeBlanc, 2004; Robins *et al*, 2004b). In that sense, computer-based programs and devices could definitely be integrated into overall therapeutic programs, especially when they meet the following requirements:

1. Provision of multiple opportunities for children with ASD to imitate modelled behaviours should be a core component of any therapeutic program.
2. Any effective program should not demand the acquisition of advanced technical skills from the carers or treatment providers.
3. Multisensory interactions (auditory and visual information), controlled and structured environments, use of multi-level interactive functions, individualised use and independence, direction of observation to salient points are features that facilitate learning of children with ASD when working with computerised devices.
4. Any program has to be designed and conceived of as a set of rules that build on learning experiences in small logical steps (task analysis), progressing at a rate tailored to the needs of each child and incorporating immediate consistent consequences (eg. positive reinforcement) for responding.
5. Integral data collection is essential for assessing and monitoring children's progress.

Virtual reality/virtual environments

An area of application still in its infancy is the use of virtual reality (VR) environments in social skills training for individuals with ASD. Early studies have suggested that using interactive computer software could encourage language use (Colby, 1973; Goldenberg, 1979) and responsivity (Frost, 1981; Geoffrion & Goldenberg, 1981) and some suggested that social skills acquired in this way can generalise to other areas (Panyan *et al*, 1984). Children with ASD were reported as being more enthusiastic when working with computers than in a 'regular toy situation' & (Bernard-Opitz, 1989), probably because the computer may appear to make fewer demands on them than a human tutor (Jordan, 1988), and reduce stimulation to a level of input tolerable to the individual (Strickland, 1997).

One of the first reports on its application described two case studies to investigate the use of VR as an aid to learning in children with ASD. Neither child was classified as having high-functioning ASD and neither spoke nor understood many normal sentence structures. The two children were given an initial test involving recognising and tracking a moving car in a street scene. Neither had previously been able to learn to recognise and track a common object when taught in the conventional way. Both children were happy to practice this task in a virtual street scene on a head-mounted display, and the explanation given for their improvement on the task after the intervention was the controlled nature of the learning environment, which limited the stimulus load on the learners. It may also have helped that the children with ASD were not exposed to social stimulation while learning the task in the virtual environment.

The controlled nature of the learning environment was one of the reasons behind the creation of 'Returning Home' (Charitos *et al*, 2000), which presents children who have ASD with possible everyday activities that may take place when they return home. The house consists of five rooms, for example, a bathroom and kitchen, on two stories, and before attempting a task, such as washing hands, the child has the option of watching an avatar perform the tasks. As yet, no findings have been reported using this application.

Parsons and Mitchell (2002) make a strong case for utilising virtual environments (VE), in social skills training for people with ASD in spite of the inherent contradiction involved in using a training medium that reduces the need for social interaction. People with ASD have little aptitude for pretence so sometimes cannot role play, but VE provide an opportunity to learn rules and basic skills, which can be repeatedly practiced before entering the real setting in which they are required (Volkmar & Klin, 2000).

This approach was tested in a study with a group of six teenagers with ASD, some of whom had an IQ in the intellectual disability range (Leonard *et al*, 2002). As a baseline assessment, they were shown a video of a real café and bus interior, and were asked to choose where they would sit and why. They then underwent an intervention in a virtual environment depicting a café similar to that shown in the video. They had to learn two rules about finding a seat: 'when there is an empty table, you should sit there rather than with strangers;' and 'when there are no empty tables, you should ask if an empty seat is available or whether you can sit down'. The participants were then reassessed on the video task, and the remaining participants learnt the rules in the virtual café before repeating the video task. After training in the virtual café, the participants showed a significant improvement in ideal behaviour and in the social appropriateness of the reasons given. However, they could not generalise the rules from the café to the bus.

Strickland identified a series of VE characteristics that justify its use by individuals with ASD:

- VE can isolate children with ASD from their surroundings to help them focus on a specific situation.
- The complexity of a VE scene can be controlled.
- VE technology allows for the successive and controlled adjustment of an environment with the aim of generalising activities at different but similar settings.
- VE can be realistic, easily comprehensible, and at the same time less hazardous and more forgiving than a real environment when a mistake is made by the user.
- The present state of VR technology focuses on visual and auditory instead of haptic (touch) or other sensory stimuli. Specifically for ASD, vision and hearing have proven to be very effective in the development of abstract concepts (Jordan & Powell, 1990).

In addition, VE may be useful especially for children with ASD because of the facility they offer for aiding mental simulation through the process of experiential role play.

This application of rehabilitative VE could be criticised for exactly the same reasons that computer-based instruction for people with ASD has been criticised. Chen and Bernard-Opitz (1993) raised the possibility that computer-assisted instruction might be a hindrance to the development of social skills. To counteract this, software could be used with a teacher sitting alongside (Cromby *et al*, 1996). Howlin (1998) speculated that an over-reliance on computer interaction could lead to obsessive behaviour and a decline in real world interaction. The predictability of the software and the sense of control this may give could become appealing. Latash (1998), talking about a variety of users, warned that, if the rehabilitative VE is too safe and attractive, the person might be reluctant to re-enter the real world. Parsons and Mitchell (2002) advise that, to counteract this, VE could be made more flexible, with more interaction being demanded so that the VE is less predictable.

Robotics

Teaching of socially relevant behaviour to children with ASD through robotic tools is an area of emerging interest (eg. Barakova *et al*, 2009; Billard *et al*, 2007; Robins *et al*, 2004a, b, c). Anthropomorphic (human-like) or zoomorphic (animal-like) shaped autonomous robots have become of special interest. Since recent studies have indicated that robots may have a great potential in the therapy of children with ASD (eg. Dautenhahn & Werry, 2004; Michaud & Théberge-Turmel, 2002; Pierno *et al*, 2008; Werry *et al*, 2001a). Furthermore, robots may provide an opportunity for their use as a replacement of a parent/caregiver or therapist in the delivery of intervention (Barakova & Lourens, 2010). In most studies, robots perform simple behaviour with the purpose of provoking reciprocal human reaction.

Initial efforts: The AuRoRA project

The majority of the investigations in the area of robots come under the AuRoRA project (Autonomous Robotic platform as a Remedial tool for children with Autism), which started in 1998 and is led by Professor Dautenhahn (Werry & Dautenhahn, 1999). Its ultimate goal has been to explore the design space of interactive systems and to develop a socially interactive robotic system as a therapeutic tool for children with ASD (Dautenhahn & Werry, 2000). Thus far, within the AuRoRA project there have been three core studies and a few ancillary ones (eg, Robins *et al*, 2006) using:

1. An autonomous non-humanoid mobile robot (like a toy truck with heat sensors that could detect nearby children and had bumper switches that allowed it to reverse upon impact; Dautenhahn *et al*, 2003; Werry *et al*, 2001b).
2. A small stationary humanoid doll robot (an off-the-shelf doll with added motors, sensors and a simple processor that allowed the doll to move, sense movement, and even recognise gestures and respond to them (Robins *et al*, 2004a, 2004c; 2005a; 2005b; Billard *et al*, 2007).
3. A touch-sensitive screen (Davis *et al*, 2006).

An autonomous non-humanoid mobile robot

In a series of trials, children with ASD were given the opportunity to interact with a mobile robot called Labo-1. The robot was able to move in any direction on the floor, avoiding obstacles, including people, following a heat source and generating simple words and phrases. The children, aged 8–12, could approach, avoid, pick up, or even ignore the robot and walk away, or just lie on the floor. Basically, in a supervised setting, the robot would follow and be chased by the children, while at the same time producing brief utterances for those children who were able to respond to speech.

A small stationary humanoid doll robot (Robota)

The humanoid robot Robota was designed to cover the main limitation of the non-humanoid robot initially used in the AuRoRa project, which offered only a very small number of interactions with the child, such as spatial approach/avoidance turn-taking games. Thus, this small humanoid doll robot can further provide additional means of interaction, such as mimicking movements of body parts (eg. hands, head) and even more complex interactions (sequences and combinations of actions). It can move its arms, legs and head; however, it cannot move from place to place and cannot readily be picked up. The idea has been based on the assumption that bodily interaction in imitative interaction games is indeed an important factor in any child's development of social skills, and hence, teaching of such skills in a playful and exploratory way might help children with ASD in coping with the normal dynamics of social interactions. In a series of sessions in which, overall, 14 children with ASD aged 5–10 years old participated, Robota was dressed in a plain costume, and had simplified head features and was able to: 'dance' to pre-recorded songs; detect vertical arm movements of the child and therefore to respond by lifting the right, left or both arms; learn and replay the action of a child when moving his/her limbs and the head.

A touch-sensitive screen (TouchStory)

This study used a touch-sensitive computer screen to explore ideas of narrative comprehension and expression in ways which were not necessarily verbal or textual. It differed from the ones mentioned above in that, while the child was free to stand or sit, he/she should be able to touch the screen or physical game and hence, interact with it. It also differed in that it was task-based in that the children were invited to play the game. Twelve children with ASD who were aged between five and 11 participated in a study wherein they were invited to make four stories with either laminated picture cards or draggable pictures on a touch-sensitive screen. It was seen as a collaborative task in that the experimenter gave the child feedback and if a wrong picture was chosen the child was invited to try another one. There was also an adaptive phase where the stories presented by the system varied depending on the interaction history with a particular child.

Collectively, and across a number of trials, the main findings of the AuRoRa project were that:

- the robot was safe for the children to use and most children were not afraid of the robot
- children interacted with the robot over a continuous period of five to 10 minutes or even longer
- children generally showed an interest in the robot (in terms of gaze, touch, physical proximity etc.) and were more engaged in interactions with the robot than with another non-robotic toy
- children played some imitation games with the robot (ie. the robot imitating children's body movements)
- in some cases, the children used the robot as a mediator or an object of shared attention in their interaction with their teachers
- the embodied nature of the robot allowed for the displays of body orientation and movements in ways that a two-dimensional display on a computer screen may be unlikely to evoke

- children might lose interest in interacting with the robot over time if it was exhibiting the same behaviour
- children were notably more social and pro-active when interacting with simple robots with few features.

Two recent developments: 2005 to present

Related to the AuRoRa project, a few more studies have been mentioned in the literature. These also focused on the investigation of human–robot interaction in the treatment of children with ASD. In 2005, Okada and Goan developed a creature-like robot, Muu, to observe how and whether children with ASD can spontaneously collaborate with the robot in shared activities, such as arranging coloured blocks together.

A couple of years later, Liu *et al* (2007) proposed a framework for a robot that might be capable of detecting and responding to affective cues with the view of helping children with ASD to explore the social interaction dynamics in a gradual and adaptive manner. In another study (Kozima *et al*, 2007), longitudinal observations of children with ASD interacting with a creature-like robot, capable of expressing attention by orienting its gaze and expressing emotions by rocking and/or bobbing up and down, were reported. Findings indicated that children spontaneously approached the simple robot and they not only engaged in dyadic (two-way) interaction with it, but they extended to triadic (three-way) interactions, including their adult caregivers. It was assumed that the minimal expressiveness of the robot facilitated social interaction by enabling the children to comprehend socially meaningful information. Similar suggestions were made by Scassellati (2005) and Duquette *et al* (2008), who found that children with ASD could perform positive preliminary social behaviours, such as touching, vocalising at, shared attention (visual contact, physical proximity) and imitate facial expressions (smile), when interacting with a simple robot.

Since 2008, an on-going development in this area has been a child-sized humanoid robot called KASPAR (Kinesics And Synchronisation in Personal Assistant Robotics) (Adaptive Systems Research Group, 2008), developed by the Adaptive Systems Research Group at the University of Hertfordshire under the lead of Professor Dautenhahn. The goal of this €3.22 million European IROMEC project has been to develop a reliable robot that can empower children with disabilities to discover the range of play styles from solitary to social and co-operative play. Although this work has gained great popularity in the media, there is only one written report, which is in German.

In 2009, Kozima *et al* developed a simple robot, Keepon, which was shown capable of facilitating triadic interactions between itself, an infant with autism, and another individual (another child or the infant's parent/caregiver). Although the interaction of hundreds of children with Keepon has been conducted and recorded over the recent years, only very few children with ASD have been included in this sample. In the same year, Costa and her colleagues investigated the use of a non human-like shape robot – LEGO MindStorms NTX – for improving the social life of adolescents with cognitive impairments, ASD and mental disease. During five sessions, two adolescents diagnosed with ASD and developmental disorder experienced a robot which was able to execute a predefined simple choreography only when either its touch sensor was pressed or when a certain sound (music, clapping, among others) was higher than a predefined value. Results were mixed and the participants behaved differently concerning the interest in maintaining the interaction throughout time. Similar results were obtained when the same robot, but with a human-like shape, was used in a subsequent study by the same investigators (Costa *et al*, 2010). Lego robots were also used in a classroom setting in an effort to foster collaboration among children at the higher-functioning end of the autistic spectrum, obtaining promising results (Wainer *et al*, 2010).

The most recent development in the area has been described in a study by Giannopulu and Pradel (2010) wherein they analysed the interactions of four children with ASD, aged 4–7 years old, with a mobile toy robot that provoked the child to engage in free spontaneous game play. Interestingly enough, the rather small cylindrical-shaped mobile robot called GIPY1, had been homemade. Specifically, a representation of a neutral facial expression constituted the cladding of the robot; the round eyes and the triangle nose were dyed olive green and the elliptical mouth was dyed red. Everything was covered with a transparent plastic sheet. According to the authors, the simplicity of the robot was driven by reports that indicated that children with ASD perform better when engaging in play with simple and predictable toys. The robot could move forward, backward and turn on itself at low speed via a wireless remote control, facilitating chasing games with the participants. Results were consistent with those from previous studies, in which narrative description of robot-child interaction has mainly been utilised. Nevertheless, a notable aspect of this study was the calculation of the exact duration of robot–child interactions during spontaneous game play based on four criteria; eye contact, touch, manipulation and posture.

Parents and healthcare professionals regularly report that individuals with ASD are drawn to technological devices and researchers have noted the importance of devising treatments that take advantage of this population who have a tendency to better use and learn from visual instructions (Goldsmith & LeBlanc, 2004; Konstantinidis *et al*, 2009). Moreover, the suggestion that children with ASD are mainly attracted to systems of low or minimal variance or even predictable (ie. technological devices/machines) (Baron-Cohen, 2006; Nadel *et al*, 2004) comes in accordance with the nature of robots, which can allow properties of repeatability and stability as well as predictability of repetitive and monotonous behaviour (Michaud & Théberge-Turmel, 2002).

Robots can further allow the presentation of a simplified social environment and then a gradual increase in the complexity of social interactions. These are significant elements for the design of successful therapeutic programmes for children with ASD (Duquette *et al*, 2008; Goldsmith & LeBlanc, 2004; Robins *et al*, 2004b).

The popularity of technology in the field of psychology is evidenced by the development of new journals in the area, such as the *Journal of Special Education Technology*, the *Journal of Educational Multimedia and Hypermedia* and the *Journal of Computer Assisted Learning*. Furthermore, Autism Speaks, one of the largest international autism funding bodies, continues to support an Innovative Technology for Autism Initiative promoting collaborations among healthcare professionals, computer scientists and designers within the ASD community. More traditional clinical psychology journals are also recognising the importance of technology in facilitating service delivery and as such are devoting special issues to the topic (eg. *Autism: The International Journal of Research and Practice*).

Last but not least, the use of technologies is becoming more mainstream because they are widely available, cost effective and easier to use, which warrants extending and combining them to address the task of helping people with ASD.

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Autism Spectrum Disorders (ASDs) are a group of developmental disabilities that can cause significant social, communication and behavioral challenges. CDC is working to find out how many children have ASDs, discover the risk factors, and raise awareness of the signs.Â The differences in how ASD affects each person means that people with ASD have unique strengths and challenges in social communication, behavior, and cognitive ability. Therefore, treatment plans are usually multidisciplinary, may involve parent-mediated interventions, and target the childâ€™s individual needs. What can innovative Technologies do for Austism Spectrum Disorders? SAGE PUB, 14(3), 155-159. Chen, S. H. A., & Bernard-Opitz, V. (1993).Â Effects of a computer-based intervention program on the communicative functions of children with autism. Journal of Autism and Developmental Disorders, 34(2), 95-113. HÄ±zal, A. (1982). Bilgisayarlar ve EÄŸitim. A.Ãœ. EÄŸitim FakÃ¼ltesi Dergisi, 15(1), 389-399. Hourcade, J. P., Bullock-Rest, N. E., & Hansen, T. E. (2012). Multitouch tablet applications and activities to enhance the social skills of children with autism spectrum disorders.Â Collaborative virtual environment technology for people with autism. Focus on autism and other developmental disabilities, 20(4), 231-243. National Autism Center (NAC).