Autism and New Technologies

Litterature review on the use of digital tools to help develop non-verbal communication and social interaction skills of children with autism spectrum disorder (ASD).

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A program supported by:

The UEFA Foundation for Children (https://uefafoundation.org/) was established on the initiative of the UEFA's desire to play a more active role in society. The Foundation, which is a public body governed by Swiss law, was formally established and began operating the 24th of April 2015. For years, the governing body of European football has been supporting initiatives and programmes that help children in difficult circumstances, working with numerous different partners to develop projects across Europe and beyond. The foundation aims to help children and safeguard their rights. Sport, and football in particular, can provide support in the areas of health and children's education, as well as promoting access to sporting activity, facilitating children's personal development and fostering the integration of minorities.

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The mission of the **FIRAH** (Foundation of Applied Research on Disability) follows two main directions, which are complementary and merge:

- The call for projects: selection and funding of applied disability research projects
- The coordination of the Resource Center. Internationally concerned, the Resource Center Applied Research and Disability aims at creating connections and bonds between researchers and field stakeholders[1]. It develops and disseminates research in order to promote an inclusive social transformation and to facilitate the full involvement of persons with disabilities.

http://www.firah.org/centre-ressources/

[1] **Field stakeholders**
Persons with disabilities, their families, and their representative organisations. Any Human Rights organisation working with persons with disabilities. Service providers and other organisations working with Persons with disabilities. Service providers and other organisations working in mainstream that are required to the meet the needs of persons with disabilities such as architects, teachers, companies, industries etc. Researchers and research institutes. Local, national and international decision makers.

In partnership with:

Autism-Europe aisbl (http://www.autismeurope.org/) is an international association whose main objective is to advance the rights of people with autism and their families and to help them improve their quality of life. It ensures effective liaison among almost 90 member autism organisations in from 38 European countries, including 27 Member States of the European Union, governments and European and international institutions. Autism-Europe plays a key role in raising public awareness, and in influencing the European decision-makers on all issues relating to the rights of people with autism. Self-advocates and parents play a central role in our organisation to ensure that the views and interests of persons with autism are adequately reflected in our work. We are also regularly consulted by the World Health Organisation (WHO) and cooperate with the United Nations (UN).

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The objective of this literature review is to assess current applied research knowledge of questions concerning the use of digital tools in assisting with non-verbal communication and social interaction among persons with autism spectrum disorder (ASD). The research selected is pertinent to this theme, and has been categorised according to a set of predetermined criteria. Of the research papers considered, 16 were selected for their relevance in terms of providing clear pathways for investigating the themes of autism and new technology.

What FIRAH means by the very general terms of applied research is:

- First, it is proper research based on precision and methodologies which allow the implementation of a scientific approach involving teams of one or more researchers or academics whose research is one of the statutory missions.
- Applied research differs from basic research. Its ultimate purpose is to increase independence and social participation of people with disabilities. It is not only aimed at producing theoretical knowledge but also tackling practical issues related to the needs and concerns of people with disabilities and their families. The collaboration between these people, professionals and researchers is a fundamental element to the achievement of this type of research
- This type of research is designed to produce directly applicable results. In addition to usual publishing (scientific articles, research reports) applied research is also designed to produce other publications called “means of application[2]” which can take various forms: development of good practices, methodological guides, training tools, and are destined to different field stakeholders (people with disabilities, professionals, policies makers).

This work does not intent to be comprehensive but to identify the results and knowledge generated by research that could be useful for field stakeholders in order to improve the quality of life and social participation for people with disabilities.

Each title in the annotated bibliography contains a link with free or paying access to the work in question.

Each reading note contains a link to the relevant research documentary note on the Resource Centre website.

[2] **Means of application**
Shaping of the findings and knowledge gained from applied research into products, services and contents to meet the expectations and needs of people with disabilities. These application supports are adjusted to be used by field stakeholders.

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Editorial

Autism is a neurodevelopmental disorder that affects communication and social interaction, and symptoms include repetitive behaviours and restricted interests. Persons with Autism Spectrum Disorder (ASD) find it particularly difficult to understand other people's facial expressions and body language, and often have problems interacting with others.

A number of interventions have focused on these aspects, with the aim of helping people with autism to improve their verbal and non-verbal communication as well as social skills. Digital tools have also been designed to address these difficulties. Some are accessible to the general public, others have been developed for research purposes.

The use of digital tools in helping people with autism dates back to the 1970s. However, over the past few years, the use of digital technology has accelerated both in research and in current practice. This is visible in the significant number of websites providing useful digital applications for persons with autism, in comments on apps on blogs and personal websites, and in the growing number of research projects on this subject. For example, the DART (Development Autism Research Technology) website offers reviews of apps for autistic people which are divided into 4 categories: Communication, Education, Life Skills and Fun.

Thanks to the decreasing cost of this type of technology, it is now increasingly accessible to parents and institutions, which facilitates its more widespread use by people with autism with the aim of helping them improve in areas in which they have difficulties.

How efficient are these approaches and how can various field stakeholders make use of these tools in order to achieve success with their practices?

FIRAH initiated a research action project that is now being led by the INSHEA, the universities of Mons, Freiburg and Paris-Est-Créteil, the NAS (National Autism Society) and the Fondation Autisme Luxembourg. This project involves six European countries and aims to provide some answers to these questions. Feedback is collected from care and institutional professionals, children with ASD and their parents in order to identify which practices they consider interesting, as well as the difficulties they have encountered. Also, thanks to the digital equipment provided to institutions, this project aims to clarify what progress is made by children with autism in terms of social interaction and non-verbal communication. The project aims to encourage an exchange between professionals and parents in terms of approaches, and to identify both best practices and potential pitfalls.

The literature review presented in this document on the use of digital tools to help develop non-verbal communication and social interaction skills is part of this project.

Methodology

In order to identify articles included in this literature review, we have used the following databases and search engines: Google Scholar, ScienceDirect, Educational Resource Information Center (ERIC), and PubMed. We used combinations of the following keywords:

- **autism keywords:**
  - autism,
  - ASD,
  - "autism spectrum disorder"
  - PDD
  - "Pervasive devepmental disorder"

- **technology keywords**
  - technology
  - tablet
  - iPad
  - computer
  - laptop
  - robot,
  - avatar,
  - Kinect,
  - eyetracking
  - biofeedback
  - augmented reality

- **non-verbal communication and social interaction keywords**
  - non-verbal interactions
  - social interaction
  - social engagement
  - social scenario
  - social sharing
  - Social skills
  - social engagement
  - social function
  - social cooperation
  - joint attention
  - imitation
  - emotion
  - attribution of attention
  - interact in groups
  - gestures

We have selected articles consistent with the objective of FIRAH's literature reviews, i.e., articles that can be used to resolve practical problems and potentially address the needs and concerns of persons with disabilities and their entourage. Some articles were excluded on the basis of being too far removed from the concerns of professional working with children and adolescents with ASD.

We then turned our attention to "grey literature" (excluding scientific reviews) on the use of digital tools with autistic children. For this we conducted standard Google searches using the same keywords as we used on the scientific search engines, as well as the keywords "use of technology".
In the end we selected a total of 60 references. These articles were read and annotated, with a view to their possible interest for professionals working with children with ASD (teachers, speech therapists, educators, psychologists, etc.). The articles were categorised by theme in order to help readers easily navigate the material.
Finally, we have selected 16 articles from the 60 references for which we have written article summaries. These 16 articles were chosen because we thought them particularly relevant, because they specifically address the question of the use of technology with children with autism, as is the case with certain literature reviews, or because we considered the work particularly useful to professionals.

Websites for applications that could be used with autistic children are indicated at the end of the literature review.

Summary

Introduction

Digital tools are particularly aligned with the autistic profile, given that digital technology operates on the basis of predictive laws, which corresponds perfectly to the way in which people with autism think. These tools also allow for immediate adjustments, which are often very helpful for children with ASD (Gillespie-Lynch, 2016).

Studies show that for a same type of activity, children with autism increasingly appreciate computer training programmes rather than those without digital technology, and demonstrate that technology can increase a child's motivation.

Also, digital activities are accessible to children that struggle with social communication (Ploog, Scharf, Nelson, & Brooks, 2013) and produce immediate responses that can be repeated at will, which is necessary for some of these children (Grossard & Grynszpan, 2015).

Digital tools have been shown to be effective in certain areas, such as developing daily skills thanks to video modeling (Bereznak et al., 2012). Beyond the tool itself, it is interesting to look at professional or parental uses of the device. In fact, the use of a digital tool is not a given and is strictly related to underlying pedagogical philosophies (Avramides et al., 2012). Also, field stakeholders must familiarise themselves with the technology and grasp the potential pedagogical approaches prior to using a specific digital tool (Ayres, Mechling, & Sansosti, 2013).
The first general question in terms of using new technologies for persons with ASD concerns the choice and use of tools. In the second part of this synthesis, the use of new technologies in relation to non-verbal communication and social interaction will be discussed.

Develop and select adapted applications

Studies have been conducted in order to identify what type of software or applications would be particularly useful for people with autism or their families. Applications focusing on social, school and organisational skills were prioritised (Putnam, C., & Chong, L. 2008).

A study was carried out to see whether it was possible to develop an effective working method that would make it possible to select applications adapted to children's specific educational needs. This method was tested with the iPad. It made it possible to select applications that stimulated greater educational engagement among students with autism compared with randomly selected applications (Arthanat, Curtin, & Kontak, 2015). Also, some game publishers enable professionals and parents to create their own games that are adapted to the specific profile of the autistic child with whom they work, in such a manner as to enable social skill development (Boujarwah et al., 2011).

Use of digital tools

Digital tools help in daily life, but their implementation is not always easy, particularly in terms of configuring applications and addressing failures (Dale & Grut, 2014). Digital tools and their applications are sometimes used counterproductively by children with autism (King, Thomeczek, Voreis & Scott, 2014). We note that young children or children with intellectual difficulties will benefit even more from a touch interface than a traditional computer (Fletcher Watson, online).

A select few research-actions focusing on the use of digital tools can be found in scientific articles (see for example Cumming, Strnadová, & Singh (2014)). If professionals and parents adopt a positive approach towards new technology, and in particular the iPad (Clark, Austin & Craike, 2015), they are advised to acquire general digital familiarity, and to understand the possible range of uses of new technologies with autistic students beyond the scope of a specific tool (Ayres, Mechling, & Sansosti, 2013).

Now let us take a look at some results concerning the two fields in which we are specifically interested: non-verbal communication and social interaction.

Non-verbal communication

In terms of non-verbal communication, we have researched the recognition and understanding of emotions and mental states.

Recognition and understanding of emotions and mental states (theory of mind)

A certain number of computer or tablet applications use pictures of static faces expressing emotions. Others use three-dimensional digitised characters that experience a role-play. The user is then asked to find which emotion the character will have in a given situation. It is therefore a question of connecting a context, a situation experienced by the avatar (virtual person) with the emotion that the character should feel in the situation. We note however that in most of these experiments, control groups were not created where students would receive similar training, without the digital interface. When this is taken into account, the description of the control situation is highly summary and makes it impossible to assess the superiority of the digital version versus the non-digital version.

A study of the implementation of the Mind Reading programme made it possible for children with autism to improve their recognition of facial and vocal emotions (LaCava et al., 2007). Another research project assessed the contribution of the "Les Transporteurs" DVD, in which trains with the faces of human actors expressing emotions go on adventures. Children that experienced this programme improved in terms of emotion recognition and were able to transfer this skill to other entities than the Transporters (i.e., real human beings) (Golan et al., 2010).

Some sophisticated software programmes make it possible to modify certain parameters in real time by means of virtual characters. We can, for example, modify facial expressions to make them more realistic or, on the contrary, tone them down by limiting the range of information expressed (Arellano

et al., 2015). Research on emotion recognition has also been carried out within the framework of virtual universes (Mantziou, Vrellis, & Mikropoulos, 2015).

An interesting article focuses on a social skills and emotion recognition training programme for children with Asperger's syndrome (Beaumont & Sofronoff, 2008). The programme consisted of 7 sessions over 7 consecutive weeks with several types of interventions: the digital game itself, but also non-digital group interventions, and training for parents and professionals. Children who experienced the intervention were compared with others who did not go through the experience, and both groups were equivalent in terms of age, IQ, and scale of autistic disorder. Target skills were diverse: recognise and control fear and anxiety, recognise facial expressions and body language. In the first level of the computer game, the child had to assess how a person felt on the basis of the person's facial expression, intonation and physical posture. In the second level, the user had to infer a character's emotions based on non-verbal and environmental indicators. In the third level, assignments were suggested, like knowing how to act when playing a game, or when being harassed. In addition to the computer game, group sessions focused on emotion recognition and social skills were organised in such a manner as to generalise the trainings carried out on the computer. Role play games or at-home exercises were created for this purpose. Parents received training. Written advice was also issued to teachers. Children made progress in terms of social skills, and this was maintained after the intervention period (two assessments were carried out, 6 weeks and 5 months respectively after the intervention). On the other hand, no progress was observed in terms of facial expression and body language recognition.

Other applications were designed to develop theory of mind skills. These experiences were not very conclusive, particularly given that the digital aspect would be an added value in developing this type of skill (Swettenham, 1996). We nevertheless note that a study focused on training in other people's point of view using video enabled children with autism to develop this skill (Charlop-Christy & Daneshvar, 2003).

Expressing emotions

A certain number of experiments were created using video modelling, a technique in which desired skills are shown in a video, in order to develop social skills and notably express emotions. Certain studies compare a test group who experience video modelling sessions, with a control group that experience direct modelling sessions, without video. A study showed video's superiority in rapidly acquiring the target behaviour of expressing emotion, compared with direct modelling (Charlop-Christy, Le & Freeman, 2000). Serious games, using an autonomous virtual agent, were designed to develop joint attention skills (Alcorn et al., 2011).
Nevertheless, in an article comparing human interventions with digital interventions, autistic children's verbal and physical communication were strongest with the therapist and weaker with the software's cartoon character (Carter et al., 2014).

Body movement imitation and non-verbal communication

A study used robots and Kinects, in such a way that a child with autism is able to imitate a robot, and, thanks to the Kinect, the robot can imitate the child's movements (Taheri et al., 2014). According to the authors, the study shows promising results in terms of using robots with children with ASD.

People with ASD's imitation of robots rather than people has a scientific basis. Experimental research shows that people with ASD imitate movement made by a robot more quickly than the same movement made by a human being, contrary to non-autistic persons who imitate the movement of another human being more quickly (Pierno et al., 2008).

Overall, digital technology interventions aimed at developing non-verbal communication proved effective in terms of recognising emotions. The use of video modelling or robots shows promise in terms of enabling autistic children to develop a form of gestural communication.

Social interaction training

Several technology-based interventions have been created in order to develop the social interactions of persons with ASD. We first list some research projects focused on this theme. We will then consider in greater detail some promising experiments using a range of new technology mediations, which are organised on the basis of the type of media used.

General social interaction interventions

An intervention was carried out using tablets to develop social skills among children with autism. The results show progress in terms of social behaviour and collaboration, and moreover encouraged an interest in social activities among the child participants (Hourcade, Bullock-Rest, & Hansen, 2012). The combination of activity sequences using video in order to develop autistic children's social skills may prove an interesting strategy (Kimball et al., 2004).

Research using video modelling to develop a game played in pairs among children with autism led to improved social interactions and general game cooperation after the intervention (MacDonald et al., 2009). Another research project studied the development of social initiation (that is, the action of initiating a social interaction) by children with autism, thanks to video modelling. This method made it possible to increase the number of social initiations among these children (Nikopoulos & Keenan, 2003).
Research into social scenarios for children with autism show that computer training in this field improves children's skills (Hagiwara & Myles, 1999). Also, using a computer-based digital programme may enable children with autism to resolve social problems, by relying on highly visual animations (Bernard-Opitz, Sriram, & Nakhoda-Sapuan, 2001).

Interventions using specific media

Collaborative work using digital tools to improve social interactions

Research has investigated whether collaborative work using digital tools could improve social interaction skills. A collaborative computer project enabled students with ASD to improve their social interaction skills (Lewis, Trushel & Woods, 2005; Bauminger-Zviely, Eden, Zancanaro, Weiss, & Gal, 2013).

A digital workshop enabling young boys with high-functioning autism to create 3D constructions enabled them to increase social interactions between each other, as well as with their parents and grand-parents (Wright et al., 2011). This article focuses on participative action research. A seminar was organised with the parents, grand-parents and teachers of seven high-functioning autistic boys from 8 to 17 years old. All had difficulties in terms of social interaction. All except one were in mainstream schooling.

The children with autism participated in five training sessions using the software. The children were taught to use SketchUp and carried out projects using this software. The researchers wanted to share the experiences of this experiment: children could ask for help from their paired partner, and their families were invited to teaching sessions. Parents could ask questions. The researchers helped the children to be able to present their work to other children in the class. Focus groups were held with the parents and grand-parents. The change in perception among parents and grand-parents is testimony to the impact these technological workshops has in facilitating intergenerational exchanges. Parents found that these workshops made it possible to build real friendships between children. Seeing their children in a position of success made it possible to change parents' as well as grand-parents' opinions, by showing the positive side of their children's skills. According to parents, this experience of success increased children's confidence, which led to the children sharing more of their experiences with their parents, which they were not in habit of doing. The children became experts and were able to share their knowledge. This led to conversations with the parents. For the same reasons, the experiment improved relationships with brothers and sisters. For professionals, it is interesting to see that an experiment that encourages students' strengths stimulated these students' personal investment in activities and helped them build a positive image for themselves, combined with a desire to share their creations. It is therefore indirectly, by focusing on the strengths of children with ASD, that these experiments have been able to develop social interaction skills, by encouraging children to share their areas of interest and creations.

Collaborative work with sensory tables to improve social interactions

Articles address experiments that make use of an uncommon digital device: cooperative games on a sensory table. For example, this device was used with the aim of stimulating social interactions among 8 boys with autism aged 9 to 12 years old (Zancanaro, Giusti, Gal & Weiss, 2011). It provokes a thoughtful reflection on the role of the teacher or therapist in collaborative games on sensory tables, given that the adult can, using the device, initiate an action on the table which will have an influence on the rest of the game. This is a question to be considered by field stakeholders who will also be able to make choices using a digital tool, even if these choices only involve adjusting certain parameters in order to optimise skill development among children with ASD.

In the experiment described in the article, certain actions need to be carried out simultaneously by the supervising adult and the children in order to obtain the reward. The adult may therefore choose not to collaborate for a moment, in such a manner as to ensure that the phase of the game continues for the children, and even has the option of playing for children, if the adult deems it useful. Also, it is technically possible for the supervising adult to intervene in order to ensure that one of two children that proves too dominant over the other may be made less so through the choice of actions. Game sessions were filmed, and participants were interviewed. The article discusses how the adult intervenes, in such a manner as to elicit maximum commitment from the autistic child. This might be of interest to field stakeholders, who are confronted with these questions.

In emphasising the role of the supervising adult, the article enables practitioners to think of the complementarity between the structure of the software and their own intervention. What does the application do, how can the professional provide added value in terms of optimal social interaction development between children with autism?

Another experiment used a digital table to create collective stories. Participants were six boys with high-functioning autism from 8 to 11 years old. The table enables different users to carry out several actions at the same time. Children were assessed before and after the intervention in order to assess their progress, as progress was observed in terms of social interaction initiation (Gal et al., 2009).

Another project (SIDES) was designed around a collaborative game device on a sensory table. Children with autism enthusiastically participated in this project and were able to work in a group (Piper et al., 2006).

Some examples of the use of augmented or virtual reality to improve social skills

Augmented reality was used successfully in certain experiments in order to improve the social skills of children with APD (Escobedo et al., 2012). Virtual reality techniques may be highly sophisticated, using motion detectors for example (Georgescu et al., 2014).

An experiment aimed at developing social skills through a virtual environmental may be carried out in various ways. For example, while accompanied by an adult, children with ASD were able to experience these virtual worlds of a café and a bus in order to develop their social skills (Parsons, Leonard, & Mitchell, 2006).

Two types of virtual environments may be offered to a student with Asperger's, in order to develop social interaction skills: an experience of a virtual environment in which the child is the only participant, or a virtual environment in which several children participate simultaneously (Cobb et al., 2002). This article presents a number of systems that use virtual reality. A person with autism must go into a virtual café and sit at a table, and some café tables are already occupied by customers. Two game modes are proposed: one is a game that is played alone, in which the autistic person meets virtual persons with whom the child may interact. The other mode is collective, in which several persons with autism can interact in the virtual universe of the café. The individual virtual environment makes it possible to develop specific social skills; there is less uncertainty, as the user is the only one who has the freedom to act, others being programmed digital characters. The author specifies that this type of environment may initially help develop skills within a certain context which can then be widened to other contexts

using another virtual environment. For example, in the café game, the autistic participant may train himself to sit down at a table, a skill which he can then transfer in another virtual game located in another context such as public transport, where he also needs to take a seat. The authors were able to obtain results, both from persons with autism and teachers. Teachers had difficulties in terms of generalising skills to real life situations.

Using interfaces with tangible and connected objects

An experiment that used the interfaces with tangible objects made it possible to develop social game skills among children with ASD. These children also experienced social interaction by playing the game on a touch interface and playing with simple legos (Farr, Yuill & Raffle, H., 2010).

The use of robots and virtual tutors

Robots may encourage children with autism to develop prosocial behaviours (Feil-Seifer & Matarić, 2009). In another study, children were in the presence of a humanoid robot for a number of sessions over several months. Children showed improved imitation, role playing and communication skills (Robins et al., 2005). Certain studies compare robot interventions with the same interventions by human beings, in encouraging the development of adapted behaviours and skills (Diehl et al., 2012). A study used virtual autonomous agents to teach social and conversational skills. Progress was made by students with ASD in this field. Children also appreciated the virtual tutor (Milne et al., 2010).

Conclusion: from research to practice

Despite a certain number of studies demonstrating the efficiency of digital tools in developing socio-emotional skills, we cannot generally affirm that the use of digital tools is an absolutely effective strategy that makes it possible to develop these skills. In fact, research has shown heterogeneous results. These might be considered promising leads that could in time lead to undeniably proven efficient practices (Ramdoss et al., 2012). Also, the digital tools used in the studies are not always available to the professionals in the field. Few studies concerning professional practices with new technologies were carried out. We also note that there were few studies that looked at the use of digital tools with children that have both an intellectual disability and ASD. Therefore, at the current time, we cannot provide absolutely certain recommendations to practitioners who would like to use digital tools with children with ASD. Nevertheless, certain papers make the link between research and practice, and may provide useful avenues for professionals.

A document developed by Fletcher Watson is very interesting, as it was designed on the basis of research results whilst at the same time giving practical advice to parents of children with autism in order to ensure their best use of technological tools (Fletcher Watson, online). This document is notably part of a study that was specifically carried out among 200 parents of children with ASD in Great Britain.

The great interest of this article is that it enables parents new to this information to benefit from the experience of parents who have already used digital tools with their autistic children. As such, those who want to use these tools will already be able to have practical information concerning their use.

Points of caution were noted. Some advice was given to parents of children with autism that are dependent, or addicted to new technologies, in order to ensure that digital tools are used without their becoming a major problem. Other advice was given in terms of choosing the right digital tools based on a child's profile. For example, young children or children with intellectual difficulties will benefit even more from a touch interface than a traditional computer.

In terms of software and applications, it is recommended to first try the app, or a light version of the app, before buying. The parent will be able to try it and see whether the application is suited to the child's needs. It may also be interesting to use applications that were not specifically designed for autism; it all depends on the objectives for the outcome of the use of this application.

Social skills training offered to the child by the digital programme may have limits. Trainings offered to children with ASD in order to improve their social interaction skills should be sufficiently rich and diverse to enable children to transfer this training to real life situations. However, this transfer is often limited due to the difficulties that people with ASD have in generalising a specific knowledge to other contexts.

In short: what research tells us in 6 key points

What research tells us in 6 key points

- Digital tools are well adapted to the autistic profile
- Specific applications have been created in order to develop non-verbal communication and social interaction skills in children with ASD.
- Some of these applications were scientifically tested on commonly used digital tools (computers, tablets), others on more sophisticated technical systems (tabletop device, virtual reality, robots, etc.).
- Digital tools help children with ASD in everyday life, but they are not always easy to integrate into services offered to children with ASD, particularly in terms of configuring applications and addressing failures.
- Children with ASD or children with intellectual difficulties benefit even more from a touch interface than a traditional computer.
- Scientific research provides promising results but does not currently make it possible to definitively determine the added value of digital tools compared with non-digital approaches in developing non-verbal communication and social skills for children with ASD.

Reading Notes

These 16 article summaries are excerpted from the general bibliography. They were selected for their relevance in terms of providing clear pathways for investigating the themes of autism and new technology.

Each summary contains a link to the full reference and the documents included on the Resource Center of Applied Research and Disability documentary database.

Reading note 1. Entraînement des compétences assistées par les technologies numériques dans l'autisme

Access the full summary and all documents related to this research on the Resource Center of Applied Research and Disability.

Reference

Grossardet C., Grynszpan O. Entraînement des compétences assistées par les technologies numériques dans l'autisme : une revue. Enfance, 2015, p. 67-85.

Keywords

ASD, human machine interaction, learning, training, efficiency

Author abstract

The number of studies on the use of digital technology in assisting people with Autism Spectrum Disorder (ASD) has increased dramatically over the past fifteen years. The interest in this field is in part due to the appeal of these technologies for people with ASD. A significant proportion of projects focus specifically on children, who will be offered social skills training adapted to their age and addressing emotion recognition, spoken and written language acquisition, and conceptual learning that is useful in school environments. Researchers in this field have been particularly inventive in the range of technology used. In addition to desktop computers and tablets, projects use technology such as robotics, virtual reality, cooperative platforms and even eye-tracking. A systematic analysis of available literature provides elements of proof in favour of the effectiveness of such training. However, questions remain concerning the wide range of methods used, the impact of human assistants, the long-term viability of the effects of this training as well their general applicability to everyday life skills.

Comments

This French language article is a literature review of the use and purpose of digital tools for people with autism. Information resulting from scientific research is given that will enable those working in the field to have an initial idea of the utility of digital tools for children with autism. The research indicates that for a same type of activity, children with autism increasingly prefer computer training programmes over activities without digital technology, and that technology increases a child's motivation. Also, digital activities are accessible to children that struggle with social communication and produce immediate responses that can be repeated at will, which is extremely useful for these children. Citing certain articles, the authors also express a number of concerns such as the potential risk of social isolation if these tools are used too extensively.

Field stakeholders will learn that some approaches using technology are beginning to be widely used, such as augmentative and alternative communication, particularly with the support of pictograms. These are adaptations of communication systems such as the PECS. Electronic calendars are also extensively used in such a way as to enable professionals or parents to easily show the child's schedule, which can be very useful for children who struggle with planning.

The article makes it possible to understand the potential advantages of mobile digital tools. Digital tools are also used for training altered skills in autism, such as recognising facial expressions, social

interaction skills, etc. In relation to potentially equivalent paper formats, the digital tool makes it possible to reduce equipment volume, as "classic" tool equivalents are stored on the tablet or computer.

Through their analysis of the limitations of research, the authors encourage professionals to avoid excessive enthusiasm and realise that research on the use of digital tools for autism is still an emerging field. It is not yet established to the point that those familiar with the information can unreservedly recommend a given type of equipment or software for specific types of difficulties. It is very difficult to compare the different forms of training referenced in research because they are highly disparate. In fact, the skills aimed for and the technology used are all very different. Also, digital tool interventions are often part of an overall educational method, and human assistance is therefore of significant importance. The level of support may vary. Sometimes it may be less, allowing the child a high degree of autonomy; sometimes it may be significant, providing substantial guidance. Those assisting children with ASD are advised to become familiar with the digital tool and its applications prior to use by the child.

Reading note 2. Computer-based interventions to improve social and emotional skills in individuals with autism spectrum disorders: A systematic review

Access the full summary and all documents related to this research on the Resource Center of Applied Research and Disability.

Reference

Ramdoss S. et al. Computer-based interventions to improve social and emotional skills in individuals with autism spectrum disorders: a systematic review. 2012. Dev Neurorehabil. 2012;15(2):119-35.

Keywords

Asperger's, ASD, Computer-based, Social skills

Author abstract

Objective: To review studies involving the use of computer-based interventions (CBI) to improve the social and emotional skills (e.g. emotional recognition) of individuals with autism spectrum disorders (ASD). Methods: The use of computer-based intervention (CBI) in the treatment of autism spectrum disorders (ASD) may offer some advantages to traditional one-to-one or group instruction including easier differentiation of instruction, decreased distractions and the incorporation of an individual's relative visual learning strengths. However, the results of past research suggest varying outcomes for CBI with individuals with ASD. This review provides a systematic analysis of studies investigating CBI to improve social and emotional skills (e.g. emotion recognition) of individuals with ASD. Electronic database searches and ancestral searches were used to identify studies that met pre-determined inclusion criteria. The included studies were then summarized in terms of: (a) participant characteristics, (b) social and emotional skills targeted, (c) details of the CBI, (d) results, and (e) certainty of evidence. Results: The results of these studies indicated that CBI's effect on social and emotional skills was mixed, with the majority of studies reporting unacceptable outcomes following intervention. Conclusions: Overall, this review suggests that the use of CBI to improve the social and emotional skills of individuals with ASD is a promising practice. A comparison of CBI plus tutoring and face-to-face social skills training suggests that CBI can be as effective as face-to-face instruction. Practitioners should carefully consider the preferences and existing abilities of individuals with ASD and the customizability of the software when deciding to use CBI and selecting a software program.

Comments

This article is a literature review of computer based intervention tools that facilitate the development of social and emotional skills. The studies selected are exclusively those for which the technology referenced may be available in class, specifically computers. Virtual reality systems for example were excluded. Video modelling training was also excluded. Eleven articles were selected.

The article concluded that despite a certain number of studies demonstrating the efficiency of digital tools in developing socio-emotional skills, we cannot generally affirm that the use of digital tools is an absolutely effective strategy that makes it possible to develop social and emotional skills.

Reading note 3. iPad® use in children and young adults with Autism Spectrum Disorder: An observational study

Access the full summary and all documents related to this research on the Resource Center of Applied Research and Disability.

Reference

King A. M. iPad® use in children and young adults with Autism Spectrum Disorder: An observational study. 2014. Child Language Teaching and Therapy, 30(2), 159-173.

Keywords

Augmentative and alternative communication (AAC), ASD, Digital technology, iPad®, School

Author abstract

This exploratory study was conducted to describe how children and young adults with autism spectrum disorder (ASD) are currently using iPads® and applications, to explore the role of education professionals on iPad® and application use, and to determine potential research needs regarding iPad® use in children with ASD. Naturalistic observations were conducted on six individuals (ages 6;6 to 20;8) with ASD while they were using iPads® in their school environment. The data suggest that (1) the participants used iPads® and applications for a variety of purposes, (2) there was considerable variability regarding whether or not the application was used consistent with its intended function, and (3) the presence of an education professional and the type of application impacted the variability in functional use of the application. Pertinent lines of research that are needed to expand the base of evidence regarding effective iPad® use in children with ASD are discussed.

Comments

This article aims to understand how children with autism spectrum disorders can use an iPad and how they are helped in doing so by education professionals. Six children and young adults were observed in their use of the iPad in class. Sixty three applications were chosen by education professionals working with the children; twenty-eight of these applications were used when conducting observations of augmentative and alternative communication, school learning and games.

This article is interesting for field stakeholders as it makes it possible to identify some potential problems in using these tools. In fact, certain uses by the students with autism do not correspond to the traditional uses of the application. This may be a repetitive use, with stereotyped gestures, of the application. It was observed that these non-traditional uses of the application represented 31% of use time, which is significant. The accompaniment variable to its importance concerning this aspect: only 16% of atypical use when education professionals assisted the students and 40% of atypical use when used independently. The interest of this article for professionals and those involved in the care of children with ASD in general is to emphasise the significant percentage of inadequate use of applications if the child is not assisted. This data is very important as it provides food for thought on the role of assistants in the use of applications with digital tablets.
The article provides avenues for action and thought on the use of applications. The authors therefore recommend conducting research on professionals' use of technology that is either helpful or difficult for students with autism.

Reading note 4. Technologies and autism: guidelines for parents

Access the full summary and all documents related to this research on the Resource Center of Applied Research and Disability.

Reference

Fletcher Watson S. Technologies and autism guidelines for parents. Not dated.

Keywords

ASD, Parents, Technology

Author abstract

Children (and adults) with autism are often keen users of technology, choosing to spend a large part of their leisure time on computers, gamers and other devices. Technology can be harnessed to give benefits, like learning new skills or giving children a chance to be independent. However with so much technology out there, it can be hard to work out which technologies provide these benefits. In addition, parents and professionals have valid worries about whether technology use can get out of hand, or prevent a child with autism from interacting with other people. We conducted a small research project, with the aim to provide evidence-based, practical advice to parents of children with autism to help them get the most benefit from technology and avoid any associated risks.

We carried out a survey of over 200 parents of children with autism in the UK (and about the same number in Spain, thanks to partners at Fundaçion Orange). The goal of this survey was to gather wisdom from parents who were already users of technology, and use their experiences to inform parents who are just starting out with technology, or with a child with autism. In addition to the online survey, we also spoke directly with a handful of parents to investigate the main issues in depth.

As a result of this survey we have now:
- Published an online pdf giving detailed advice to parents of children with autism on how to get the most from technology: free to download here
- Contributed to a National Autistic Society web page which distils the key advice from the research
In addition, we're now carrying out a comparison of attitudes to technology among parents of autistic children in the UK and Spain, and developing this for academic publication

Comments

This document is very interesting, as it was derived from research results whilst at the same time giving practical advice to parents of children with autism in order to ensure their best use of technological tools. A study was specifically carried out among 200 parents of children with ASD in Great Britain.

The great interest of this article is that it enables parents new to this information to benefit from the experience of parents who are already using digital tools with their autistic children. As such, those who want to use these tools will already be able to have information concerning their use.

Points of caution were noted. Some advice was given to parents of children with autism that are dependent, or addicted to new technologies, in order to ensure that digital tools are used without

their becoming a major problem. Other advice was given in terms of choosing the right digital tools based on a child's profile. For example, young children or children with intellectual difficulties will benefit even more from a touch interface than a traditional computer.

In terms of software and applications, it is recommended to first try the app, or a light version of the app, before buying. The parent will be able to try it and see whether the application is suited to the child's needs. It may also be interesting to use applications that were not specifically designed for autism; it all depends on the objectives for the outcome of the use of this application.

Reading note 5. East Park iPad Project Report: 2013/2014

Access the full summary and all documents related to this research on the Resource Center of Applied Research and Disability.

Reference

O'Brien S. East Park iPad Project Report: 2013/2014. The University of Edinburgh. 9 pages

Keywords

ASD, iPad, Education

Author abstract

This research report has been prepared by Sinéad O'Brien, an Educational Research Masters student from Moray House School of Education, at the University of Edinburgh. The research project was conducted at East Park, which is a registered charity based in the Maryhill area of Glasgow. Since 1874 East Park has provided both education and residential care facilities to children and young people with additional support needs, and more recently autism spectrum disorder. At the beginning of the 2013 academic year East Park received funding for the purchase of 21 iPads. The iPads were to be used as education aids for specific students with the main aim of developing communication skills. The University of Edinburgh was then approached and asked to provide an independent evaluation of the first year of the East Park iPad Project (EPiP). iPads are increasingly being adopted to educational settings. To date, most evaluations investigating the incorporation of the iPad in schools have focused on its effectiveness as educational tool and the positive outcomes it has for students. However, few studies have explored the influence of the teacher on the successful implementation of iPads. Furthermore, no known study has examined the impact that the presence of the iPad has on teachers and their pedagogy. This research explored these topics and addressed the following questions: 1. Can iPads be used effectively in a classroom for students with additional support needs? 2. How do teachers influence the effective use of iPads to support students learning goals? 3. How does the introduction of the iPad affect teachers own practice? 4. Are there factors, outside the classroom setting, which influence the effective use of an iPad? The participants for this study were in two groups: teachers and students. All seven class teachers took part in the study. In addition to this, the iPad coordinator who was responsible for selecting the students and the apps was also a participant. A total of 20 (N of boys = 15) students, whose mean age was 15.05 years were included in the research project. The research data was drawn from an interview with the iPad co-ordinator and from interviews with the teachers at three different time-points across the academic year.

Comments

This report is interesting as it reveals the development of teaching approaches and practices of educators working with students with autism when an iPad is introduced into the classroom.

Teachers questioned in the study found that students with ASD are more willing to participate and are more motivated and concentrated with digital tablets. However, the motivation tends to lessen over time: at the end of a year, students were a bit less motivated than at the beginning, perhaps because they were still using the same applications.

In terms of teacher practices, the iPad makes it possible to collect data, store assessments and therefore clearly visualise their students' progress. The iPad is found to be easier to use than other technological tools. Nevertheless, difficulties concerning the use of certain apps limit the use of the iPad. Also, according to their teachers, certain students with significant difficulties benefited from substantial support. It is difficult to assess the progress of some students if they are left to use the iPad independently.

The professors think that it's more a choice of the right applications than the device itself that leads to good practice.

The author of the report issued recommendations following the study:

- Do not impose the choice of applications but allow teachers to choose, or at least include them in the selection process.
- All teaching teams must receive training on the use of the iPad and applications.
- Teachers must learn to use the iPad and its applications prior to introducing the device as a teaching tool with their students with autism.

Reading note 6. SketchUp™: A technology tool to facilitate intergenerational family relationships for children with autism spectrum disorders (ASD)

Access the full summary and all documents related to this research on the Resource Center of Applied Research and Disability.

Reference

Wright C. et al. SketchUp™: A technology tool to facilitate intergenerational family relationships for children with autism spectrum disorders (ASD). 2011. Family and Consumer Sciences Research Journal, 40(2), 135-149.

Keywords

ASD, Intergenerational relationships, Social engagement, SketchUp, Technology

Author abstract

This study used a qualitative design to examine intergenerational relationships facilitated by an intervention employing Google SketchUp, a freeware 3D design program. Seven high-functioning boys (ages 8–17) with autism spectrum disorders (ASD) participated in computer workshops. The investigators capitalized on the boys' strengths in visual–spatial skills. The interdisciplinary team structured the workshops to facilitate computer skill development as well as social interaction. Qualitative analysis involved thematic analysis of transcripts from focus groups with parents and grandparents. The two key themes that emerged were as follows: (i) reframing expectations (parental efficacy and creating a safe environment) and (ii) building intergenerational bridges among parents, children, siblings, and grandparents. These findings indicate that technology can build on the strengths of children with ASD and promote social engagement of the children with their families.

Comments

This article focuses on participative action research. A seminar was organised with the parents, grand-parents and teachers of seven boys from 8 to 17 years old. All had difficulties in terms of social interaction. All except one are in mainstream classrooms.

The children with autism participated in five training sessions using the SketchUp software. All are high-functioning autistic students. The children were taught to use SketchUp and carried out projects using this software. The researchers wanted to share the experiences of this experiment: children could ask for help from their paired partner, and their families were invited to teaching sessions. Parents could ask questions. The researchers helped the children to be able to present their work to other children in the class. Focus groups were held with the parents and grand-parents.

The change in perception among parents and grand-parents is testimony to the impact these technological workshops have in facilitating intergenerational exchanges. Parents found that these workshops made it possible to build real friendships between children. Seeing their children in a position of success made it possible to change parents' as well as grand-parents' opinions, by showing the positive side of their children's skills.

According to parents, this experience of success increased children's confidence, which led to the children to be more willing to share more of their experiences with their parents, which they were not in habit of doing. The children became experts and were able to share their knowledge. This led to conversations with the parents, leading children with autism to speak more than usual. For the same reasons, the experiment improved relationships with brothers and sisters.

For professionals, it is interesting to see that an experiment that encourages students' strengths stimulated these students' personal investment in activities and helped them build a positive image for themselves, combined with a desire to share their creations. It is therefore indirectly, by focusing on the strengths of children with ASD, that these experiments have been able to develop social interaction skills, by encouraging children to share their areas of interest and creations.

Reading note 7. Software and technologies designed for people with autism: what do users want?

Access the full summary and all documents related to this research on the Resource Center of Applied Research and Disability.

Reference

Putnam C., Chong L. Software and technologies designed for people with autism: what do users want?. 2008. In Proceedings of the 10th international ACM SIGACCESS conference on Computers and accessibility (pp. 3-10)

Keywords

User-centered design, ASD, Software and technology design

Author abstract

Software developers, designers and researchers have been looking to technology for solutions to help and educate people with autism for over two decades. There are many examples of seemingly successful technology-based products and prototypes, yet very little is known about how well these solutions are currently integrated into lives of children and adults with autism and their families. This paper reports on results from an anonymous on-line survey intended as a first step to elucidate information about software and technology use. Additionally, data was analyzed to aid creation of future technology-based products for people with autism that are not just effective, but that also meet important user goals and align to their interests and strengths. Major findings included: (1) very few respondents (25%) had any experience with software or technology designed for people with cognitive disabilities; (2) when asked an open-ended question about what they desire in technology design, respondents reported three major goals (social skills, academic skills, and organization skills), and many suggestions for improvements to software and hardware design; and (3) technology was reported as both a major strength and interest for people with autism.

Comments

Although the study is particularly interesting for application designers, it is also useful to field stakeholders who are required to select a certain number of applications for children with autism. It makes it possible to identify what is in demand and what problems exist in terms of new technology for people with ASD.

We note that 89% of responses of the survey are from parents about their children with ASD; approximately 20% are responses from adults with ASD.

The responses show the positive aspects concerning software used by people filling out the questionnaire. These software applications are aimed at developing communication and social skills and 32% of respondents cited these as goals. The academic field, the scholarly skills are represented at 20%. Applications to develop the sense of organisation are also cited.

Criticism was expressed concerning the design of the software, in terms of sensory problems, obstacles to an easy to use format and the lack of vocal synthesis.

This study is interesting as it directly concerns the lives of people with autism and their parents, who are consulted in order to help create digital tools and applications that respond to their needs. This can provide professionals with the information necessary to select software and applications that meet the requirements of those directly concerned. It also provides a certain understanding of current uses of this new technology, for example in the family environment, and enables professionals to act based on feedback, prior to their specific intervention.

Reading note 8. State-of-the-art in TEL to support social communication skill development in children with autism: a multi-disciplinary review

Access the full summary and all documents related to this research on the Resource Center of Applied Research and Disability.

Reference

Avramides K. et al. State-of-the-art in TEL to support social communication skill development in children with autism: a multi-disciplinary review. 2012. International Journal of Technology Enhanced Learning, 4(5-6), 359-372.

Keywords

Technology enhanced learning, Social communication, Multi-disciplinary, Children, ASD, ASC, Virtual agent, Virtual environment, Multi-touch, Affective computing, User modelling, Participatory design

Author abstract

The paper reviews state-of-the-art in TEL to support social communication skill development in children with autism. We identify the driving research directions, and their associated challenges, from three broad perspectives that shape TEL: pedagogical foundations, technology, and learner involvement in the design process. We further explore these challenges through the discussion of ECHOES, an example state-of-the-art system. The review assists researchers working in multi-disciplinary teams to identify the new directions that are shaping state-of-the-art in order to drive successful future research projects in this area.

Comments

This article is useful as it is a literature review of the digital tools that make it possible to encourage the development of social communication among children with autism. The authors categorise the type of interventions with digital tools in this field into four types:

- Skill training in isolation, independent of everyday life. This includes, for example, training to recognise facial expressions or a virtual environment that makes it possible to select the signs to understand a social situation and know how to act as a result.
- Training in a context where there are structured activities and interactions with other children or adults. These may use robots in order to develop joint attention, virtual agents, etc.
- The third proposes an environment in which the child may play. Social interaction here is highly related to the child's partners, and technology simply serves as a medium for social interactions with other humans
- The fourth category includes tools for visual communication, tools for recognising facial expressions in real time which are indirectly a help for social communication and its development.

The article therefore enables field stakeholders to envisage several strategies using digital tools in order for children with autism to be able to improve their social communication skills.

The article reiterates that in terms of interventions in an ecological context, it is difficult to differentiate between progress that comes from the digital tool and that which results from other environmental

factors. This reminder is interesting as it enables professionals to question whether progress observed is due to the digital tools or to interventions other than digital tools, or a combination of both.
The article concludes by focusing on the difficulties encountered by the authors in developing a software programme, employing a virtual agent in a virtual universe, in order to develop the social communication skills of children with autism or others. Thanks to these questions, the field stakeholder will be able to consider the choice of this or that tool or application based on the specific needs of each child.

Reading note 9. Three around a table: the facilitator role in a co-located interface for social competence training of children with autism spectrum disorder

Access the full summary and all documents related to this research on the Resource Center of Applied Research and Disability.

Reference

Zancarano M. et al. Three around a table: the facilitator role in a co-located interface for social competence training of children with autism spectrum disorder. 2011. In IFIP Conference on Human-Computer Interaction (pp. 123-140). Springer Berlin Heidelberg.

Keywords

ASD, Collaborative games, Multi-user colocated interfaces, Cognitive-Behavioral Therapy

Author abstract

In this paper we describe a co-located interface on a tabletop device to support social competence training for children with Autism Spectrum Disorder. The interface has been developed on the multi-user DiamondTouch tabletop device as a 3-user application for two children and a facilitator (therapist or teacher). It takes advantage of the DiamondTouch table's unique ability to recognize multiple touches by different users in order to constrain interactions in a variety of ways. This paper focus on the support provided by the system to enhance a facilitator's management of interaction flow to increase its effectiveness during social competence training. We discuss the observations collected during a small field study where two therapists used the system for short sessions with 4 pairs of children. Although limited by the number of participants to date, the interactions that emerged during this study provide important insight regarding ways in which collaborative games can be used to teach social competence skills. Thus the children benefit from the motivational and engagement value of the games while the facilitator gains access to new tools to intrinsically support and shape the session.

Comments

This article is interesting as it evokes a work with an uncommon digital device, a cooperative game on a tabletop device with the aim of supporting social interactions between 8 boys from 9 to 12 years old with autism.

It provokes a thoughtful reflection on the role of the teacher or therapist in collaborative games on sensory tables, given that the adult can, using the device, initiate an action on the table which will have an influence on the rest of the game. This is a question to be considered by field stakeholders who will also be able to make choices using a digital tool, even if these choices only involve adjusting certain parameters in order to optimise skill development among children with ASD.

In the experiment described in the article, certain actions need to be carried out simultaneously by the supervising adult and the children in order to obtain the reward. The adult may therefore choose not to collaborate for a moment, in such a manner as to ensure that the phase of the game continues for the children, and even has the option of playing for children, if the adult deems it useful. Also, it is technically possible for the supervising adult to intervene in order to ensure that one of two children that proves too dominant over the other may be made less so through the choice of actions.

Game sessions were filmed, and participants were interviewed. The article discusses how the adult intervenes, in such a manner as to elicit maximum commitment from the autistic child. This might be of interest to field stakeholders, who are confronted with these questions.

In emphasising the role of the supervising adult, the article enables practitioners to think of the complementarity between the structure of the software and their own intervention. What does the application do, how can the professional provide added value in terms of optimal social interaction development between children with autism?

Reading note 10. Applied virtual environments to support learning of social interaction skills in users with Asperger's Syndrome

Access the full summary and all documents related to this research on the Resource Center of Applied Research and Disability.

Reference

Cobb S. et al. Applied virtual environments to support learning of social interaction skills in users with Asperger's Syndrome. 2002. Digital Creativity, 13(1), 11–22

Keywords

Asperger's Syndrome, Collaborative virtual environments, Social skills learning, Virtual environments

Author abstract

Asperger's Syndrome (AS) is an autistic spectrum disorder characterised by normal to high IQ but with marked impairment in social skills. Successful social skills training appears to be best achieved either in situ or in role-play situations where users can explore different outcomes resulting from their social behaviour. Single user virtual environments (SVEs) provide an opportunity for users with AS to learn social interaction skills in a safe environment which they can visit as many times as they like. The use of game-like tasks can provide an incentive and can also be used to guide the user through progressive learning stages. Collaborative virtual environments (CVEs) allow several users to interact simultaneously within the virtual environment, each taking different perspectives or role-play characters. Within the AS interactive project a series of SVEs and CVEs have been developed in collaboration with users and professional groups with an overall aim of supporting social skills learning. Initial evaluation studies have been carried out which have been used to both inform and refine the design of these virtual environments (VEs) as well as giving an insight into the understanding and interpretation of these technologies by users with AS.

Comments

The article presents a number of virtual reality systems. A person with autism must go into a virtual café and sit at a table, and some café tables are already occupied by customers. Two game modes are proposed: one is a game that is played alone, in which the autistic person meets virtual persons with whom they may interact. The other mode is collaborative, in which several persons with autism can interact in the virtual universe of the café. The single user virtual environment makes it possible to develop specific social skills; there is less uncertainty, as the user is the only one who has the freedom to act, others being programmed digital characters. The author specifies that this type of environment may initially help develop skills within a certain context which can then be widened to other contexts using another virtual environment. For example, in the café game, the autistic participant may train himself to sit down at a table, a skill which he can then transfer in another virtual game located in another context such as public transport, where he also needs to take a seat. The authors were able to obtain results, both from persons with autism and teachers. Teachers had difficulties in terms of generalising skills.

The article may be of interest to professionals who will thereby be able to identify the challenges related to virtual reality to train persons with autism to develop social skills.

Reading note 11. MOSOCO: a mobile assistive tool to support children with autism practicing social skills in real-life situations

Access the full summary and all documents related to this research on the Resource Center of Applied Research and Disability.

Reference

Escobedo L. et al. OSOCO: a mobile assistive tool to support children with autism practicing social skills in real-life situations. 2012. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (pp. 2589-2598). ACM.

Keywords

Assistive technology, ASD, Child-computer interaction, Social skills, Augmented reality, Mobile applications

Author abstract

MOSOCO is a mobile assistive application that uses augmented reality and the visual supports of a validated curriculum, the Social Compass, to help children with autism practice social skills in real-life situations. In this paper, we present the results of a seven-week deployment study of MOSOCO in a public school in Southern California with both students with autism and neurotypical students. The results of our study demonstrate that MOSOCO facilitates practicing and learning social skills, increases both quantity and quality of social interactions, reduces social and behavioral missteps, and enables the integration of children with autism in social groups of neurotypical children. The findings from this study reveal emergent practices of the uses of mobile assistive technologies in real-life situations.

Comments

This article details a particularly interesting experiment where students with ASD are included in mainstream schools thanks to augmented reality.

The idea is to provide a curriculum for improving social skills, which from the outset is not on a computer but on mobile devices in order to generalise the skills learned in class. The article presents a mobile system that revisits this curriculum with augmented reality.

A smartphone is used to show additional visual supports in addition to the real environment.

Initially when a child with autism has a partner nearby, this is indicated to them, helping them constitute a partnership. The application then makes it possible to detect reduced adaptation social behaviours, such as not looking at the partner or on the contrary staring at the partner, placing oneself at a socially unusual distance, having a specific vocal intonation, etc.

The application facilitates work as a pair: when the two children have had a correct visual interaction, they move on to the next stage of the curriculum.

An experiment was conducted with both ASD and non-ASD students.

One particularly interesting aspect for practitioners is that the article indicates that students with autism may progress in terms of social skills, and that in addition, non-ASD students become aware that they can be more understanding of social mishaps of students with ASD. Also, non-ASD students may develop strategies in order to know what to do when a social mishap occurs in terms of students with autism.

At the end of the experiment, the social skills of students with autism improved. For example, students were better aware of how to engage in conversation and join a group of children in the process of playing thanks to the application. The experiment allowed students with ASD to be better integrated with other children in the various activities.

Reading note 12. Use of computer-assisted technologies (CAT) to enhance social, communicative, and language development in children with autism spectrum disorders

Access the full summary and all documents related to this research on the Resource Center of Applied Research and Disability.

Reference

Brooks P. J.et al. Use of computer-assisted technologies (CAT) to enhance social, communicative, and language development in children with autism spectrum disorders. 2013. Journal of autism and developmental disorders, 43(2), 301-322.

Keywords

Computer-assisted technology, Autism Efficacy Language, Social skills, Emotion recognition, ASD

Author abstract

Major advances in multimedia computer technology over the past decades have made sophisticated computer games readily available to the public. This, combined with the observation that most children, including those with autism spectrum disorders (ASD), show an affinity to computers, has led researchers to recognize the potential of computer technology as an effective and efficient tool in research and treatment. This paper reviews the use of computer-assisted technology (CAT), excluding strictly internet-based approaches, to enhance social, communicative, and language development in individuals with ASD by dividing the vast literature into four main areas: language, emotion recognition, theory of mind, and social skills. Although many studies illustrate the tremendous promise of CAT to enhance skills of individuals with ASD, most lack rigorous, scientific assessment of efficacy relative to non-CAT approaches.

Comments

This article is a literature review concerning the use of digital tools for ASD students specifically focused on a specific field: communication, language, social skills and emotion recognition. The article addresses several international university research works that have been carried out in these specific fields.

Emotion recognition studies are therefore referenced. A certain number of applications use static face images that express emotions. Others use three-dimensional digitised characters that experience a role-play. The user is then asked to predict which emotion the character will have in a given situation. It is therefore a question of connecting a given situation with the emotion, as incarnated by the avatar, that corresponds to this situation. We note however that most of these experiments do not have a control group where students received similar training without the digital interface. When this has been carried out, the description of the control group remains highly summary and makes it impossible to determine whether the digital version is better than the non-digital version.

Other applications were designed to develop theory of mind skills. These experiments were not very conclusive, particularly in terms of whether the digital aspect is an added value in developing these types of skills.

A certain number of experiments were created using video modelling in order to develop social skills such as expressing emotions. Certain studies compare a test group who experience video modelling sessions, with a control group that experience direct modelling sessions, without video. One study showed the superiority of video modelling in quickly acquiring a target behaviour compared with direct imitation. Video modelling was also used for work on social scenarios.

Virtual reality experiments are also indicated.

This literature review enables field stakeholders to take into account the degree of proven effectiveness in each field of intervention, and therefore identify priorities for interventions carried out with the autistic children for whom they care.

Reading note 13. The clinical use of robots for individuals with autism spectrum disorders: A critical review

Access the full summary and all documents related to this research on the Resource Center of Applied Research and Disability.

Reference

Diehl J. J. et al. The clinical use of robots for individuals with autism spectrum disorders: A critical review. 2012. Research in autism spectrum disorders, 6(1), 249-262

Keywords

ASD, Asperger, Therapy, Intervention, Social skills, Robot

Author abstract

We examined peer-reviewed studies in order to understand the current status of empirically-based evidence on the clinical applications of robots in the diagnosis and treatment of Autism Spectrum Disorders (ASD). Studies are organized into four broad categories: (a) the response of individuals with ASD to robots or robot-like behavior in comparison to human behavior, (b) the use of robots to elicit behaviors, (c) the use of robots to model, teach, and/or practice a skill, and (d) the use of robots to provide feedback on performance. A critical review of the literature revealed that most of the findings are exploratory and have methodological limitations that make it difficult to draw firm conclusions about the clinical utility of robots. Finally, we outline the research needed to determine the incremental validity of this technique.

Comments

Robots have received a lot of media attention lately. It is therefore useful for field stakeholders to have a summary of research concerning the use of robots prior to investing in this often costly equipment.
This article is also a literature review concerning the use of robots in clinical applications for autism. The article discusses whether or not persons with autism prefer robots to toys that are not robots. Another question is to know whether persons with autism are more interested in a humanoid robot or in a non-humanoid robot. According to the experiments, robots are used in order to avoid reduced adaptation behaviours, encourage interactive behaviours with the robot, with or without other children. They may be also used for imitation training as well as reinforcement and reward.
The results of the various experiments vary considerably depending on the children with ASD.

The author indicates that the proof obtained from robotics studies is limited and that what would be necessary is a comparison in the development of the same types of skills between interventions that use the robot and interventions without the robot. As the results of the interventions varied widely depending on the children with autism, it is a question of determining which children respond well to help with the robot and which respond less well.

Reading note 14. Selecting Computer-Mediated Interventions to Support the Social and Emotional Development of Individuals with Autism Spectrum Disorder

Access the full summary and all documents related to this research on the Resource Center of Applied Research and Disability.

Reference

Gillespie-Lynch K. et al. Selecting Computer-Mediated Interventions to Support the Social and Emotional Development of Individuals with Autism Spectrum Disorder. 2016. Special and Gifted Education: Concepts, Methodologies, Tools, and Applications, 32.

Keywords

ASD

Author abstract

This chapter is designed to provide parents, professionals, and individuals with Autism Spectrum Disorder (ASD) with tools to help them evaluate the effectiveness of computer-mediated interventions to support the social and emotional development of individuals with ASD. Starting with guidelines for selecting computer-mediated interventions, we highlight the importance of identifying target skills for intervention that match an individual's needs and interests. We describe how readers can assess the degree to which an intervention is evidence-based, and include a brief overview of different types of experiments and statistical methods. We examine a variety of computer-mediated interventions for people with ASD and the evidence base for each: computer-delivered instruction (including games), iPad-type apps, virtual environments, and robots. We describe websites that provide additional resources for finding educational games and apps. We conclude by emphasizing the uniqueness of each individual with ASD and the importance of selecting interventions that are well-matched to the specific needs of each individual.

Comments

This chapter, which was drafted by researchers, consists of practical advice addressed to parents and professionals using new technology as they work with children with autism. Information is provided concerning the scientific results that shows how technology can help children with autism progress.

Recommendations are provided for selecting an application that corresponds to the child's needs. Is the application compatible with the other interventions conducted with the child, does it make it possible to assess progress? An important point concerns the customizable aspect of the application, so that it can most closely correspond to the specific needs of each young person with autism. It is advised to use a demo version in order to see if the application is usable.

It is also important to consider whether there was scientific proof that the application provides something for children with autism. According to the authors, this is rarely the case. A paragraph is devoted to scientific proof. A number of applications are described for which research experiments have been conducted. Some focus on emotion recognition and others on virtual reality in order to help develop social skills.

One paragraph is also written on applications for tablets in order to encourage social and emotional development. The authors comment on the use of robots. The article concludes with a certain number

of search engine indicators that enable readers to find applications of interest to children with ASD on tablets and smartphones.

Reading note 15. Affective computing and autism

Access the full summary and all documents related to this research on the Resource Center of Applied Research and Disability.

Reference

El Kaliouby R. et al. Affective computing and autism. 2006. Annals of the New York Academy of Sciences, 1093(1), 228-248.

Keywords

ASD, Socio-emotional skills, Technology

Author abstract

This article highlights the overlapping and converging goals and challenges of autism research and affective computing. We propose that a collaboration between autism research and affective computing could lead to several mutually beneficial outcomes—from developing new tools to assist people with autism in understanding and operating in the socioemotional world around them, to developing new computational models and theories that will enable technology to be modified to provide an overall better socioemotional experience to all people who use it. This article describes work toward this convergence at the MIT Media Lab, and anticipates new research that might arise from the interaction between research into autism, technology, and human socioemotional intelligence.

Comments

This article addresses the notion of empathy and indicates that persons with autism have difficulties with this skill. It provides some indications concerning affective computing. There is a convergence between programmers of software that stimulate an empathic approach and persons with autism who also do not have spontaneous empathy towards others.

The authors then turn to the systemization, the implementation of systems to understand the world, that corresponds to autistic functioning. Persons with ASD have a tendency to systemize empathy.

There are a certain number of tools that make it possible to capture physical data (facial expressions, posture, heart rate, etc.) and to transform this data into various signals (luminous signals for example).

With cameras carried by the person with autism, those close to them could interpret the videos in real time in order for the person with ASD to be able to see them later and understand the challenges of the social situations filmed.

The article helps field stakeholders envisage original approaches that incorporate digital technology and that enable persons with autism to move beyond their difficulties in terms of empathy and social relations.

Reading note 16. A multi-component social skills intervention for children with Asperger syndrome: The Junior Detective Training Program

Access the full summary and all documents related to this research on the Resource Center of Applied Research and Disability.

Reference

Beaumont R., Sofronoff K. A multicomponent social skills intervention for children with Asperger syndrome: The Junior Detective Training Program. 2008. Journal of Child Psychology and Psychiatry, 49(7), 743-753.

Keywords

ASD, Asperger syndrome, Affective computing, Affective sensors, Mindreading software

Author abstract

The study aimed to investigate the effectiveness of a new multi-component social skills intervention for children with Asperger syndrome (AS): The Junior Detective Training Program. This 7-week program included a computer game, small group sessions, parent training sessions and teacher handouts. Method: Forty-nine children with AS were recruited to participate and randomly assigned to intervention (n = 26) or wait-list control (n = 23) conditions. Results: Relative to children in the wait-list group, program participants showed greater improvements in social skills over the course of the intervention, as indicated by parent-report measures. Teacher-report data also confirmed that children receiving the intervention made significant improvements in social functioning from pre-to posttreatment. Treatment group participants were better able to suggest appropriate emotion-management strategies for story characters at post-intervention than at pre-intervention, whereas control participants were not. However, there was no difference in the improvements made by children in the intervention and control conditions on facial expression and body-posture recognition measures. Follow-up data suggested that treatment gains were maintained by children at 5-months post-intervention. Conclusions: The Junior Detective Training Program appeared to be effective in enhancing the social skills and emotional understanding of children with AS. Limitations and suggestions for future research are discussed.

Comments

This interesting article investigates a social skills training programme for children with Asperger's syndrome. The programme consists of 7 sessions over 7 consecutive weeks with several types of interventions: the digital game itself as well as non-digital group interventions and training for parents and professionals.

Children who experienced the intervention were compared with others who did not go through the experience; both groups were equivalent in terms of age, IQ, and degree of autism.

Target skills are diverse: recognise and control fear and anxiety, recognise facial expressions and body language.

In the first level of the computer game, the child has to assess how a person felt on the basis of the person's facial expression, intonation and physical posture. In the second level, the user has to infer a character's emotions based on non-verbal and environmental indicators. In the third level, assignments are suggested, like knowing how to act when playing a game, or when being harassed.
In addition to the computer game, group sessions focused on emotion recognition and social skills are organised in such a manner as to generalise the trainings carried out on the computer. Role play games or at-home exercises were created for this purpose.

Parents received training. Written advice was also issued to teachers.

Children made progress in terms of social skills, and this was maintained after the intervention period (two assessments were carried out, 6 weeks and 5 months respectively after the intervention). On the other hand, no progress was noted in terms of facial expression and body language recognition.

This research is particularly interesting as it uses a simple device accessible within institutions (computer and software programs) and implements a cooperative work between researchers, teachers and parents, while simultaneously offering students computerised sessions and a reinvestment with non-computerised sessions.

Annotated bibliography

The following bibliography presents the 60 references researchers used to carry out their research.

Each reference in the annotated bibliography contains a link that provides access to the corresponding document. These are either available free of charge or by paid access (certain resources used are only available via restricted access on the platforms hosting these documents).

For those references that were the object of a summary, the link provides access to the full document summary on the Resource Center for Applied Research and Disability website.

- **Avramides, K., Bernardini, S., Foster, M. E., Frauenberger, C., Kossyvaki, L., & Mademtzi, M. (2012). State-of-the-art in TEL to support social communication skill development in children with autism: a multi-disciplinary review. *International Journal of Technology Enhanced Learning*, *4*(5-6), 359-372**

This article is a literature review of the digital tools that make it possible to develop social communication among children with autism. It allows field stakeholders to have an overview of available technology and the various intervention approaches that use digital tools to develop social communication skills.

- **Ayres, K. M., Mechling, L., & Sansosti, F. J. (2013). The use of mobile technologies to assist with life skills/independence of students with moderate/severe intellectual disability and/or autism spectrum disorders: Considerations for the future of school psychology. *Psychology in the Schools*,*50*(3), 259-271**

This articles provides recommendations to educational psychologists on the various ways of familiarising themselves with digital tools, as well as understanding the wider use of digital technology as opposed to training to use a specific tool. Educational psychologists may then become resources on the use of these technologies with children with autism.

- **Bereznak, S., Ayres, K. M., Mechling, L. C., & Alexander, J. L. (2012). Video self-prompting and mobile technology to increase daily living and vocational independence for students with autism spectrum disorders. *Journal of Developmental and Physical Disabilities, 24(3)*, 269-285 (Paid access)**

This articles demonstrates the use of smartphones to develop everyday life skills thanks to video modelling. It allows field professionals to see that in order to develop a range of skills (for example social skills), interventions may be conducted using everyday equipment such as the video function of smartphones.

- **Grossard, C., & Grynszpan, O. (2015). Entraînement des compétences assistées par les technologies numériques dans l'autisme: une revue. *Enfance*,*2015*(01), 67-85 (Paid access)**

This French language article is a literature review of the use and purpose of digital tools for people with autism. Information resulting from scientific research is given that will enable those working in the field to have an initial idea of the utility of digital tools for children with autism. The research indicates that for a same type of activity, children with autism increasingly prefer computer training programmes over activities without digital technology, and that technology increases a child's motivation. Also, digital activities are accessible to children that struggle with social communication and produce immediate responses that can be repeated at will, which is extremely useful for these children.

- **O'Brien S. (2014). East Park iPad Project Report: 2013/2014**

This report is interesting as it shows the evolution of representations and practices of teachers working with students with autism when an iPad is used in schools.

- **Ploog, B. O., Scharf, A., Nelson, D., & Brooks, P. J. (2013). Use of computer-assisted technologies (CAT) to enhance social, communicative, and language development in children with autism spectrum disorders. *Journal of autism and developmental disorders*, *43*(2), 301-322**

This article is a literature review concerning the use of digital tools for ASD students specifically focused on a specific field: communication, language, social skills and emotion recognition. The article addresses several international university research works that have been carried out in these specific fields.

- **Ramdoss, S., Machalicek, W., Rispoli, M., Mulloy, A., Lang, R., & O'Reilly, M. (2012). Computer-based interventions to improve social and emotional skills in individuals with autism spectrum disorders: A systematic review. *Developmental neurorehabilitation, 15*(2), 119-135**

This article is a literature review focused on computer based intervention tools that facilitate the development of social and emotional skills.
It concludes that in the end, despite a certain number of studies demonstrating the efficiency of digital tools in developing socio-emotional skills, we cannot generally affirm that the use of digital tools is an absolutely effective strategy that makes it possible to develop these skills.

Interventions to develop specific skills

Non-verbal communication

Emotion recognition

- **Arellano, D., Helzle, V., Schaller, U. M., Rauh, R., Spicker, M., & Deussen, O. (2015). The SARA Project: An Interactive Sandbox for Research on Autism. In *Proceedings of the XVI International Conference on Human Computer Interaction* (p. 17). ACM**

This is a research article on the SARA project. Using virtual characters, a software programme makes it possible to have real time animations. It is therefore possible to modify facial expressions to make them more realistic or, on the contrary, tone them down by limiting the range of information expressed. The article addresses a number of programmes that make it possible to develop emotion recognition using virtual characters, and enables field stakeholders to consider a selection of software programmes and configurations, making it possible to work on emotion recognition.

- **Golan, O., Ashwin, E., Granader, Y., McClintock, S., Day, K., Leggett, V. and Baron-Cohen, S. (2010). Enhancing emotion recognition in children with autism spectrum conditions: an intervention using animated vehicles with real emotional faces, *Journal of autism and developmental disorders, Vol. 40 No. 3, pp. 269 – 279***

This research focuses on emotion recognition. It assesses the contribution of the "Les Transporteurs" DVD which uses vehicles with faces of actors expressing emotions. Children that watched this programme improved in terms of emotion recognition and were able to transfer this skill to other entities than the Transporters.

- **Kwanguk, K., Rosenthal, M.; Gwaltney, M., Jarrold, W., Hatt, N.; McIntyre, N., Swain, L., Solomon, M., Mundy, Peter. A (2015). Virtual Joy-Stick Study of Emotional Responses and Social Motivation in Children with Autism Spectrum Disorder. Journal of Autism & Developmental Disorders. Vol. 45 Issue 12, p3891-3899**

This article describes the use of a joystick by autistic children in order to move forward or backward in relation to an avatar with facial expressions, gestures and verbalisations that correspond to six base emotions (anger, joy, sorrow, surprise, fear, disgust). The authors found that compared with a control group, children with autism showed fewer approach behaviours in relation to avatars expressing joy. The children from both groups showed equal behaviours in terms of moving backwards from avatars expressing negative emotions, and they recognised the six emotions in the same way . According to the authors, these results suggest that children with ASD did not have a problem in recognising the expression of an emotion, but rather demonstrated fewer approach behaviours in relation to positive emotions.

- **LaCava, P. G., Golan, O., Baron-Cohen, S., & Myles, B. S. (2007). Using assistive technology to teach emotion recognition to students with Asperger Syndrome. *Remedial and Special Education, 28*, 174–181**

This article assesses an emotion recognition software programme. The study implemented the Mind Reading programme for children with autism. This programme made it possible for children to progress in terms of recognising emotion in facial and vocal expressions.

- **Mantziou, O., Vrellis, I., & Mikropoulos, T. A. (2015). Do Children in the Spectrum of Autism Interact with Real-time Emotionally Expressive Human Controlled Avatars?. *Procedia Computer Science*, *67*, 241-251**

This fairly technical article which focuses on the restricted field of virtual environments, is interested in emotion recognition.

Social communication

- **Alcorn, A., Pain, H., Rajendran, G., Smith, T., Lemon, O., Porayska-Pomsta, K., ... & Bernardini, S. (2011). Social communication between virtual characters and children with autism. In International Conference on Artificial Intelligence in Education (pp. 7-14). Springer Berlin Heidelberg**

This article demonstrates the benefit of using a serious game, including an autonomous virtual agent, in order to develop joint attention skills. The virtual person "looks" at the child with autism participating in the game, then looks at the flower, and occasionally points to the flower. The child with autism must then click on the correct flower on the screen, identifying it from among two decoys (flowers not designated by the virtual agent). The children reacted well to the game and most designated the correct flower.

- **Trepagnier, C. Y., Sebrechts, M. M., Finkelmeyer, A., Stewart, W., Woodford, J., & Coleman, M. (2006). Simulating social interaction to address deficits of autistic spectrum disorder in children. Cyberpsychology & Behavior, 9(2), 213-217 (Paid access)**

This research uses eye-tracking and a virtual face. Young children with autism were rewarded by their favourite video clips when they expressed non-verbal communication behaviours, such as eye contact, following the virtual face by sight, etc.

Gestural communication

- **Carter, E. J., Williams, D. L., Hodgins, J. K., & Lehman, J. F. (2014). Are children with autism more responsive to animated characters? A study of interactions with humans and human-controlled avatars. *Journal of autism and developmental disorders*, *44*(10), 2475-2485 (Paid access)**

This article makes it possible to compare several types of interventions aimed at developing verbal and non-verbal communication: direct intervention by a therapist, intervention by an avatar controlled by an adult, and a computer intervention with a cartoon character. The verbal communication of children with autism was strongest with the therapist and less strong with the cartoon character. The article thereby allows field stakeholders to nuance the contribution of digital tools in relation to the progress of children with autism in certain fields.

Imitation

- **Charlop-Christy, M. H., Le, L., & Freeman, K. A. (2000). A comparison of video modeling with in vivo modeling for teaching children with autism. Journal of autism and developmental disorders, 30(6), 537-552**

This article is interesting as it shows the efficiency of video modelling in relation to direct modelling for the acquisition of target behaviours. These behaviours have been able to be generalised thanks to video modelling.

- **Forbes, P., Xueni; C., Hamilton, A. (2016). Reduced Mimicry to Virtual Reality Avatars in Autism Spectrum Disorder. Journal of Autism & Developmental Disorders. Vol. 46 Issue 12, p3788-3797**

Mimicry consists of unconsciously copying the actions of others. Research suggests that persons with autism may copy the objective of an observed action but that they show differences in terms of mimicry. Authors have used a virtual reality device in order to study these aspects (virtual character that points to virtual objects; real physical game board). Even though they were asked to copy only the objective of the action conducted by the virtual character, the participants (autistic or not) also copied the movements themselves. However the autistic participants copied the movements of the virtual character less than the non-autistic participants.

- **Pierno AC, Mari M, Lusher D, Castiello U. (2008). Robotic movement elicits visuomotor priming in children with autism. *Neuropsychologia. ;46*:448–454**

This experimental research shows that people with ASD imitate movement by a robot more quickly than the same movement by a human being, contrary to non-autistic persons who imitate the movement of another human being more quickly. These results are consistent with a teaching strategy that could emphasise imitating a robot rather than a human.

- **Taheri, A. R., Alemi, M., Meghdari, A., PourEtemad, H. R., & Basiri, N. M. (2014). Social robots as assistants for autism therapy in Iran: Research in progress. In *Robotics and Mechatronics (ICRoM), 2014 Second RSI/ISM International Conference on IEEE* (pp. 760-766)**

This study uses robots and Kinects in such a way that a child with autism is able to imitate a robot, and, thanks to the Kinect, the robot can imitate the child's movements. The article is interesting as it

provides an innovative approach combining two types of technology (robot and Kinect) enabling the child with autism to initiate a form of communication by reciprocal imitation.

- **Wainer, A., Ingersoll, B. (2015) Increasing Access to an ASD Imitation Intervention Via a Telehealth Parent Training Program. *Journal of Autism & Developmental Disorders. Vol. 45 Issue 12,* p3877-3890 (Paid access)**

This article describes a system of distance training aimed at parents with autistic children. The training focused on imitation intervention techniques. The assessment was carried out on 5 parents and their children.

Theory of mind, others' point of view

- **Charlop-Christy, M. H., & Daneshvar, S. (2003). Using video modeling to teach perspective taking to children with autism. *Journal of Positive Behavior Interventions, 5*, 12–21**

This study considers training on others' point of view by means of video. The intervention was effective and enabled children with autism to develop this skill.

- **Beaumont, R., & Sofronoff, K. (2008). A multi-component social skills intervention for children with Asperger syndrome: The Junior Detective Training Program. *Journal of Child Psychology and Psychiatry, 49*(7), 743-753**

This interesting article investigates a social skills training programme for children with Asperger's syndrome. The programme consists of 7 sessions conducted over 7 consecutive weeks with several types of interventions: the digital game itself, but also non-digital group interventions, and training for parents and professionals.
The children made progress in terms of social skills, and this was maintained after the intervention period (two assessments were carried out, 6 weeks and 5 months respectively after the intervention). On the other hand, no progress was noted in terms of facial expression and body language recognition.

- **Swettenham, J. (1996). Can children with autism be taught to understand false belief using computers?. *Journal of Child Psychology and psychiatry, 37*(2), 157-165 (Paid access)**

This article addresses an experiment where a computer version helped to improve during Sally Anne type tests, in order to understand others' point of view. It did not enable children with ASD to progress in this area.

Social interactions

Collaborative work and social interactions

- **Bauminger-Zviely, N., Eden, S., Zancanaro, M., Weiss, P. L., & Gal, E. (2013). Increasing social engagement in children with high-functioning autism spectrum disorder using collaborative technologies in the school environment. *Autism*,*17*(3), 317-339**

This study shows how two specific computer programmes that enable the development of social communication, social engagement, collaboration and conversation are effective for students with autism.

- **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. *Personal and ubiquitous computing*, *16*(2), 157-168**

An intervention was carried out using tablets to develop social skills among children with autism. The results show progress in terms of social behaviour and collaboration, and moreover encouraged an interest in social activities among the child participants.

- **Kimball, J. W., Kinney, E. M., Taylor, B. A., & Stromer, R. (2004). Video enhanced activity schedules for children with autism: A promising package for teaching social skills. *Education and Treatment of Children, 27*, 280–298**

This article emphasises the combination of activity sequences using video in order to develop autistic children's social skills.

- **Lewis, L., Trushell, J. & Woods, P. (2005). Effects of ICT group work on interactions and social acceptance of a primary pupil with Asperger's Syndrome. *British Journal of Educational Technology, 36(5),* 739-755. Mc climmens**

A student with Asperger's syndrome has collaborative working sessions on a computer with two other children. Moderate progress was perceived in terms of social interactions.

- **MacDonald, R., Sacramone, S., Mansfield, R., Wiltz, K., & Ahearn, W. H. (2009). Using video modeling to teach reciprocal pretend play to children with autism. *Journal of Applied Behavior Analysis, 42*, 43–55**

This research uses video modelling in order to develop play in pairs among children with autism. We note an improvement in social interactions and cooperative games after the intervention.

- **Nikopoulos, C. K., & Keenan, M. (2003). Promoting social initiation in children with autism using video modeling. *Behavioral interventions*, *18*(2), 87-108**

This research studies social initiation development among children with autism following video modelling. This method made it possible to improve social initiation skills among these children.

- **Wright, C., Diener, M. L., Dunn, L., Wright, S. D., Linnell, L., Newbold, K., & Rafferty, D. (2011). SketchUp™: A technology tool to facilitate intergenerational family relationships for children with autism spectrum disorders (ASD). *Family and Consumer Sciences Research Journal*, *40*(2), 135-149**

This research focuses on a computer workshop that enables young high-functioning autistic boys to use a 3D construction programme. The workshop enabled these young people to increase interactions among themselves, as well as with their parents and grand-parents.

Tabletop devices

- **Gal, E., Bauminger, N., Goren-Bar, D., Pianesi, F., Stock, O., Zancanaro, M., & Weiss, P. L. T. (2009). Enhancing social communication of children with high-functioning autism through a co-located interface. *Ai & Society*, *24*(1), 75-84**

This research used an interactive digital tool that makes it possible to create stories collectively. An experiment was conducted among six boys with high-functioning autism from 8 to 11 years old. The tabletop device enabled several users to take action at the same time. The children were assessed before and after the intervention in order to see the progress made.

- **Piper, A. M., O'Brien, E., Morris, M. R., & Winograd, T. (2006, November). SIDES: a cooperative tabletop computer game for social skills development. In *Proceedings of the 2006 20th anniversary conference on Computer supported cooperative work* (pp. 1-10). ACM**

This article discusses the SIDES project and describes a cooperative tabletop computer game. Children with autism enthusiastically participated in this project and were able to work in a group.

- **Zancanaro, M., Giusti, L., Gal, E., & Weiss, P. T. (2011). Three around a table: the facilitator role in a co-located interface for social competence training of children with autism spectrum disorder. In *IFIP Conference on Human-Computer Interaction* (pp. 123-140). Springer Berlin Heidelberg**

This article is interesting as it evokes a work with an uncommon digital device, a cooperative game on a tabletop device with the aim of supporting social interactions between 8 boys from 9 to 12 years old with autism.

Develop social skills thanks to a virtual environment

- **Cobb, S., Beardon, L., Eastgate, R., Glover, T., Kerr, S., Neale, H., Parsons, S., Benford, S., Hopkins, E., Mitchell, P., Reynard, G., & Wilson, J. (2002). Applied virtual environments to support learning of social interaction skills in users with Asperger's Syndrome. *Digital Creativity*, 13(1), 11–22**

In this article, two types of virtual environments were offered to a student with Asperger's in order to develop social interaction skills: an experience of a virtual environment in which the child is the only participant, or a virtual environment in which several children participate simultaneously. Research makes it possible for field stakeholders to consider the type of virtual environment according to the child and type of skills to develop.

- **Didehbania, N., Tandra A., Michelle K., Daniel Krawczyka, S. Chapman. Virtual Reality Social Cognition Training for children with high functioning autism. 2016. Computers in Human Behavior, Volume 62, Pages 703–711**

This study assessed social skills training with 30 participants with autism. Social scenarios were the same for different development ages, but their complexity were adapted to the participants' age. Participants interacted in real time in a virtual world called Second Life, along with one or two avatars controlled by one or two carers or by another autistic participant: class, playground, meals at the cafeteria. The authors observed improvements in terms of recognising emotions, attributing social intention to animated geometric forms and analogical reasoning concerning two similar images.

- **Georgescu, A. L., Kuzmanovic, B., Roth, D., Bente, G., & Vogeley, K. (2014). The use of virtual characters to assess and train non-verbal communication in high-functioning autism. *Frontiers in human neuroscience*, *8*, 807**

The article distinguishes two types of characters in virtual universes: virtual agents that are controlled by computer algorithms, and avatars which are controlled in real time by a real person. The studies show that the facial and body expressions of an avatar are more easily perceived than those of a real human being. The techniques used range from the most common, i.e., a simple computer with a mouse that moves the character, to the most sophisticated, using motion detectors.

- **Newbutt, N., Sung, C., Kuo, H.-J., Leahy, M., Lin, C.-C., Tong, B. (2016). Brief Report: A Pilot Study of the Use of a Virtual Reality Headset in Autism Populations. *Journal of Autism & Developmental Disorders,* Vol. 46 Issue 9, p3166-3176 (Paid access)**

This study assessed the use of virtual reality headsets by 29 participants with autism (acceptability, sense of presence and immersion). The headset was an occulus rift and 3 short scenarios (10min) were used initially, followed by 2 longer scenarios (25min): visualise a film in a virtual cinema, sit face to face with a person in a café (social interaction with the virtual person through a gaze), participate in a virtual safari (move the car, look at the animals), space mission, visit a house in Italy. Most participants reported that they appreciated the use of headsets and also reported a strong sense of presence.

- **Parsons, S., Leonard, A., & Mitchell, P. (2006). Virtual environments for social skills training: Comments from two adolescents with autism spectrum disorder. *Computers & Education, 47*, 186–206**

This article addresses virtual environments so that young people with autism can develop social skills. These young people were able to experience the virtual worlds of a café and a bus in order to develop their social skills.

Resolve social problems, social scenarios

- **Bernard-Opitz, V., Sriram, N., & Nakhoda-Sapuan, S. (2001). Enhancing social problem solving in children with autism and normal children through computer-assisted instructions. *Journal of Autism and Developmental Disorders*, 31, 377–384**

This article describes the use of a computer programme that enables children with autism to resolve social problems by using highly visual animations. Over the course of the sessions, children with autism progressed. It is therefore interesting for field stakeholders to have children with autism work in this area using digital tools.

- **Hagiwara, T., & Myles, B. S. (1999). A multimedia social story intervention teaching skills to children with autism. *Focus on Autism and other developmental disabilities*, *14*(2), 82-95**

This article addresses computer research on social scenarios for children with autism. It shows that training in this field improves children's skills.

- **Zheng, Z., Warren, Zachary; Weitlauf, A., Fu, Q., Zhao, H., Swanson, A., Sarkar, N. (2016). Brief Report: Evaluation of an Intelligent Learning Environment for Young Children with Autism Spectrum Disorder. *Journal of Autism & Developmental Disorders. Vol. 46 Issue 11,* p3615-3621 (Paid access)**

This study assessed the use of a training system focused on orientation towards social indices for participants with autism and participants without autism. The two user groups responded well to the social indices shown by the system.

Use of augmented reality

- **Escobedo, L., Nguyen, D. H., Boyd, L., Hirano, S., Rangel, A., Garcia-Rosas, D., ... & Hayes, G. (2012). MOSOCO: a mobile assistive tool to support children with autism practicing social skills in real-life situations. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 2589-2598)**

This article details a particularly interesting experiment where students with ASD are included in mainstream schools thanks to augmented reality.
The idea is to provide a curriculum for improving social skills, which from the outset is not on a computer but on mobile devices in order to generalise the skills learned in class. The article presents a mobile system that revisits this curriculum with augmented reality.

- **O'Brien, A., Schlosser, R., Shane, H., Abramson, J., Allen, A., Flynn, S., Yu, C., Dimery, Katherine (2016). Brief Report: Just-in-Time Visual Supports to Children with Autism via the Apple Watch: A Pilot Feasibility Study. *Journal of Autism & Developmental Disorders. Vol. 46 Issue 12*, p3818-3823 (Paid access)**

The use of augmented reality from an AppleWatch enabled children with ASD to understand a certain number of directives when these children had difficulties understanding verbal language alone. The article is interesting, as it shows that photos or video clips in the context of augmented reality make it possible, even on a small device such as the watch, to help children with ASD understand instructions and directives.

Using interfaces with tangible and connected objects

- **Farr, W., Yuill, N. and Raffle, H. (2010) Social benefits of a tangible user interface for children with Autistic Spectrum Conditions. *Autism, 14(3),* 237-52 (Paid access)**

This experiment uses interfaces with tangible objects and made it possible to develop social game skills among children with ASD. These children also experienced social interaction by playing the game on a touch interface and playing with simple legos.

The use of robots and virtual tutors

- **Diehl, J. J., Schmitt, L. M., Villano, M., & Crowell, C. R. (2012). The clinical use of robots for individuals with autism spectrum disorders: A critical review. *Research in autism spectrum disorders*, *6*(1), 249-262**

This literature review concerns the use of robots in interventions among children with ASD. Some studies compare robot interventions with the same interventions by human beings, in terms of how they encourage the development of adapted behaviours and skills. It enables field stakeholders to see the potential of robots in terms of social interaction and non-verbal communication interventions, and to identify the scientific proof for each type of intervention.

- **Feil-Seifer, D., & Matarić, M. J. (2009). Toward socially assistive robotics for augmenting interventions for children with autism spectrum disorders. In *Experimental robotics* (pp. 201-210). Springer Berlin Heidelberg**

This study shows that robots can successfully bring children with autism to have proactive social behaviours.

- **Kaboski, J., Diehl, J., Beriont, J., Crowell, C., Villano, M., Wier, K., Tang, K.(2015). Brief Report: A Pilot Summer Robotics Camp to Reduce Social Anxiety and Improve Social/Vocational Skills in Adolescents with ASD. *Journal of Autism & Developmental Disorders. Vol. 45 Issue 12*, p3862-3869 (Accès payant)**

This article details an experiment around a robotics workshop in which students with ASD work with non-ASD students. The experiment is interesting in the sense that this cooperative workshop enabled children with ASD to have less social anxiety. It provides options in terms of organising educational workshops using robotics to encourage contact and consequently decrease social anxiety.

- **Milne, M., Luerssen, M., Lewis, T., Leibbrandt, R. and Powers, D. (2010) 'Development of a virtual agent based social tutor for children with autism spectrum disorders' in *IJCNN 2010: Proceedings of the 2010 International Joint Conference on Neural Networks*, pp. 1 – 9**

This study used autonomous virtual agents to teach social and conversational skills. Progress was made by students with ASD in this field. Children also appreciated the virtual tutor.

- **Robins, B., Dautenhahn, K., Te Boekhorst, R., & Billard, A. (2005). Robotic assistants in therapy and education of children with autism: can a small humanoid robot help encourage social interaction skills?. *Universal Access in the Information Society*, *4*(2), 105-120**

This article presents quantitative and qualitative research results concerning a robot and children with autism. The children are in the presence of the robot during sessions over the course of several months. Children show improved imitation, role playing and communication skills.

- **Simut, R., Vanderfaeillie, J., Peca, A., Perre, G., Vanderborght,B. (2016). Children with Autism Spectrum Disorders Make a Fruit Salad with Probo, the Social Robot: An Interaction Study. *Journal of Autism & Developmental Disorders. Vol. 46 Issue 1,* p113-126 (Paid access)**

This article compares the social interaction of children with ASD with a robot and and with a person, when playing a game. It showed that visual contact was more significant with the social robot than with the human being.

Develop and select adapted applications

- **Arthanat, S., Curtin, C., & Kontak, D. (2015). An Evaluation Protocol for Selection of Educational Technologies for Students with Developmental Disabilities: A Demonstration Study Using iPad Apps. *Journal of Occupational Therapy, Schools, & Early Intervention*, *8*(3), 236-255 (Paid access)**

A method to search for applications corresponding to the needs of students with developmental disabilities was developed. This approach was tested with the iPad. Research showed that students with developmental disabilities were more inclined to engage with training sessions offered by the applications chosen by the method rather than applications chosen at random.

- **Boujarwah, F. A., Riedl, M. O., Abowd, G. D., & Arriaga, R. I. (2011). REACT: intelligent authoring of social skills instructional modules for adolescents with high-functioning Autism. *ACM SIGACCESS Accessibility and Computing*, (99), 13-23 (Paid access)**

This article presents a game publisher that enables professionals and parents to create their own games that are adapted to the specific profile of the autistic child with whom they work, in such a manner as to enable social skill development.

- **Putnam, C., & Chong, L. (2008). Software and technologies designed for people with autism: what do users want?. In *Proceedings of the 10th international ACM SIGACCESS conference on Computers and accessibility*(pp. 3-10). ACM.b**

This study was conducted in order to identify what type of software or applications would be particularly useful for people with autism or their families. Applications focusing on social, school and organisational skills were prioritised.

Use of digital tools

- **Clark, M. L., Austin, D. W., & Craike, M. J. (2015). Professional and parental attitudes toward iPad application use in autism spectrum disorder. *Focus on Autism and Other Developmental Disabilities, 30(3),* 174-181 (Paid access)**

This article looks at the attitudes of parents and professionals in relation to the use of the iPad by children with autism. Parents and professionals have a positive attitude towards digital tools, and in particular the iPad. Parents indicate that their children with ASD frequently use new technology.

- **Cumming, T. M., Strnadová, I., & Singh, S. (2014). iPads as instructional tools to enhance learning opportunities for students with developmental disabilities: An action research project. *Action Research, 12(2)*, 151-176.**

This is a research project organised by a computer specialist and five teachers concerning the use of the iPad with students with developmental disabilities. The experiment is described and the points of views of teachers and students are presented. Recommendations for the implementation of educational approaches with the iPad are issued.

- **Dale, O., & Grut, L. (2014). Mainstream ICT Can Support Children and Adolescents with ADHD and/or Autism in Their Everyday Activities. *Studies in health technology and informatics*, *217*, 679-684 (Paid access)**

This case study focuses on the use of technology by children with autism in everyday life (particularly the most commonly available technology in the family home). The study shows that digital tools help in everyday life, but that their implementation is not always easy, particularly in terms of configuring applications and addressing failures.

- **Fletcher Watson, S.: Technologies and autism: guidelines for parents**

Some advice was given to parents of children with autism that are dependent, or addicted to new technologies, in order to ensure that digital tools are used without their becoming a major problem. Other advice was given in terms of choosing the right digital tools based on a child's profile. For example, young children or children with intellectual difficulties will benefit even more from a touch interface than a traditional computer.

- **King, A. M., Thomeczek, M., Voreis, G., & Scott, V. (2014). iPad® use in children and young adults with Autism Spectrum Disorder: An observational study. *Child Language Teaching and Therapy, 30(2*), 159-173**

This study focuses on the use of an iPad with 6 children with autism. To do so, class sessions were filmed. It was noted that the use of applications is often counter-productive, particularly in an autonomous situation. The support role is therefore crucial.

- **Pas, E., Johnson, S., Larson, K., Brandenburg, L., Church, R., Bradshaw, C. (2016). Reducing Behavior Problems Among Students with Autism Spectrum Disorder: Coaching Teachers in a Mixed-Reality Setting. *Journal of Autism & Developmental Disorders. Vol. 46 Issue 12*, p3640-3652 (Paid access)**

This study uses the environment http://teachlive.org/

The article is particularly interesting because it focuses on the impact of virtual reality not directly on ASD students, but on their teachers. In fact, thanks to a simulation, the teachers are trained to take decisions in a virtual universe in order to manage behavioural difficulties of students with ASD. This research provides potential virtual reality solutions for training teachers to manage the difficulties that they encounter when teaching students with ASD.

- **Xin, J., Leonard, D.(2015). Using iPads to Teach Communication Skills of Students with Autism. *Journal of Autism & Developmental Disorders. Vol. 45 Issue 12*, p4154-4164 (Paid access)**

This article discusses the role of interactive devices such as telephones and digital tablets in developing communication among students with ASD. Training in the use of the tablet with their teachers and other students was conducted for a period of six weeks. All students progressed, and increasingly initiated requests thanks to the use of the tablet, both in and outside of class.

Additional resources

English

- **Autism Speaks**
- **Iautism.info**
- **Touch Autism**
- The DART (Development Autism Research Technology) **website offers reviews of apps for autistic people which are divided into 4 categories: Communication, Education, Life Skills and Fun.**

French

- Autism section of the **ORNA website**
- **Eric Greff compilation of autism applications**
- **Applications-Autisme**

This literature review was drafted in the context of the "Autism and New Technology" programme supported by the UEFA foundation for childhood and implemented by FIRAH.

This 3 year project is the fruit of a close collaboration with several European partners and is the opportunity to provide a scientifically validated perspective and information on the use of new technologies with children with ASD aged 2 to 18.

The objective of this literature review is to assess current knowledge in applied research on questions concerning the use of digital tools in assisting with non-verbal communication and social interaction among persons with Autism Spectrum Disorder (ASD).

This work does not aim to be exhaustive, but rather to identify research results and information that may be useful to field stakeholders in order to improve the quality of life and social participation of persons with disabilities.


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