The Use of Innovative Technology-Based Interventions for Children with ASD

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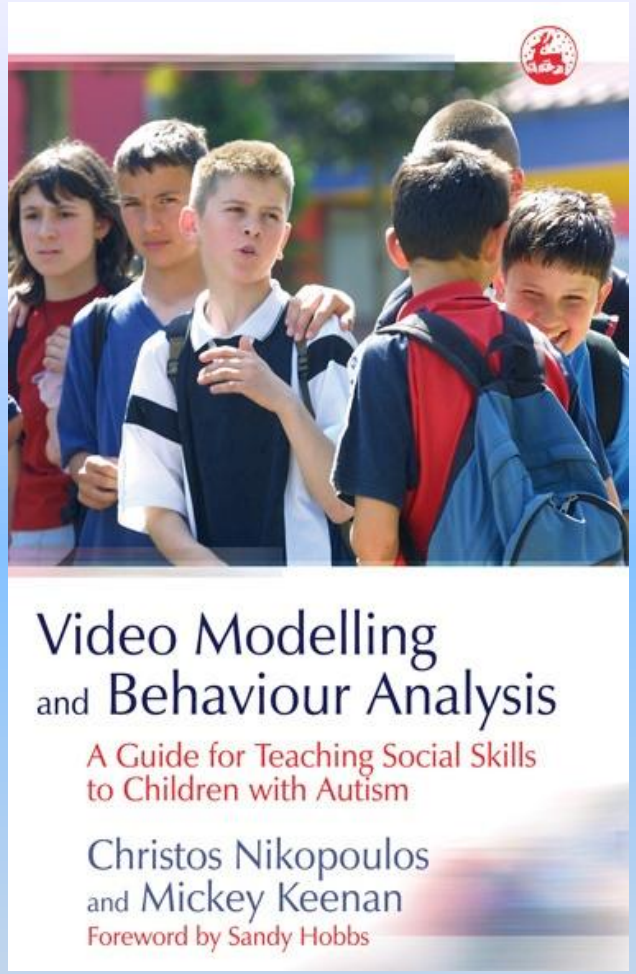
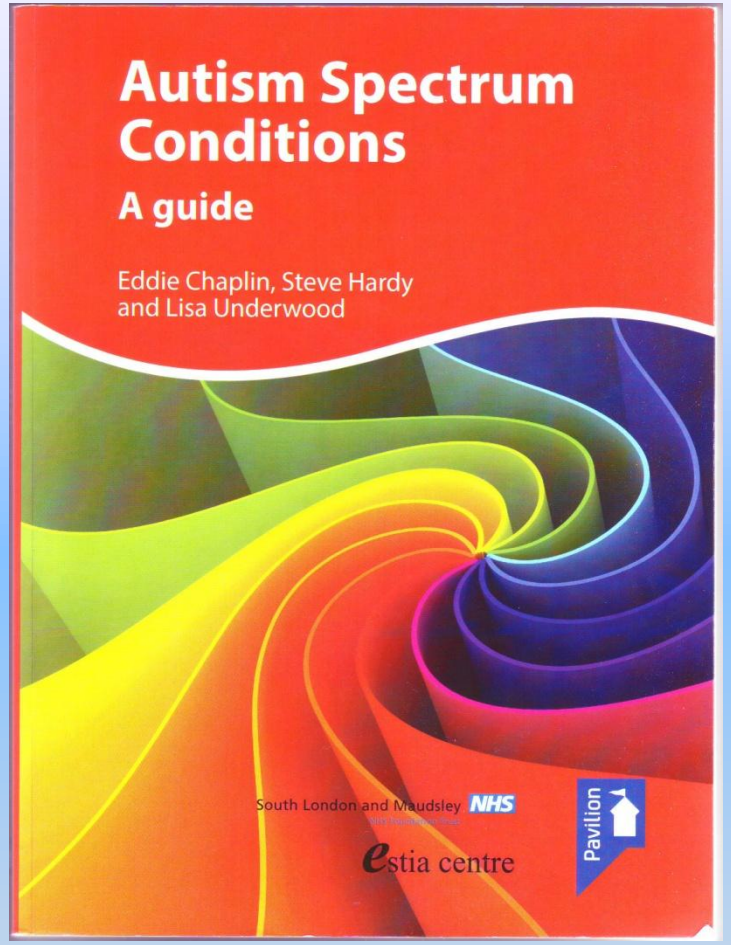




Nikopoulos, C.K., & Keenan, M. (2006). *Video modelling and behaviour analysis: A guide for teaching social skills to children with autism.* London: Jessica Kingsley Publishers.

Nikopoulos, C.K., & Tsakanikos, E. (2013). *Innovative technology-based interventions for people with autism spectrum disorders.* In Chaplin , E., et al., (Eds.) Autism spectrum conditions. A guide. London: Pavilion Publishing.

Introduction

Autism Spectrum Disorder has a range of impacts on the health, economic wellbeing, social integration, and quality of life of individuals with the disorder, and also affects families, healthcare professionals, teachers, and, potentially, the rest of the society.

From an economic perspective, recent estimates in the UK have shown that the aggregate annual costs in treatment, lost earnings, care and support for children and adults with ASD is£32 billion per year!!! That makes ASD the most costly medical condition in the UK!

More specifically, most of these costs are accounted for the provision of effective … treatments! Thus, consistent reports within the literature have identified the critical need for further research that aims to expand and/or improve the currently available interventions.

One way of addressing the demand for effective supports has been through the design and development of innovative interventions based on assistive technology.

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 ASD.

Advances in ICT have led to a number of innovative applications, in which many of the visual supports have been integrated, forming the design of technology-based interventions.

Recent studies have attributed the extensive use of these interventions to a number of factors:

- **Technology-based applications are - widely used for leisure and educational purposes - social interaction interventions;**
- **Enable participation in a meaningful way in the wider community life by facilitating new communication, socialising, learning, leisure and employment opportunities;**
- **Serve as efficient and cost-effective tools as they remove, for example, the requirement to create and re-produce paper-based training aids;**
- **It is common for people with ASD to respond to a restricted set of cues within an environment (i.e., over-selectivity). 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;**

- Usually, interventions based on technology do not require high levels of social skills;
- Individuals with ASD exhibit difficulties in situations involving environmental change. Technology-based interventions can serve as an efficient medium to present adaptive learning contexts while supporting the option to slowly and systematically increase the levels of complexity;
- Finally, the use of technology-based interventions can strengthen internal consistency and reliability since behavioural measurement can be easily standardized.

Technology-Based Interventions Applications

Computer-based training

The design of any computer-based device and programme would involve a task analysis, whereby the complex sequence of behaviours (tasks) are broken down into its elements to tailor the demands of the task to the individual's needs.

Computer-based programmes can further allow a presentation of a simplified social environment and then gradually increase the complexity of social interactions.

Computer-based programs specifically for people with ASD are sparse… they should meet the following - at least - requirements:

- provide multiple opportunities to imitate modelled behaviours;
- should not demand advanced technical skills from the carers/treatment providers;
- facilitate multisensory interactions (auditory and visual information) in controlled and structured environments;
- has to be conceived of as a set of rules that build on learning experiences;
- are divided in small logical steps progressing at a rate tailored to the needs of each child; and
- permit integral data collection and is essential for assessing and monitoring child's progress.

Virtual Reality (VR) / Virtual Environments (VE)

An area of application still in its infancy is the use of VR environments, mainly, in facilitating the development of social skills training in individuals with ASD.

The controlled nature of the learning environment has been one of the reasons behind the creation of VE. People with ASD have little aptitude for pretence so cannot role play, but VE can provide an opportunity to learn rules and basic skills which can be repeatedly practiced before entering the real setting in which they are required.

Literature has identified a series of VE characteristics that justify its use:

- 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 generalizing 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.
- The present state of VR technology focuses on visual and auditory stimuli; in autism, vision and hearing have proven to be very effective in the development of abstract concepts.

Robotics

Teaching socially relevant behaviour to children with ASD through robotic tools (anthropomorphic or zoomorphic shape autonomous robots) has been an area of emerging interest. In most studies, robots perform simple behaviour with the purpose of provoking reciprocal human reaction.

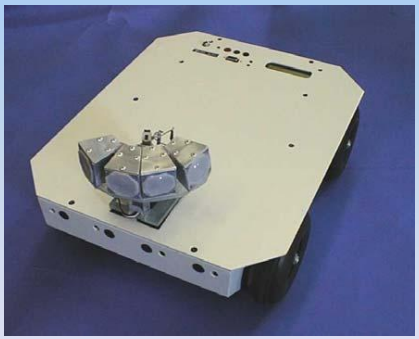
Initial Efforts: The AuRoRA project

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 led by Prof Dautenhahn.

Its ultimate goal has been to explore the design of interactive systems and to develop a socially interactive robotic system as a therapeutic tool for children with autism.

Main studies within AuRoRA project

a) an autonomous non-humanoid mobile robot (alike a toy truck with heat sensors that could detect nearby children and bumper switches that allowed it to reverse upon impact);



The robot would follow and be chased by children producing brief utterances for those children who were able to respond to the speech.

b) 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 the gestures and respond to them;

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.

Collectively and across a number of trials, main findings of the AuRoRa project showed 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 ten 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 (i.e., 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; and
- children were notably more social and pro-active when interacting with simple robots with few features.

Since 2008, there have been many efforts within this area. Possibly, the most interesting case has been a child-sized humanoid robot called KASPAR (Kinesics And Synchronisation in Personal Assistant Robotics). 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.

Additional Efforts

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 and colleagues (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 autism to explore the social interaction dynamics in a gradual and adaptive manner.

In another study (Kozima et al., 2007), longitudinal observations of children with autism 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.

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.

In the same year, Costa and her colleagues investigated the use of a non human-like shape robot - LEGO MindStorms NTX - 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.

Giannopulu and Pradel (2010) analysed the interactions of young children with ASD with a 'home made' mobile toy robot that provoked the child to engage in free spontaneous game play. Results were consistent with those from previous studies, in which narrative description of robot-child interaction has mainly been utilised.

Parents and healthcare professionals regularly report that individuals with ASD are drawn to technological devices. The suggestion that children with ASD are mainly attracted to systems of low or minimal variance or even predictable comes in accordance with the nature of robots that can allow properties of repeatability and stability as well as predictability of repetitive and even monotonous behaviour.

Video modelling

Video modelling is defined as the instances of modelling in which the model is not a live one, but one that is videotaped, in an effort to change existing behaviours or learn new ones. Initially, an observer discriminates a model's behaviour and, afterwards, he/she demonstrates that specific behaviour in natural settings.

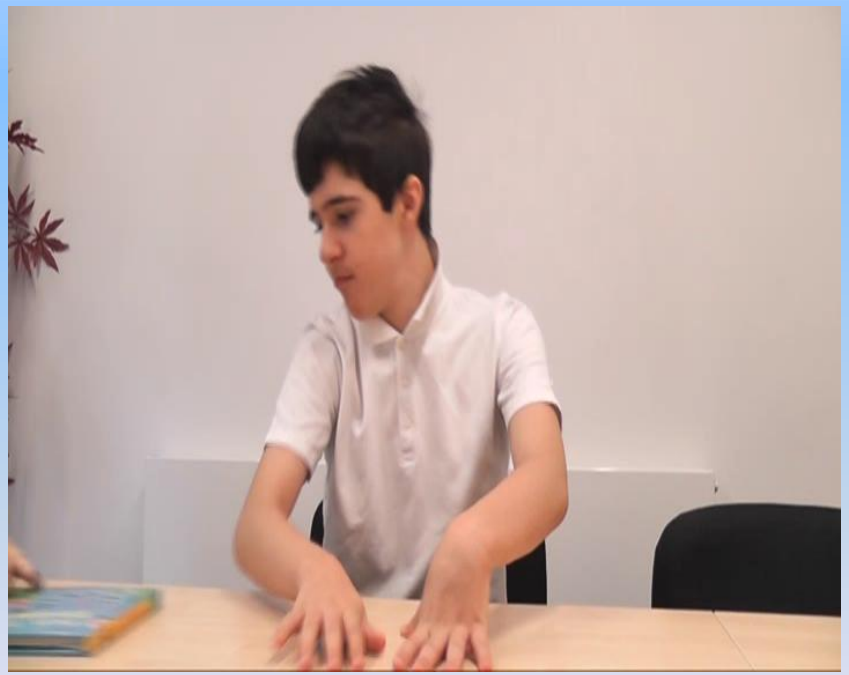
VIDEO EXAMPLE

Video self-modelling (VSM)

- VSM gives individuals the opportunity to view themselves performing a task just beyond their present functioning level via creative editing of videos using VCRs or video software. Thus, the VSM intervention involves recording the child performing a prompted behaviour.
- Videos for self-modelling are created and edited to show the child with autism performing the target skill. This can be accomplished by recording the child's behaviour over time and editing the video so that only examples of appropriate target behaviours are on the final tape. Another method of creating the videos is to have the child imitate or role-play the target behaviour and edit the videos so that only appropriate target behaviours are on the final video.
- During intervention, the child watches a video of him- or herself performing the target behaviours and then participates in the activity that was depicted in that video.

VIDEO EXAMPLES

BEFORE



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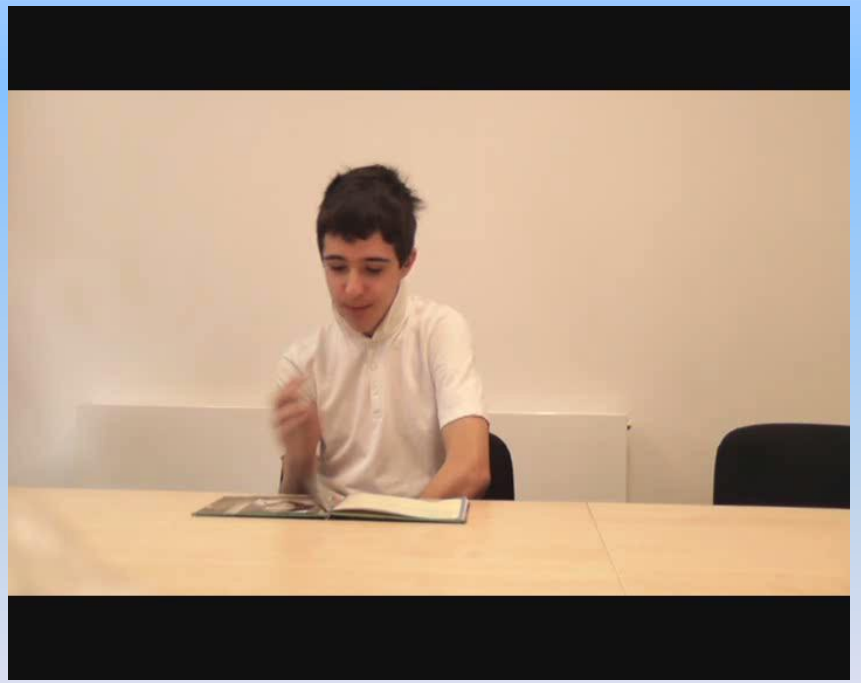

AFTER

Video modelling (VM)

- VM is a teaching method used to promote desired behaviour and interactions. This method is also very useful when the child has mastered individual skills but does not know how to combine them. For example, a child may know the individual steps required to put on his coat but not know how to combine them to perform this task himself. Video modelling can be used across many areas, such as self-help skills, communication skills, social behaviours, or academic behaviours.

- Possible skills to improve via VM include:

  Social initiation:

  - "Can I sit with you?"
  - "Look at this/that."
  - "Let's play" etc.

Video modelling (VM) (cont.)

- Possible skills (cont.):

  Greetings:

  - Giving greetings
  - Responding to/greetings

  Appropriate non-verbal communication:

  - Showing interest in what someone is saying (eye-contact, nodding)
  - Smiling
  - Identifying others' non-verbal cues

  Play:

  - Initiating game play
  - Statements appropriate for games
  - Comments appropriate within the context of specific games
  - Sports behaviours

Video modelling (VM) (cont.)

- **Possible skills (cont.):**

  Conversational skills:

  - **Maintaining conversation on-topic**
  - **Comments regarding previous activities**
  - **Responding to others' comments**
  - **Making jokes**
  - **Sharing attention or enjoyment with another child or adult**
  - **Telling stories**
  - **Using manners, appropriate language (please you)**
  - **Saying something only once or twice**

  Appropriate behaviour in the school building:

  - **Cafeteria**
  - **Waiting in the hall before school starts**

Video modelling (VM) (cont.)

- **Possible skills (cont.):**

  Making comments

  Appropriately demonstrating disagreement/dislike

  Complimenting others and reciprocating compliments

  Daily living skills [e.g., cooking, cleaning, getting dressed)

  Answering/asking informational questions

  Making requests:

  - **Asking permission**
  - **"I want [food, preferred item, activity]."**
  - **Asking for a turn or to borrow something**
  - **Expressing sensory needs**
  - **Asking/offering to do a new activity**
  - **Asking for help**

Video modelling (VM) (cont.)

- Possible skills (cont.):

  Community outings:

  - Purchasing items
  - Medical/dental visits
  - Appropriate social behaviour at special events (e.g., weddings, birthday parties, holidays, family events, funerals)
  - Haircuts
  - Travel (plane, car)
  - Waiting in line
  - Table manners

  Responding appropriately to an adult's requests/demands

  Responding to teasing

Main types of video modelling (VM) (cont.)

2. Point-of-view video modelling:

   It involves the treatment provider carrying or holding the video camera at eye level (from the child's perspective) and without recording models (persons) to show the environment as a child would see it when he or she was performing the targeted skills.

– One potential advantage of point-of-view video modelling over the typical is that it further restricts the stimuli to those that are directly related to the target behaviour, eliminating the necessity of identifying optimal characteristics of the model.

Main types of video modelling (VM) (cont.)

3. **Instructional video modelling:**

   It is basically an instructional teaching method in which videos show a step-by-step walk-through of each target skill. It requires a task analysis and also a narrator may be used.

4. **Video prompting:**

   It consists of showing each individual step of the task and then giving the participant an opportunity to perform that step before moving on to view the next step in the videotaped task analysis. In addition, the video clips are filmed from the perspective of the performer completing the task (point-of-view video modelling). Again task analysis is a required component.

5. **Priming video modelling:**

   "Priming" is a way to manipulate antecedent events, or set up establishing operations; in priming, a child previews future events so that they become more predictable.

Concluding

- **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 amongst 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.**

Concluding (cont.)

- **Parents and clinicians regularly report that individuals with autism 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. Thus, the use of technologies are 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.**

Autism Challenges Solutions
International Moscow Conference

Спасибо!!!

Any Questions?

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