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# EVIDENCE-BASED VIDEOGAME TO FOSTER INCLUSION OF PUPILS WITH ASD: A PRELIMINARY SYSTEMATIC REVIEW

# VIDEOGAME *EVIDENCE-BASED* PER FAVORIRE L'INCLUSIONE DEGLI ALLIEVI CON DISTURBO DELLO SPETTRO AUTISTICO: UN'ANALISI PRELIMINARE DI UNA REVISIONE SISTEMATICA

**Emanuela Zappalà**[1]
University of Salerno
ezappala@unisa.it

**Ilaria Viola**[2]
University of Salerno
iviola@unisa.it

**Paola Aiello**[3]
University of Salerno
paiello@unisa.it

## Abstract

Despite its impact, it seems that Perspective Taking (PT) has rarely been investigated in children and adolescents with Autism Spectrum Disorder (ASD; Cardillo, Erbì & Mammarella, 2020), whose social impairment may be associated with difficulties in perspective taking tasks, as suggested by Frith and de Vignemont (2005). Moreover, according to several neuroscientific research, PT is a fundamental prerequisite for social, empathic, motor and academic skills, as well as visuospatial working memory, perceptual learning and agency (Berthoz, 2006; Cardillo, Erbì, & Mammarella, 2020; Di Tore, Aiello, Sibilio, Berthoz, 2020; Sulpizio et al., 2015), and it may be promoted using edugames with a virtual avatar (Berthoz, 2015). Therefore, this investigation will survey the existing literature on PT and social skills of pupils with ASD to reflect on the potential to use evidence-based edugame to foster these skills and their inclusive potential.

Nonostante il suo impatto, sembra che il *Perspective Taking* (PT) sia stato raramente studiato in bambini e adolescenti con Disturbo dello Spettro Autistico (Cardillo, Erbì & Mammarella, 2020), la cui compromissione sociale può essere associata a difficoltà nell'assunzione di compiti di prospettiva, come suggerito da Frith e de Vignemont (2005). Inoltre, secondo diverse ricerche neuroscientifiche, la PT è un prerequisito fondamentale per le capacità sociali, empatiche, motorie e accademiche, nonché per la memoria di lavoro visuospaziale, l'apprendimento percettivo e l'agency (Berthoz, 2006; Cardillo, Erbì, & Mammarella, 2020; Di Tore, Aiello, Sibilio, Berthoz, 2020; Sulpizio et al., 2015) e può essere sviluppata utilizzando edugame con un avatar virtuale (Berthoz, 2015). Pertanto, il presente contributo esaminerà la letteratura esistente sulla PT e le abilità sociali degli alunni con Disturbo dello Spettro Autistico per individuare pratiche evidence-based che prevedono l'utilizzo di edugame per promuovere queste abilità e le loro potenzialità inclusive.

[1] Emanuela Zappalà is the author of paragraph "1. What is the evidence of promoting the learning process of pupils with ASD through technologies?", "2. Methods and materials" and "3. Results".
[2] Ilaria Viola is the author of "Introduction" and Conclusions".
[3] Paola Aiello is the scientific coordinator of the research.

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**Keywords**

Evidence-based practice; Autism Spectrum Disorder; Inclusion
Evidence-based practice; Disturbo dello Spettro Autistico; Inclusione

## Introduction

Pupils with Autism Spectrum Disorder (ASD) have deficits in communication and social interaction, obsessive and stereotyped behaviors, interests or activities (American Psychiatric Association, 2013), but also in Perspective Taking (PT) skill (Cardillo, Erbì & Mammarella, 2020; Hamilton, Brandley, Frith, 2009). This skill is pivotal to the development of several abilities related to school learning (Piaget, 1972; Vogely, Fink, 2003; Trisciuzzi & Zappaterra, 2014; Sibilio, 2014; Di Tore, Aiello, Sibilio, & Berthoz, 2020). It is a prerequisite for social skills development too. Therefore, a deficit in the area of PT is a vulnerability factor for the social, emotional and cognitive area, and it is related to phenomena of social exclusion, labeling and ostracism (Berthoz, 2021). In fact, it is crucial for managing interpersonal relationships, overcoming conflicts, increasing understanding and reducing prejudice towards members of other social groups (Corcoran & Mallinckrodt, 2000; Epley & Caruso, 2012, Van der Graaff et al., 2014).

Moreover, PT may be defined as the ability to manipulate space through gross motor and complex visuospatial skills that help "to put oneself in the shoes of others" (Berthoz, 2011) and considered fundamental not only to foster social skills and fostering inclusive processes, but it is also crucial for success in Science, Technology, Engineering and Mathematics (STEM; Cardillo, Lanfranci, Mammarella, 2018). Furthermore, studies show that it may be developed from 6 to 11 years old, and that children with ASD from 8 to 16 years old have more difficulty with the spatial perspective-taking tasks (Cardillo, Lanfranci, Mammarella, 2018).

The educational effects of a deficit in the area of PT require the adoption of strategies and tools that respond to the complex and transdisciplinary nature of the ability under examination. For this reason, it is important to adopt validated practices that encourage "strategic interaction" (Goffman, 1969) between educational figures and pupils, which help the teacher to "process complex situations very quickly, elegantly and effectively" (Berthoz, 2011, p.5).

As National and International guidelines invite to use early interventions in order to foster pupils with ASD development and learning process, and to select evidence-based practice (EBP), it is important to investigate on EBP that improve PT skills training specific tasks (Knoll & Charman, 2000; Di Tore, Aiello, Sibilio, & Berthoz, 2020). Therefore, researchers and educators should take this into account and adopt evidence-based practices, as suggested by the same guidelines, to improve PT skills as well. Berthoz (2015) and Gee (2013) suggest adopting videogames because they usually require the inhibition of one's point of view in favor of a digital avatar and critical and divergent thinking in order to advance in the game:

> "Many virtual games require the ability to change spaces with a mental agility that young people today seem particularly gifted with. We are constantly changing referents. To indicate this action. I will use the expression manipulation of spatial referents, as if it were a mental operation, and not a manual one [...] At school, the teacher has an opinion of the pupil, but he may also wonder what the pupil thinks of him. In the theater, the actor may wonder what the spectator feels. In social life we often change referents by taking others as our reference. Sometimes we have to adopt these different points of view simultaneously" (Berthoz, 2014, cap. 4).

To date, there are few tools that promote this skill (Di Tore, Aiello, Sibilio, & Berthoz, 2020) that usually exploit the potential of edugames that require one's perspective inhibition to put oneself in the shoes of an avatar (Berthoz, 2011). For this reason, this contribution collects and analyses studies that investigate how to improve PT using videogames as a learning tool and that are considered evidence-based-practices (EBP).

## 1. What is the evidence of promoting the learning process of pupils with ASD through technologies?

School inclusion of pupils and students with ASD may be considered an educational challenge (Frith, 1989) for teachers and scholars who deal with this and that need support to identify practices that may be effective. To address this need, several researchers are investigating the effectiveness of practices and on its feasibility, and both national and international guidelines suggest EBP that may be adopted in order to foster the development of several skills in different contexts. Along with it, there is increasing evidence of the value of technologies in supporting and improving the education and inclusion process (Higgins et al., 2012; Global Education Monitoring Report Team, UNESCO, 2020). As a matter of fact, there has been a greater interest in the potential of technologies and digital supports to promote a wide range of learning outcomes of pupils and students with ASD, during the last decades (Hume et al., 2021; Kim et al., 2018; Odom et al., 2021; Wong et al., 2015). These technology-assisted interventions (TAII) may be defined as "instruction or intervention in which technology is the central feature and the technology is specifically designed or employed to support the learning or performance of a behavior or skill for the learner" (Hume et al., 2021). The Autism Focused Intervention Resources & Modules (AFIRM) evidence-based practice overview of 20 studies published until 2014 on TAII for people with ASD (Hedges & AFIRM Team, 2018). The review shows that there are 11 single case design studies and 9 group design studies that employ innovation tools (smartphones, tablets, avatar assistants, virtual reality) and to support people with ASD to develop multiple skills. Only a few of these investigations adopt video games to foster pupils with ASD development, they usually involve high functioning people with ASD and computerized face-training programs to favor mind reading ability and emotion recognition.

Furthermore, the most recent systematic review conducted by Hume et al. (2021) describes a set of EBP that demonstrate positive effects with autistic children and youth. Among several articles published between 1990 and 2017, only twenty-eight may be considered EBP and two of them are TAII: the *FaceSay* (Hopkins et al., 2011) and *Mind Reading* (Golan, & Baron-Cohen, 2006). *FaceSay* employ a computer program with a realistic avatar assistant, whereas *Mind Reading* it's a game and both are designed to improve joint attention skill and to support children and adults with ASD (both low and high functioning) to interpret expressions of emotions and discriminating faces (Golan, & Baron-Cohen, 2006; Hopkins et al., 2011). These studies show good outcomes to enhance specific social skills and support other findings that confirmed how using computer-based training may improve emotion recognition and facial recognition abilities within controlled settings (Goldsmith and LeBlanc 2004, in Hopkins et al., 2011). In addition, other studies demonstrate the effectiveness of some educational and playful technologies to foster the full development and learning process of pupils and students with ASD (Grizpan et al., 2014; Hume et al., 2021; Odom et al., 2015; Steinbrenner et al., 2020; Zervogianni et al., 2020), also by enhancing and developing social, emotional, academic skills or adaptive behaviors (Bölte, Golan, Goodwin and Zwaigenbaum, 2010). Actually, using technologies, some people with ASD may minimize the difficulty to select the useful sensory stimuli and information needed in order to complete a task, avoid social demands, provide consistent and predictable responses, as well as increase motivation when playful as usually

are videogame; in addition, digital devices may give the teachers the possibility to individualize the task according to their pupils' abilities and cognitive preferences (Knight et al., 2013), their use may strengthen autonomy (Higgins and Boone, 1996).
Nonetheless, "the lack of research-based literature combined with the zeal of an appealing practice has led researchers to continue to debate the promises and limitations of technology for this population" (Knight, McKissick, & Saunders, 2013). According to Costantin et al. (2017), it may probably be due to a lack of autistic consumer involvement since digital supports are frequently developed in research projects.
Additionally, the selection of an EBP because of its effectiveness is not sufficient. Its adoption in educational contexts requires an accurate analysis of the context, a personalized training and, sometimes, also a specific adaptation of the practice itself on the basis of contextual and individual peculiarities of pupils with ASD (Fixen et al., 2005; Waligórska et al., 2019). For this reason, Fixsen et al. (2005), Cottini, Morganti (2015) and other researchers observe that it is crucial to translate research into practices by implementing and adapting the EBP to the peculiarities of educational and school contexts, to the singularity of pupils with ASD and promoting teachers professional development (Aiello 2020; Fixsen et al., 2005; Grynszpan et al., 2014; Hume et al., 2021; Knight, McKissick, & Saunders, 2013; Stahmer et al., 2018; Wong et al., 2015; Zappalà, Zierhut, Aiello, 2021; Zervogianni et al., 2020).
In addition, the reviews and other meta-analyses make no references on TAII or other practices published until 2017 that promote social and academic skills through developing perspective taking. To date, it seems there are no EBP that are TAII or that, as suggested by Berthoz (2011), adopt videogame to support PT development in pupils and adolescents with ASD and, consequently, as well as other skills, in multiple contexts. Considering that PT is impaired in children and adolescents with ASD and that it correlates with several abilities but also to performance on a false-belief task more studies are needed as these are crucial for mentalizing ability (Hamilton, Brindley, & Frith, 2009), social cognition (Frith & Vignemont, 2005) and mental rotation (Cardillo, Erbì & Mammarella, 2020; Hamilton, Brandley, Frith, 2009).

**2. Methods and materials**

Since previous synthesis show that there are no explicit references to EBP that may support the development of PT in pupils with ASD (Hume et al., 2021; Steinbrenner et al., 2020; Zervogianni et al., 2020), this contribution aims to investigate the existence of EBP that may promote PT and social skills development in pupils with ASD through videogames. To achieve the purpose, authors decided to do a preliminary systematic review adopting the PICO conceptual framework (Richardson et al., 1995). Furthermore, based on the suggestions of Hume's research group (2021) and Cochrane[4], this review followed four phases: searching, screening, data extraction and comprehensive review of the included studies (Davies, 2011; Hume et al., 2021; Richardson et al., 1995). The PICO conceptual framework will be used as it invites, those who need to identify EBPs, to pay attention to specific elements that are summarized through the acronym:

P - Patient or problem: main characteristics of the patient; problem or condition coexisting with a particular pathology.
I - Intervention: type of intervention /practice adopted.
C - Comparison: alternative interventions.
O - Outcome: expected outcomes or effects.

During the first phase, a literature search was conducted using nine international databases (ACM Digital Library, Educational Resource Information Center (ERIC), Google Scholar,

[4] It is suggested to get more information about Cochrane reviews and protocols browsing the following hypertext: https://www.cochranelibrary.com/cdsr/about-cdsr

Google trends, JStor, PubMed, Sage Journal, ScienceDirect, Scopus, Worldcat) using keywords related to the following macro-categories: Autism Spectrum Disorder, Perspective Taking, videogame, evidence. The articles considered were those published (or pre-published online) in a peer-reviewed journal until 20/03/2022.

In order to narrow down the search and retrieve all the bibliographic resources, exclusively referring to the aforementioned macro-categories, it was decided to use only the Boolean operator "AND". In addition, the systematic review process included the search for studies already published, peer-reviewed and full-text in English.
During the second phase, all duplicates were removed, the most relevant contributions were identified based on the analysis of the title and, subsequently, of the abstract.
Following this selection, the contributions were downloaded and further screened based on the inclusion and exclusion criteria (Tab. 1) defined according to PICO conceptual framework suggestions and the method used by Hume et al. (2021).

| **Category** | **Inclusion criteria** | **Exclusion criteria** |
|---|---|---|
| Literature | Articolo pubblicato (o pre-pubblicazione online) su rivista *peer-reviewed.* | Gray literature (thesis or doctoral thesis, proceedings, ...). |
| Language | English. | Other languages. |
| Design | Group experimental and single-case studies. | Systematic reviews, meta-analysis, scoping review. |
| Population/Participants (P) | People with a diagnosis of ASD from 0 to 16years old. | Participants with other comorbidities or whose age is not clearly identifiable. |
| Intervention (I) | Evidence-based practice that involve the use of videogame. | Medical or psychopharmacological interventions. |
| Comparison (C) | Exergame, Serious game e or another educational videogame. | Not digital games. |
| Outcomes (O) | Outcomes on Perspective Taking Studies that do not exclusively evaluate PT are included. | Parents or caregivers' outcomes of other abilities only. |

Tab. 1 Inclusion and exclusion criteria

All studies that met the inclusion criteria were independently analyzed by the authors and critically discussed in the conclusion of the analysis. The summary and analysis of the articles was summarized in a table structured as follows: (I) author / year of publication / title, (II) sample, (III) research objectives, (IV) type of videogame; (V) improvements or other significant results for the development of PT.

**3. Results**

The literature search produced one hundred contributions. These were found in only three of the nine databases. Following this finding, during the screening phase, the duplicates were eliminated (n. 3) and a selection of the contributions was then proceeded because of their relevance in relation to the title (n. 25 = relevant; n.72 = not relevant) and, consequently, to the abstracts (n. 11 = relevant; n. 12 = not relevant; n. 2 = not available for consultation).

During the third phase, data of each contribution were extracted, considering the inclusion and exclusion criteria previously explained. The extraction revealed that the studies were not eligible because they did not meet the criteria of the categories: research design, intervention, comparison, outcomes and participants. Therefore, the review shows that there are currently no EBPs that promote the development of PT through the use of video games.

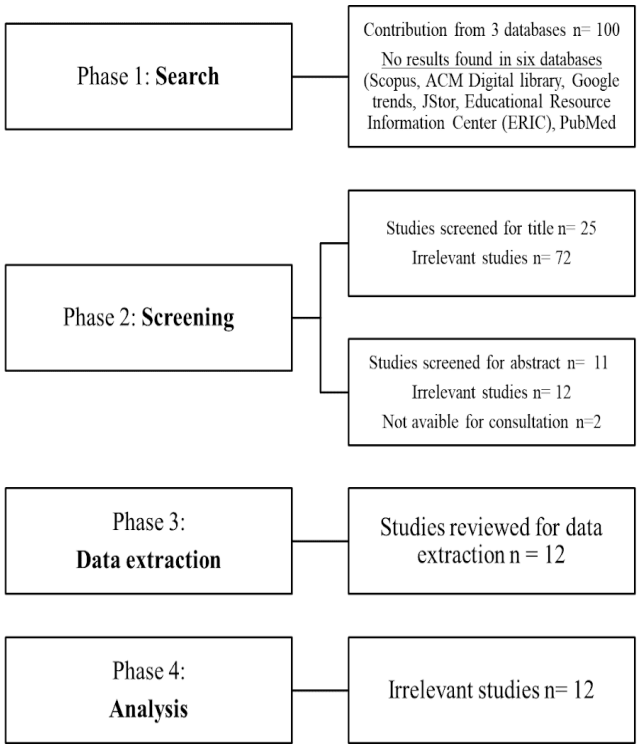

Fig. 1 PRISMA flow chart

Since no studies were available under these criteria, the lack of evidence in this field led to further investigations to identify gaps in knowledge (Gray, 2021). Although that, it is relevant to note that five of the studies excluded due to their design, participants characteristics and outcome, demonstrate a large interest of researchers and caregivers on the potential benefits of technologies to enhance people with ASD development (Dechsling et al., 2021; Malinverni et al., 2017; Silva et al., 2021; Tsikinas, & Xinogalos, 2020; Valencia et al., 2019). It seems that there is a lack of investigations on their feasibility for multiple people with ASD and within different contexts and it actually hinders the possibility to define some of these practices as EBPs, but it also paves the way towards future researches on the topic. Moreover, two investigations highlight the importance of evaluating videogame design decisions in order to proceed with the implementation of the game and to give pleasant experiences also to people with ASD (Costantin et al., 2017; Tsikinas, & Xinogalos, 2020). In particular, Tsikinas and Xinogalos (2020) cite an interesting study whose aim is that of designing educational technologies for children with ASD in order to develop multiple skills and perspective taking is among them (Parsons, 2015).

Parsons (2015) clarifies it is important to integrate a complex range of factors, including pedagogical and cognitive theories, the affordances of the technology, and the real-world contexts of use. Moreover, going in depth through the investigation Parsons shows how a game, named *Block Challenge*, may support children with ASD to collaborate with peers in order to develop communication and perspective taking skills. Since this study was not found during the preliminary systematic review, it is important to continue this investigation using other

Boolean operators (such as "OR") and adding other keywords to look for other practices that are used to develop or evaluate perspective taking skill for the same sample and investigate their effectiveness. Hence, further studies are needed to explore the possible implementation of those practices at school that could foster PT skills and improve social skills using video games.

## Conclusions

As the PT is crucial for the development of both academic, social skills and STEM competences, and that the National Recovery and Resilience Plan[5] (2021) highlight these are among the skills gaps to be developed, it is crucial to look for or develop EBPs that foster PT and, consequently, the other too. Studies shows the potentials of developing these skills through digital gaming and opening a reflection on the use of technology in teaching-learning interaction also for pupils with ASD. On one hand, literature shows the positive impact of technologies on the development of new forms of social interaction and motivation to learn (Higgins et al., 2012), on the other, researchers show some criticalities. Hattie (2009) and Tamim (2011) highlight a low influence of the use of educational technology on learning outcomes in school age and adolescence. The analysis shows that in the interaction between the learner and technology, the type of technology used is significant; hence, the role of the teacher, on selecting the appropriate tool, and the developer, to design and educational videogame considering the peculiarities of pupils with ASD, is pivotal.
Hence, teachers should identify tools capable of responding to individual needs to promote an education that harmoniously includes, in the training process, different cognitive potentials, diversifying the ways of access to knowledge (Sibilio, 2016). Moreover, it would be necessary to have appropriate knowledge and be guided to promote human-computer interaction and teaching-learning (Clark, Nguyen and Sweller, 2006; Hattie, 2009; Sibilio, 2020; Vivanet, 2013). It would require more implementation investigations to support teachers on acquiring knowledge and skills useful to adopt EBP in their educational context, but also to actively collaborate with researchers to adapt it to the peculiarities of their schools (Cottini & Morganti, 2015; Fixsen et al., 2005).
Before that, as the review found that there are currently no EBPs promoting PT development using videogames, further investigations would be useful by adopting other search terms and keyword relationships to identify effective video games for the development of this skill, expand the set of articles consulted and explore their possible implementation in schools. This need stems from the observation of a widespread interest in the potential of technologies for the development of different skills for children and adolescents with ASD (Hume et al., 2021).

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[5] The National Recovery and Resilience Plan (PNRR) was approved in 2021 to relaunch Italian economy after the COVID-19 pandemic. The PNRR provides for an investment of 222.1 billion € and reform package divided into six missions (Digitization, innovation, competitiveness and culture; Green revolution and ecological transition; Infrastructure for sustainable mobility; Education and research; Inclusion and cohesion; Health). For more information, please consult the following website: https://www.mise.gov.it/index.php/it/68-incentivi/2042324-piano-nazionale-di-ripresa-e-resilienza-i-progetti-del-mise

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