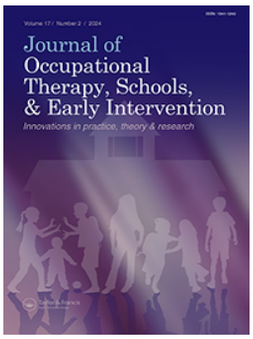

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TEAttention!: A pilot study of occupational therapy and virtual reality for improving school participation in children with autism spectrum disorder

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ABSTRACT

One of the environments that child with autism spectrum disorder (ASD) find particularly challenging is school, which has an impact on their involvement. Virtual reality (VR) could provide appropriate repetitive or difficulty-controlled experiences relevant for children with ASD, where the environment's constancy can be crucial to facilitating their adaptation and participation. This study aimed to explore whether an intervention called "TEAttention!" using a combination of a VR system and sensory processing strategies could be beneficial for improving participation in children with ASD in the school environment. The study used a pre- and post-intervention methodology. The participants were five students with ASD enrolled in a primary school. The Sensory Profile-2, unstructured observations and the System of Usability Scales were used. The TEAttention! program showed good usability for occupational therapists and teachers, and the children exhibited increased participation at school, improving their play, communication, and social relationships. VR could be a motivating and supportive component of therapies for children with ASD that could enhance their focus and comprehension of the sensory environment.

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KEYWORDS
Autism; occupational therapy; virtual reality; sensory processing; sensory profile; school; children

Introduction

Autism spectrum disorder (ASD) is characterized by persistent deficits in social cognition, which affect the initiation and maintenance of reciprocal social interaction and communication (Isaksson et al., 2019). People with ASD can show limitation to joint attention, following instructions and understand different points of view (Mundy, 2018). Also, they could find challenges in understanding and anticipating the actions that another person would be expected to perform in each situation (Isaksson et al., 2019; Mundy, 2018). Furthermore, ASD has been

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associated with restricted, repetitive, and inflexible patterns of behavior, interests, or activities (Hirvikoski et al., 2016; Isaksson et al., 2019). Children can exhibit restricted interests, spending hours on the same material, while others might have difficulties to maintain attention on a single focus, constantly shifting their focus from one object to another (Kodak & Bergmann, 2020). This may result in them observing details of objects without fully integrating them and without making functional use of them (Isaksson et al., 2019; Mundy, 2018). Additionally, these children show differences in sensory processing, which causes the stimuli to be perceived in an amplified way, showing hyperresponsiveness to them (Demopoulos et al., 2015, 2017; Siemann et al., 2020; Tomchek & Dunn, 2007). These characteristics can influence in areas of personal, family, social, educational, and occupational functioning, decreasing the quality of life of people with this diagnosis and their families (Baghdadli et al., 2014).

One of the environments that represents a significant challenge for children with ASD is school, impacting their participation (Hodges et al., 2020; Wuang et al., 2020; Zhai et al., 2023). This is due, on the one hand, to the difficulties that schools encounter in including children with special educational needs (Hodges et al., 2020; Nuske et al., 2019) and, on the other hand, to the individual characteristics of each child, which could make the school experience unpleasant (E. I. Williams et al., 2019).

There are a large number of information and communication technology (ICT) experiences based on assistive technologies for ASD, which have shown to be valuable supports for performing assisted activities (Wali & Sanfilippo, 2019; Zaniboni et al., 2021). On the other hand, the application of Virtual Reality (VR) - based experiences has recently attracted more attention. VR involves digitally generated representations that simulate real-world objects, responding to human actions (Mesa-Gresa et al., 2018; Shahmoradi & Rezayi, 2022). The features of VR enable simulation of the real world, allowing complete control of the environment and its stimuli. This is appropriate for repetitive or difficulty-controlled experiences that are relevant for children with ASD, where the environment's constancy can be crucial to facilitating their adaptation and participation. VR systems share with the rest of ICT the advantages of being useful tools for intervention, learning, and emotional control of people with ASD. The immersive environment facilitates experimentation in different facets that are necessary for the autism spectrum, such as social and emotional skills or everyday life skills (Mesa-Gresa et al., 2018; Shahmoradi & Rezayi, 2022).

This study aims to explore whether an intervention called "TEAttention!" using a VR system and sensory processing strategies is beneficial for improving participation in children with ASD in the school environment. The study hypothesized that children with ASD would improve their ability to direct their attention to relevant stimuli and enhance their participation in school after completing the TEAttention! Additionally, it was hypothesized that therapists and teachers would positively value the TEAttention! and the use of VR in the classroom.

Method

Design

This is a pretest-posttest quasi-experimental design pilot study with one group.

Participants

The sample consisted of four boys and one girl, all of them students from a primary school in Andalusia, Spain, who attended a specific classroom for children with ASD. The sampling method used was convenience sampling. Their ages were between 5 and 9 years old. According to DMS-5, all the children had a clinical diagnosis of ASD, at severity level 2, "requiring substantial support," characterized by marked deficits in initiating interactions or exhibiting reduced or atypical responses. They frequently experienced interference due to inflexibility and difficulties shifting attention focus and joint attention. The inclusion criteria were as follows: 1) children aged between 5 and 12 years; 2) have special educational needs; 3) be enrolled in the ASD classroom at school; 4) written informed consent obtained from parents. Children who did not obtain informed consent from their legal guardians or who did not want to participate were excluded.

Instruments and Measures

Assessment tools:

School Sensory Profile-2 (SSP-2)

SSP-2 was used (Dunn, 2016). The sensory profile is a questionnaire administered to teachers regarding how the child behaves in response to sensory stimuli. The SSP-2 could be applied from 3 years to 14:11 years. This instrument consists of 5 sensory sections: auditory, visual, tactile, movement, and behavior. It is scored from 1 to 4, with 1 "almost never or never" and 4 "almost always or always." It allows us to know how children react to different sensory stimuli in everyday life, showing if the child shows any of the following 4 sensory quadrants: 1) Avoider: when the child avoids or cannot deal with sensory stimuli in the environment; 2) Sensitive: when the child perceives more sensory information in everyday life; 3) Seeker: when the child searches for sensory information in the environment; and 4) Bystander: when the child does not perceive sensory stimuli at school. SSP-2 allows us to know the child's participation in school through four school factors. School factor 1 reflects the student's need for external help to participate in learning. School factor 2 reflects students' awareness and attention to the learning environment. School factor 3 shows the student's tolerance of the learning environment. School factor 4 allows us to know the student's willingness to learn in the learning environment. The internal consistency of the SSP-2 for the Spanish population is excellent (Cronbach's alpha = 0.87) and the retest reliability is between good and excellent (0.74 to 0.90) (Dunn, 2016).

Unstructured Observations in the Context of Occupational Performance

A tool based on the Riviére's Autism Spectrum Inventory (Inventario Del Espectro Autista: IDEA) (García Gómez, 2022; Riviére, 2002; Ventoso & Brioso, 2007) was developed by the occupational therapists who carried out the interventions to measure compliance with the objectives set for each session. It was designed considering the dimensional conceptualization of the spectrum in autism, according to the DSM-5 (instead of the categorical conceptualization of previous classifications) (Doernberg & Hollander, 2016), and the social and cognitive characteristics that might be observed in ASD from the point of view of development (García Gómez, 2022). The information collected was obtained from unstructured observations carried out in free play activities, movement in the class, and in the school garden and recorded taking into account the following six areas: 1) social relationships (i.e.: performs social smile; brings objects to adults); 2) communication (i.e.: establishes eye contact, responds to his name, follows instructions, responds to simple commands); 3) Play (i.e: shows symbolic play, uses toys correctly); 4) academic skills (i.e.; recognizes numbers and letters, skills to write, skills to read); 5) sensory-motor and neurological factor (i.e: exhibits ritualistic behaviors, overreacts to environmental stimuli, appears lethargic); 6) cognitive factor (i.e.: shows difficulty making transitions from one activity to another, shows the ability to self-regulate, imitates gestures). Each one of these areas was scored from 0 to 2, with 0 "rarely or never" and 2 "almost always or always." For areas 5 (sensory-motor and neurological factor) and 6 (cognitive factor), the lower the score, the better the performance.

System Usability Scale (SUS)

SUS is a tool used to assess the usability of a technological system, product, or service. It consists of 8 items related to the usability of the system. Users who have interacted with the system indicate the extent to which they agree or disagree with each of these statements using a five-point Likert-type response scale (1 = totally disagree and 5 = totally agree). One point is subtracted from the score indicated by the participants for odd items. In the case of even items, the value indicated by the participant is subtracted from the value of five. The new values obtained are added and multiplied by 3.125, which corresponds to the total score. A value ≥ 80.3 indicates that they loved the tool and would recommend it to their friends; values between 68 and 80.2 indicate that it is a good tool but could be better; a score < 51 indicates that usability is poor (Brooke, 1996; Grier et al., 2013). The internal consistency of the SUS for the Spanish population is excellent (Cronbach's alpha = 0. 96) (Sauro & Lewis, 2012).

Questionnaire About Teacher's Satisfaction

Finally, the teachers completed a questionnaire to determine their satisfaction with the program. It consisted of eight questions: 1) What is your overall satisfaction with the program on a scale of 0 to 10 ? 2) Do you think the program provides useful strategies for children? 3) Do you think the program provides useful strategies for teachers? 4) Do you think the program provides useful strategies for parents? 5) What did you like most about

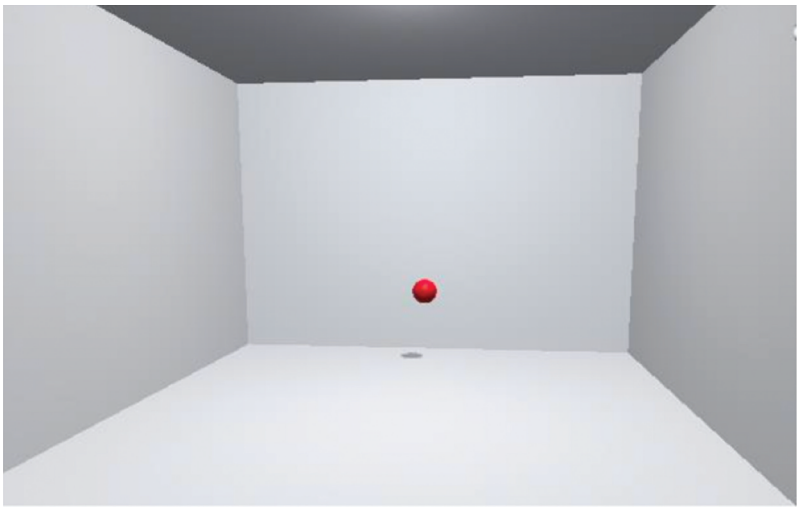

Figure 1. Tracking the red ball.

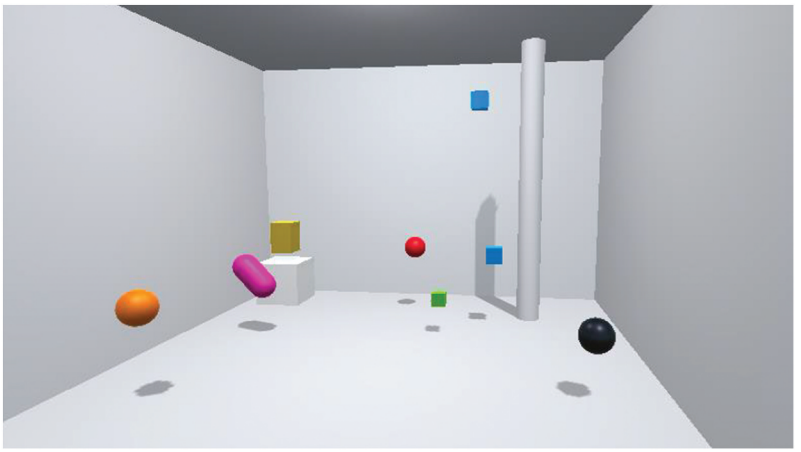

Figure 2. Tracking the red ball with distractors.

the program? 6) What was your negative aspect of the program? 7) Would you suggest any changes for future editions? 8) Do you have any other observations or comments?.

Intervention tools

VR System: TEAttention. TEAttention! It is a set of three independent applications developed as games with the aim of studying behavior and training basic attention activities with three different degrees of difficulty in children with ASD. Each application is designed to treat attention with a different degree of difficulty, with the first being the simplest, based on visual tracking of the movement of a sphere using a VR device (Figure 1). The second and, especially the third, present higher degrees of difficulty because they deal with attention problems in more complex systems that include various distractors (Figure 2) and simple reasoning and task resolution activities (Figure 3). These games are controlled solely with

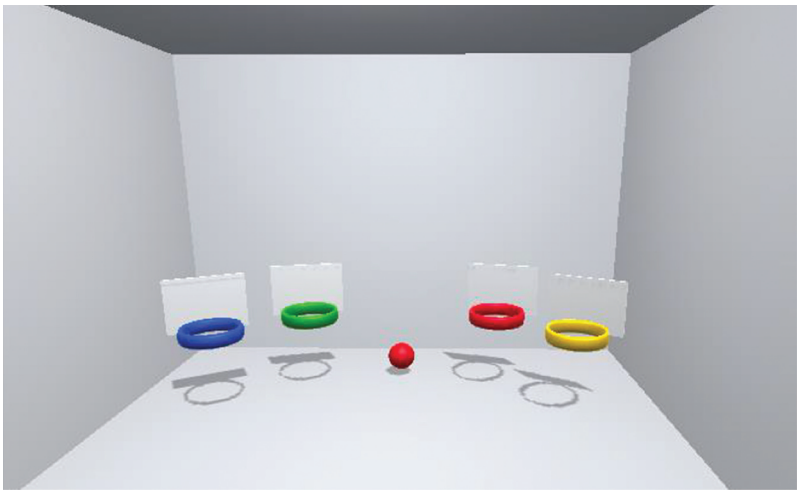

Figure 3. Where does each ball go?

your eyes, thus placing special emphasis on the objective of the games: focus attention and sustained attention.

Tracking the Red Ball. This game presents a white room with a single object, and a red sphere floating in space. This sphere will move smoothly through eight positions and will remain in each position for three seconds. After the last position, the sphere will pass through the ground and reappear in the first position. If the child orients his head properly to look toward the sphere, the sphere will stay in a central position, it will change color using a gradient from red to blue, and relaxing music will be gradually played. If they stop looking at the dial, the color will return to red, and the music will be muted. This application aims to keep the child's attention on the sphere for as long as possible. The sphere uses the colors red and blue because they are two of the three basic colors of the visual spectrum, which are used in different centers to attract the attention of children. The gradual change in color is used to make the child notice that something is happening when looking at the sphere. The first movement the sphere makes is to cross from the top left, in front of the user's view, to the bottom right, to maximize the chances of visually contacting the sphere (Figure 1).

Tracking the Red Ball Using Distractors. This game consists of a more difficult variation of the previous one in which several objects of different colors (distractors) have been added with uniform movements. The direct operation remains the same as that in the previous application. The distractors present in the space are as follows:

- Green Cube: orbits the player with a wide radius.
- Blue cubes: they orbit a column at different heights.
- Orange sphere: represents a rotation with a small radius on the X-axis.
- Black sphere: represents a rotation with a small radius on the Y-axis.
- Pink capsule: rotates on itself along the Y-axis.

- Yellow cube: rotates on itself in all three axes simultaneously.

The objective is identical to that of the first application, except that having distractors (objects that can distract the child's attention) around the room makes this task more difficult and complex. Each object that has a different movement has an equally different color, thus associating each color with a specific movement. This design gives more weight to the fact that the sphere to be looked at is the only red element, which is animated with a different movement than the rest of the objects (Figure 2).

Where Does Each Ball Go? The third game changes the dynamics used until now and considerably increases the difficulty. This app shows a white room with four different colored baskets and the previous red sphere on the floor. When looking at the sphere, it begins to follow the player's view in a smooth movement. If the child puts the sphere in the basket of his color (in the first case it is red), it will stop following his gaze and fall to the ground. When it hits the ground, it disappears and reappears in its original position with a new color to repeat the action. The objective is for the child to be able to associate the colors of the spheres and baskets with the action of scoring. The two previous applications have taught the child to look at the red sphere, so the object to be used could not be, for example, a basketball. It must be the sphere that he already knows, and it must first be red because it is the color that has been presented to him as the objective to look at (Figure 3).

Procedure

The TEAttention! program is a sensory-based intervention that uses discrete sensory experiences or environmental modifications to facilitate behavior regulation (Case-Smith et al., 2015; Miller-Kuhaneck, 2015) through different types of sensory information.

Children with ASD show difficulties in modulation (Bundy & Lane, 2020). To address them, the TEAttention! program considers sensory-based principles, to provide enhanced sensations, enabling children to self-regulate their level of arousal, attention, affect and actions. This approach is grounded in Ayres' theory of sensory integration (Bundy & Lane, 2020). Like the Alert program (M. S. Williams & Shellenberger, 2011, 2012), our program begins with the most basic level of biological self-regulation, with sensorimotor regulation (M. S. Williams et al., 2020), focusing on the touch, move, look, and listen. It is based on the principle that enhancing sensorimotor self-regulation improves cognitive, emotional, and behavioral regulation. In this context, the TEAttention! program acknowledges that self-regulation is the ability to attend to, sustain, and adjust the arousal level necessary for engaging in school activities. In addition to the tactile, proprioceptive, and vestibular (Benson et al., 2019; Garland, 2014; Piller & Pfeiffer, 2016; Worthen, 2010) information that is traditionally used in this type of interventions, the TEAttention! program also uses visual and auditory information through VR glasses, as previously described.

TEAttention! Program has the following objectives: 1) to improve the scholar participation of ASD children; and 2) to encourage socialization and play among peers; 3) to promote communication skills between children with their classmates, teachers, and occupational therapists; and 4) to facilitate tools for a collaborative practice among occupational therapists and teachers.

A meeting was held with the teaching team to present the project, the objectives, evaluations required by the teachers, and planned dates, as well as to introduce the people

in charge of conducting the study. Subsequently, a virtual meeting was held with the children's parents. Once parental permission and acceptance were obtained, the study was initiated. The role of occupational therapists in this program was to encourage and maximize student participation while supporting their well-being (O'Donoghue et al., 2021; WFOT, 2016). All sessions were delivered by two occupational therapists specialized in childhood, in the children's usual classroom, together with two teachers. Therefore, TEAttention! can be framed within a collaborative practice model (O'Donoghue et al., 2021).

TEAttention! program consisted of 12 sessions on Fridays, from 12:00 to 13:00, considering the security measures of COVID-19. Two of these sessions were to perform the initial and the final evaluation, respectively and consisted of completing the sensory profile of each child by the teachers and conducting unstructured observations by the occupational therapists. The remaining ten sessions were used for the intervention. Compliance with the objectives of each intervention session carried out by the occupational therapists was recorded. The structure of the intervention sessions was as follows: 1) first, pictograms were presented that anticipated the activities that were going to be carried out (Miller-Kuhaneck, 2015); 2) sensory strategies were used to facilitate regulation and reach an optimal state of alert (Brack, 2004; Garland, 2014; Miller-Kuhaneck, 2015); 3) group activities were carried out that also had sensory components, for example, doing a puzzle together and having to look for the chips in a container with rice (Brack, 2004; Garland, 2014; Miller-Kuhaneck, 2015). Regarding VR activities, while one child used the VR glasses, the others stayed seated in chairs arranged in a "U" shape in the classroom so that everyone could observe their peers' activities. While one occupational therapist explained, supported, and modeled the participation of the child who was doing the VR activity, the second occupational therapist, together with the teachers, supported the other children so that they learned to wait their turn. As each child was performing the activity with the glasses, the occupational therapist who was with him/her could monitor on a computer screen what stimuli the child was attending, providing feedback if necessary. For example, for task one (Figure 1), if the occupational therapist observed difficulty starting the activity, the child was told "*red ball, where is the red ball*?" (Figure 4). Feedback at the end of the activity was simple, for example, "*Very good*." To change the turn with other child, it was vocalized: "It's Daniel's turn." The fact that all the children observed how their classmates did the activity and they took turns, served as a model for them. All the activities were brief, 3–5 minutes each, given the time that these children could maintain their joint attention on the activity and avoid possible disruptive behaviors.

In order to know how the children performed while participating in the activities to learn to regulate their attention with VR, a sheet with a series of items was designed to record whether the child: 1) used the glasses according to the instructions or not; 2) looked and paid attention to the target visual stimulus; 3) asked for or needed help to start, perform or finish the activity; 4) showed perseverations in performing the activities; 5) seemed calm; 6) following the rules; 7) enjoyed or showed enthusiasm when putting on the glasses (for example, verbalizing that they wanted to put them on, or smiling when it was their turn to put them on). Each item was scored 0 (almost never or never) or 1 (almost always or always) (Figure 4).

Figure 4. Example of procedure with virtual reality tasks.

Each session ended with the same song, allowing the children to anticipate its end. In each session, the reason for each of the interventions was explained to the teachers, in what aspects they promoted the children's self-regulation, inviting them to practice some activities to facilitate their performance during the day school. The activities of each of the sessions were sent weekly to the parents so that they were aware of the proposed objectives, the activities carried out, and the implementation of the project.

Once finished the TEAttention! program, the occupational therapists and the teachers were asked to fill in a technology usability questionnaire (SUS) to determine whether they found the VR activity useful and easy to use and whether they would like to use VR glasses in future interventions.

Statistical Analysis

Descriptive frequency statistics for sex, mean and standard deviation for age, and quantitative variables were used. Because of the small sample size, the exact Wilcoxon signed-rank test was used to determine the differences in means before and after the intervention (Dwivedi et al., 2017). The values of the mean and standard deviation are reported since they are better understood. However, we want to indicate that when using non-parametric statistics and the Wilcoxon rank test, the median is also reported. The reliability of SSP-2 and unstructured observations was calculated using Cronbach's alpha. All statistical analyses were performed using SPSS software version 27. The level of statistical significance for all analyses was set at a p-value <.05.

Results

No statistically significant differences were found in any of the variables measured in SSP-2, but it should be noted that there were marginal significances for School Factor 1 of SSP-2 ($Z = -2.03$; $p = .063$), which refers to the need for external help that students need to participate in learning. After the intervention, it was also observed that children showed better awareness of the school environment (Factor 2), better tolerance to the learning environment (Factor 3), and a better willingness to learn (Factor 4). Likewise, it was observed that children showed lower scores in search behaviors and avoidance of sensory stimuli, especially in visual, tactile and movement stimuli, indicating more adaptive behavior in the classroom for learning (Figure 5). Regarding the internal consistency of SSP-2, a Cronbach's alpha value of .768 was obtained.

In addition, no statistically significant differences were found in any of the variables measured in the Unstructured Observations, although for "Play" it was marginally significant ($Z = -2.06$; $p = .063$). It was observed that following the intervention, the children demonstrated improvements in their communication, social interaction, and play. Additionally, they exhibited fewer difficulties in academic, sensorimotor, and cognitive skills (Figure 6). A Cronbach's alpha value of .722 was obtained for the Unstructured Observations.

The results of the virtual tasks are shown for four children; one of them did not attend the sessions. The simplicity of the proposed activity allowed the children to follow the game correctly, except for subject 1, who expressed rejection of the use of glasses. The rest calmed down with the games, and with the music when it played when achieving the objective of maintaining their gaze and following the red ball.

Teachers showed great satisfaction with the activity, on a scale of 1–10, where 10 was the maximum satisfaction, indicating that her satisfaction was 9. Teachers also indicated that the program provides useful strategies for them and for children and families. Likewise, what they liked most what the liked most about the program was: "*the organization and how it has been adapted to the students in the classroom*."

The SUS showed a mean score of 85, with good usability for occupational therapists and teachers. In particular, because it appeared to them that the children would quickly learn to play and that they would like to play again, it was easy to handle, and it was a comfortable game for children with ASD.

Discussion

According to the standards proposed by the American Occupational Therapy Association for School-based occupational therapy, the TEAttention! occupational therapy program aims to prepare children for and participate in meaningful learning and development activities within the school environment (Clark et al., 2004). The main objective of this study was to develop a tool through VR and to explore whether occupational therapy intervention could be useful and beneficial in improving the self-regulation of attention and participation of children with ASD in school. Sensory needs in children can have a detrimental impact on their academic achievement, their ability to stay paying close attention and engaged in the classroom, and their daily functioning (Worthen, 2010). Other studies that have used sensory strategies in the school setting have also shown positive effects to improve attention in the classroom (Parham & Mailloux, 2015, Bagatell et al., 2010), especially with therapy ball in ASD Children which

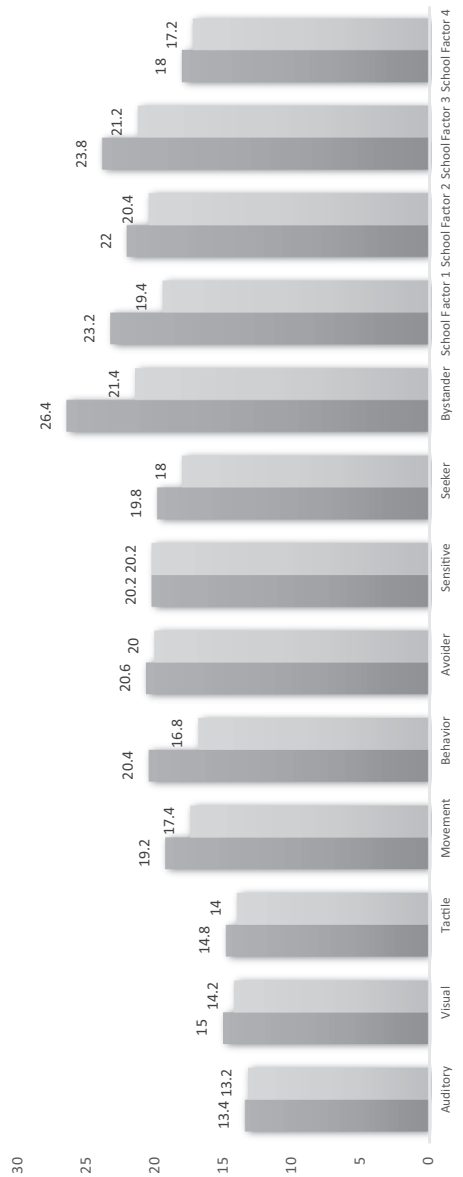

Figure 5. Scoring changes in school sensory profile-2 (SSP-2).

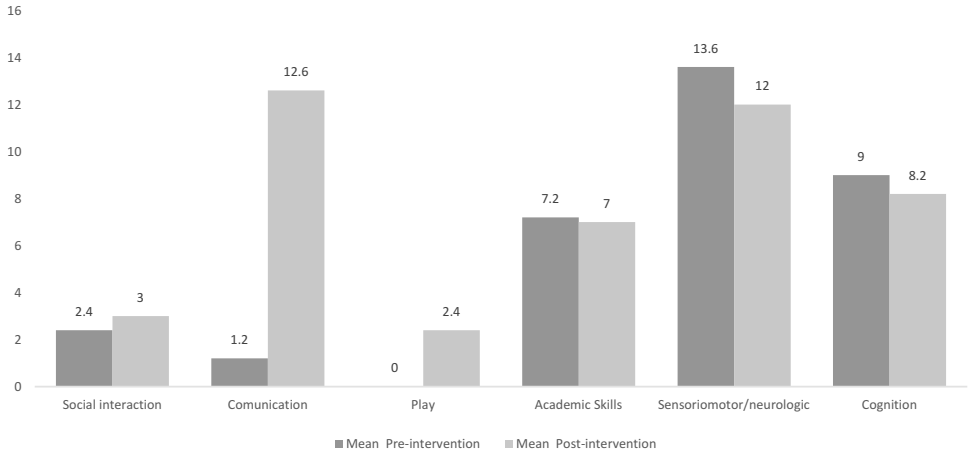

Figure 6. Scoring changes in unstructured observations.

showed a strong vestibular -proprioceptive sensory seeking (Bagatell et al., 2010). Similarly to other studies (Benson et al., 2019; Worthen, 2010), the results obtained after the intervention of the TEAttention! program in a specific classroom for children with ASD showed changes in the students' need for external help to participate in learning (Dunn, 2016). Therefore, these preliminary results could support the collaborative practice of occupational therapy intervention to facilitate the school inclusion of these children (Lynch et al., 2023). The four school factors of the SSP-2 reflect teachers' perspectives on students as learners in their classrooms, evidencing how the student can be successful or challenged within the learning environment (Tomchek & Dunn, 2007). The results showed marginally significant differences in School Factor 1 of SSP-2, suggesting that children would have reduced the need for external help to participate in learning, being able to internalize certain strategies or behaviors that allow them to be regulated (Hodges et al., 2020; Romero-Ayuso et al., 2022). As can be observed, the teacher's experience recognizes the usefulness of occupational therapy intervention in the classroom with children with ASD (de Oliveira Borba et al., 2020; Lynch et al., 2023; Romero-Ayuso et al., 2022), which supports collaborative interventions (Lynch et al., 2023).

The maintenance of the same structure of the intervention sessions and the use of pictograms were considered within the TEAttention! program. Possibly, the repetition of identical opening and closing activities in each session could be linked to the observation that, during the fourth session, when a child saw the therapists arriving at the classroom, prepared the chairs, and sat down waiting for the beginning of the activity. In addition, two children said "boot" or "ball" anticipating that it would be the first activity that they would carry out (Figure 4). Furthermore, when the final song was introduced to close each session, disruptive behaviors that occurred when finishing and preparing to leave or go to the school-dining room decreased (Keifer et al., 2021).

In our study, the value obtained for Cronbach's alpha for the SSP-2 was lower than that reported in the validation study for the Spanish population indicated in the SSP-2 manual (Dunn, 2016), although it can be considered as good. Likewise, the value obtained on the internal consistency of unstructured observations showed a good result, although lower than the value indicated in other studies that also used an adaptation of the IDEA inventory

(García Gómez, 2022; García-López & Narbona, 2014), which could be due to our small sample size.

Considering the results obtained in the unstructured observations, the TEAttention! it could be beneficial for improving the play of children with ASD. After the program, the children would have a greater playful repertoire and interests in different games than at the beginning of the program, and repetitive behaviors have decreased. These results could support the usefulness of occupational therapy programs in the field of ASD (de Oliveira Borba et al., 2020; Lynch et al., 2023; Romero-Ayuso et al., 2022). The use of similar games using VR to help modulate visual attention in children with ASD during school occupational therapy intervention could be a new line of study.

One of the objectives of the program was "to encourage socialization and play among equals." The interventions conducted in each session tended to achieve a sensory balance that would then allow activities to be performed between the children, promoting social skills, communication skills, shared activities and games between the five children, such as building something together, building a puzzle, pass a ball, etc (Hilton et al., 2010). In the case of children with ASD, it is necessary to generate these strategies "from the outside" either with activities or modifications in the environment and promote their awareness so that, to the extent possible, they know how to identify what things benefit them and what prevents them from participating and what they can do to regulate their behavior. The results would suggest that these types of activities could be useful in improving their communication skills and social behaviors in the classroom (Gentil-Gutiérrez et al., 2021; Zhai et al., 2023).

Furthermore, it was found that the design of the three games for children with ASD with VR to improve their attention was rated very useful by the occupational therapists, and the program was rated very satisfactory by the classroom teachers. Therefore, TEAttention! could be a new tool for the intervention with children with ASD to analyze and evaluate the behavior and abilities of users. The use of VR could be a motivating and complementary element in interventions in children with ASD to improve their attention and understanding of the sensory environment.

The combination of sensory strategies with the use of VR could help improve attention modulation. Play is an area of occupational performance (Reilly, 1974; J. Sterman et al., 2020; J. J. Sterman et al., 2020), which can be developed both in the school environment and in other performance contexts, which usually requires cognitive, communicative, and social skills. The fact of being able to appreciate subtle changes in these three dimensions could be of interest and encourage the development of experimental studies in this area.

Several limitations should be considered when interpreting the results. These data must be read with caution due to the small sample size, so it should be increased in future studies. Second, the type of sampling used in the study was convenience, although this type is useful in exploratory studies like this (Piller & Pfeiffer, 2016). Another limitation is the use of a non-standardized questionnaire based on the IDEA subscales. Finally, the children have not been followed up over time to determine if the results obtained were maintained over time or if they improved only during the process in which the intervention was conducted.

Conclusion

Based on these preliminary findings, the "TEAttention!" program suggests that it might be of interest to continue investigating the usefulness of incorporating VR into occupational

therapy interventions at school, as well as to investigate whether children with ASD could improve their attention, social relationships, understanding of the sensory environment and participation in play activities related to school.

Research Ethics and Participants Consent

To conduct the study, approval was obtained from the Research Ethics Committee of the University of Granada (Andalusia, Spain) and the participating institution. Informed consent was also obtained from the legal guardians of each child through the IPasen App of the Andalusian Government. The professionals who carried out the project presented the certificate of "Crimes of a sexual nature" established by law 26/2015 of July 28 of the Government of Spain to work with minors, to check they did not have a criminal record for sexual offenses. Organic Law 7/2021, of May 26, on the protection of personal data processed for prevention, detection, investigation, and prosecution of criminal infractions and execution of criminal sanctions, was also considered.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

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