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Social cognition interventions for adolescents with autism spectrum disorder. A systematic review

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ABSTRACT

Introduction. Early intervention during childhood in patients with Autism Spectrum Disorder (ASD) has been strongly advocated. As adolescence is reached, new, more complex social demands emerge. These demands require a therapeutic approach that has not been widely studied. The aim of this review is to examine and synthesize the existing literature on social cognition interventions in adolescence and lay the groundwork for future interventions.

Methods. Searches were conducted in the PubMed, PsycINFO, and Web of Science databases up until April 20, 2023. Quantitative or qualitative research aimed at examining the influence of social cognition-focused interventions in the treatment of ASD in adolescence, in either English or Spanish language, was included. Quantitative and qualitative studies were evaluated using a modified version of the Newcastle-Ottawa Scale and the Critical Appraisals Skills Programme checklist, respectively.

Results. Nineteen original studies that met the inclusion criteria were selected. The selected studies included a total of 916 patients. The average duration of the interventions was 13.28 weeks. They were categorized into group-based social skills interventions, experience-based interventions, and computer-mediated interventions.

Conclusions. The scarcity of social cognition interventions specifically designed for adolescents with ASD is striking. The neuroplasticity window between puberty and the transition to adulthood provides an opportunity for structural and dynamic functional reorganization. Therefore, adolescence is a unique developmental stage that is amenable to specific interventions.

Keywords. autism spectrum disorder; social cognition; adolescents; intervention; systematic review.

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RESUMEN

Introducción. La intervención temprana durante la infancia en pacientes con trastorno del espectro autista (TEA) ha sido fuertemente promovida. Al alcanzar la adolescencia, aparecen nuevas demandas sociales más complejas. Estas demandas precisan nuevamente un abordaje terapéutico, que no ha sido tan ampliamente estudiado. El objetivo de esta revisión es examinar y sintetizar la literatura existente sobre intervenciones en cognición social en adolescencia, y sentar las bases para futuras intervenciones.

Método. Se realizaron búsquedas en las bases de datos PubMed, PsycINFO y Web of Science hasta el 20 de abril de 2023. Se incluyeron investigaciones cuantitativa o cualitativa dirigida a examinar la influencia de las intervenciones centradas en cognición social en el tratamiento del TEA en adolescencia, en lengua inglesa o española. Los estudios cuantitativos y cualitativos se evaluaron utilizando una versión modificada de la Escala de Newcastle-Ottawa y la Critical Appraisals Skills Programme checklist, respectivamente.

Resultados. Se seleccionaron 19 estudios originales que cumplieron los criterios de inclusión. Los estudios seleccionados incluyeron a un total de 916 pacientes. La duración media de las intervenciones fue de 13,28 semanas. Se categorizaron en intervenciones en habilidades sociales basadas en grupos, intervenciones basadas en la experiencia e intervenciones mediadas por ordenador.

Conclusiones. Resulta llamativa la escasez de intervenciones en cognición social diseñadas específicamente para adolescentes con TEA. El intervalo de neuroplasticidad entre la pubertad y la transición a la edad adulta brinda la oportunidad de mejorar la reorganización estructural y funcional dinámica. Por tanto, la adolescencia es una etapa de desarrollo única y susceptible de intervenciones específicas.

Palabras clave. Trastorno del espectro autista; cognición social; adolescentes; intervención; revisión sistemática.

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INTRODUCTION

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by deficits in social communication, the presence of restricted interests, and repetitive behaviors¹. The World Health Organization (WHO) estimates the international prevalence of ASD to be 0.76%. It represents approximately 16% of the global child population², with most diagnoses made during the preschool years². ASD occurs in all racial, ethnic, and socioeconomic groups, but its diagnosis is more frequent in Caucasian children ².

In the DSM-V, the diagnostic concept of a "spectrum" was created by combining the separate diagnoses of pervasive developmental disorder (PDD) and pervasive developmental disorder not otherwise specified (PDD-NOS) into a single category. Additionally, severity level descriptors were added to help categorize the level of support needed.

In addition to the core symptoms, these patients often present a variety of medical, developmental, behavioral, or psychiatric problems that impact their daily functioning and quality of life³. Treatment approaches for ASD may include intensive behavioral therapies, medication, educational programming, or speech/language, occupational, and physical therapy⁴. Early intervention has been strongly advocated to align with the limited postnatal neuroplasticity timeframe, but it is insufficient. As adolescence is reached, new, more complex social demands emerge, such as acquiring autonomy from parents, and success in fulfilling these tasks predicts adaptive functioning in adulthood (5). It is estimated that 30% of children with ASD experience functional difficulties when they reach these pubertal changes⁶.

Adolescents with this disorder are more likely to experience symptoms of anxiety due to significant social and communication deficits², heightened sensory sensitivity⁷, and difficulty regulating emotions^{2,8}. Therefore, a second key objective occurs during this stage of development⁹. This new area of intervention is highly promising, as the onset of puberty triggers a hormonal cascade that stimulates numerous structural and functional changes in the brain¹⁰. Changes occur in networks that involve regions implicated in thinking about mental states, observing faces and their movements, applying social knowledge, and understanding others' actions and emotions^{13,14}. Adolescence is a period of experience-dependent socio-affective learning and neuronal plasticity^{11,12}, manifested as improved regulation of emotional reactivity and greater social understanding.

Adolescents with ASD face difficulties in the multidimensional construction of social cognition, delineated

as four critical and partially overlapping domains: emotion processing, social perception, theory of mind/mental state attribution, and attributional style/bias¹⁵. Social cognition interventions (SCI) have increased, but they are generally designed for children or adults. Therefore, the aim of this review is to examine and synthesize the existing literature on social cognition interventions, laying the groundwork for future research.

MATERIAL AND METHODS

To achieve the objectives of this review, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Statement recommendations were followed^{16,17}.

STUDY SELECTION CRITERIA

The inclusion criteria for the studies were as follows: (1) quantitative or qualitative research aimed at examining the influence of social cognition-focused interventions in the treatment of autism spectrum disorder in adolescents, (2) publications in English or Spanish language, (3) participation of adolescent population, and (4) randomized clinical trials. The exclusion criteria were: (1) review articles and meta-analyses, (2) articles that included patients with diagnoses other than ASD and did not separate the results based on such diagnoses, (3) studies with patients who did not meet the DSM or ICD criteria for ASD diagnosis, and (4) studies that included patients from other age groups and did not separate the results based on years.

SEARCH STRATEGY

Searches were conducted in the PubMed, PsycINFO, and Web of Science databases up until April 20, 2023. The search strategy employed in each of these databases was as follows: "autis*" AND "social cognition" OR "attributional style" AND intervention. Gray literature was also searched, and the references of selected articles were manually reviewed.

STUDY SELECTION PROCESS

This process was carried out in 4 phases. First (article identification phase), the results from the searches in the 3 databases were merged, and duplicate articles were removed. Second (screening phase), the titles and abstracts of the articles that potentially met the inclusion criteria were read. If there were doubts, the full text of the doubtful article was reviewed. Third (eligibility phase), the preselected articles from the previous phase and the doubtful articles were independently examined and read in full. Lastly (inclusion phase), the articles included in this systematic review were definitively selected. This process is depicted in Figure 1.

Figure 1 Flow diagram of study selection – adapted from the diagram template provided by PRISMA



Own elaboration

DATA EXTRACTION PROCESS FOR EACH STUDY

The following information was extracted from the selected articles: (1) Author(s) and year of publication, (2) country, (3) sample size, (4) age range, (5) treatment duration, (6) control group, (7) type of treatment received by the patients, and (8) conclusions. These results are presented in Table 1. The quantitative studies were evaluated using a modified version of the Newcastle-Ottawa Scale (NOS)¹⁸. Using the NOS, we assessed the representativeness and sample size of the study. The selected quantitative studies were considered to have a low risk of bias (\geq 3 points) or a high risk of bias (<3 points). The qualitative studies were evaluated using the Critical Appraisals Skills Programme checklist¹⁹.

RESULTS

Nineteen original studies that met the inclusion criteria were selected. The selection process for these studies is presented in Figure 1. The main characteristics of these studies are summarized in Table 1. The selected studies included a total of 916 patients. Based on the available data (19 studies), the average duration of the interventions was 13.28 weeks. Most of the studies were conducted in the United States (US), totaling 7. The study design and key findings are presented and analyzed below, categorized into group-based interventions, experience-based interventions, and computer-mediated interventions²⁰.

Group-based Social Skills Interventions

In recent years, group-based social skills interventions have significantly increased, and their implementation has been facilitated. These groups vary in content, teaching strategies, and intensity, but are often framed within cognitive-behavioral therapy.

Several reviews were found in the search that employed these therapies for ASD in adolescents, such as Wolstencroft et al.²¹, but they were not randomized clinical trials. Thirteen studies that met the inclusion criteria were identified. In all cases, the patients had a verbal intelligence quotient > 70 or its equivalent. Six studies described implementations of PEERS (Program for the Education and Enrichment of Relational Skills), one of the few evidence-based programs available for adolescents with ASD. Other applied programs included the Multimodal Anxiety and Social Skills Intervention (MASSI), Social Skills Group Training (SSGT; "KONTAKT"), and SOSTA-FRA (Social Skills Training Autism-Frankfurt). An additional study employed a multifamily group psychoeducation approach (Transitioning Together) designed for families of individuals with ASD during the transition to adulthood. The most recent research implemented a school-based intervention program.

PEERS utilizes cognitive-behavioral therapy principles to teach real-life social problem-solving skills, assess social and emotional contexts, and initiate and maintain conversations. It also includes structured practical interactions during socialization activities, and parents attend sessions to learn how to manage situations with adolescents. Laugeson *et al.*²² found that there was an improvement in social skills and responsiveness that persisted over time. Schohl *et al.*²³ conducted their research by applying PEERS along with additional measures of social anxiety and problem behaviors. They also concluded that there was improvement and a reduction in social anxiety and core symptoms of ASD.

Table 1	Characteristics of the selected studies.						
First author and year of publication	Country	N	Age range (years)	Term (weeks)	Control group	Inter- ventior	n Results
Cheung <i>et al.</i> (2020)	China	74	6-14	10	AE	G	Improvement in children's social interaction in the home environment, community and school.
Choque-Olsson et al. (2017)	Suecia	13	8-17	12	AE	G	Improvement in social responsiveness, general clinical severity, and adaptive functioning.
DaWalt (2018)	EEUU	41	14-17	8	LE	G	Significant improvement in parents' depressive symptoms.
Fage <i>et al.</i> (2018)	Francia	29	12-17	12	TDI, AE	С	Improvement in social interactions.
Freitag <i>et al</i> . (2016)	Alemania	209	8-19	14	TH	G	Improve socio-adaptive behaviors and social response at school.
Hochhauser <i>et al</i> . (2017)	lsrael	36	12-18	6	TH	E	Improvement in the capacity for social interaction.
lreri <i>et al.</i> (2019)	Kenya	40	5-21	n/a	TH	G	Significant improvement in the severity of core symptoms of ASD and social anxiety.
Jonsson <i>et al</i> . (2019)	Suecia	50	8-17	12	AE	G	Improvement in behavior, functioning, and perceived stress in relation to social interactions.
Laugeson <i>et al.</i> (2012)	EEUU	28	12-17	14	TP	G	Improves your knowledge of social skills, responsiveness, and general social skills in the areas of social communication, social cognition, social awareness, social motivation. Reduces mannerisms typical of ASD. Increase the frequency of interactions between classmates.
Matthews <i>et al.</i> (2018)	EEUU	44	13-17	20	TP	G	Significant improvement in knowledge of social skills. Minor improvements in knowledge of autism and loneliness
Olivar-Parra <i>et al.</i> (2011)	España	20	12-17	9	NT	E	Improvement in the complexity of the messages issued
Rabin <i>et al</i> . (2018)	Finlandia	41	12-17	16	TP	G	Improvement in their social skills, greater participation in social encounters, greater empathy, and greater knowledge of social skills
Schohl <i>et al.</i> (2013)	EEUU	58	11-16	14	TP	G	They improved their knowledge of friendship and increased the number of social gatherings. Their levels of social anxiety decreased. symptoms and problem behaviors before and after PEERS
Shum e <i>t al</i> . (2018)	China	72	12-15	14	TP	G	Significant improvement in knowledge of social skills and social functioning. Reduction of mannerisms typical of autistic people
Silver&Oakes (2007)	Reino Unido	22	12-18	12	LH	С	Improved recognition of emotions.
Strickland <i>et al</i> . (2013)	EEUU	22	13-19	4	NT	E	Improvement in significantly more effective verbal content skills
Vernon <i>et al.</i> (2018)	EEUU	40	12-17	20	LE	E	Improvement in the social preparation of adolescents
White <i>et al</i> . (2013)	EEUU	30	12-17	20	LE	G	Improvement in the social deterioration typical of ASD. Non-significant improvement in social anxiety
Yoo <i>et al.</i> (2014)	Corea del Sur	47	12-18	14	TP	G	Significant improvement in knowledge of social skills, interpersonal skills and play/leisure skills. Reduction of depressive symptoms and cardinal symptoms of ASD

Note. N = number of patients; AE= Standard Atention LE= Waiting list; TDI= DI patients and Tablet; TH= Usual treatment; TP= control group with subsequent treatmentt; NT= Not treatment; LH= Usual lessons; G= Group-based Social Skills Interventions; C= Computer-based Interventions.; E = Experience-based Interventions.

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One challenge in the implementation of PEERS is the use of the Test of Adolescent Social Skills Knowledge (TASSK), a self-report measure created by the developers of PEERS, Laugeson *et al.*²⁴, to evaluate test outcomes. Therefore, it would be interesting to measure the application of skills in a real and novel situation. In the case of Matthews *et al.*²⁵, they compared peer-mediated PEERS (PwP) to a group with the standard program. The findings suggest that there is a modest advantage over the traditional approach in improving social skills and social functioning. The Hebrew, Chinese, and Korean adaptations were carried out through randomized clinical trials by Rabin *et al.*²⁶, Shum *et al.*²⁷, and Yoo *et al.*²⁸, respectively.

Cheung *et al.*²⁹ implemented a school-based social cognition intervention program. It was originally designed by a Canadian group³⁰. The results were very promising, showing significant improvements in social interaction of patients at home, school, and in the community, enhancing their linguistic and non-verbal skills.

The Multimodal Anxiety and Social Skills Intervention (MASSI) was developed due to the high comorbidity between ASD and social anxiety disorder and the evidence that ASD-related relational problems may have an underlying anxious background³¹. This intervention combines cognitive-behavioral therapy strategies with specific and individualized content selected by the therapist. White *et al.*³¹ conducted their intervention in adolescents with ASD with moderate or severe anxiety symptoms. The results suggest that the improvement is due to the intervention targeting core social deficits rather than anxiety symptoms. Ireri *et al.*³² adapted this scale in a special educational setting in Kenya, providing more sessions focused on skill practice and also involving teachers. They achieved significant improvements in social impairment related to the condition and anxiety.

SOSTA-FRA (Social Skills Training Autism-Frankfurt) is a group-based social skills intervention based on cognitivebehavioral therapy developed in Germany. It combines computer-assisted social learning methods to teach and practice social skills. Freitag *et al.*³³ conducted a study in which significant improvement was achieved compared to standard treatment. Additionally, a significantly important improvement was found between therapy response and intelligence quotient.

Swedish intervention KONTAKT or SSGT (Social Skills Group Training) includes social skills exercises and discussions on social cognition, interaction, and self-concept. Choque-Olsson *et al.*³⁴, through their clinical trial, compared the effectiveness of this intervention to standard therapy, observing that sex and age may moderate the effects of

this therapy. Jonsson *et al.* (2018) conducted the extended version, with 24 sessions instead of 12, and obtained promising post-treatment results that were maintained over time. This indicates that the efficacy of this therapy may be related to its duration.

Transitioning Together is a multifamily group intervention designed to improve social functioning in adolescents with ASD and assist families in coping. DaWalt *et al.*³⁵ found significant improvements in adolescents following the treatment, as well as in parental depressive symptoms. However, it was found that intelligence quotient could influence the results and should be considered as a moderating variable.

The most recent research by Cheung et *al.*²⁹ in 2020 evaluated the efficacy of a school-based social skills intervention for children with autism in Hong Kong. They employed a program based on theory of mind with visual support. The patients included in the intervention group showed significantly greater gains in theory of mind and social skills, both at home and in the community and school settings. The improvements included the use of more expressive language and more positive social behaviors, better social interactions with parents and family members, and exhibited enhanced play skills. This improvement was also subjectively perceived by the parents.

Experience-based Interventions

The opportunity to practice social skills acquired by individuals with ASD in the real world is very limited. Additionally, there is the issue of peer rejection. Therefore, the START program (Social Tools and Rules for Teens), designed by Vernon *et al.*³⁶, consists of an immersive socialization intervention focused on improving motivation, knowledge, and social skills in a club-like environment. This helps learning through experiential and interactive lessons. The results of the intervention were very promising, showing improvements in the social preparedness of these adolescents.

Strickland *et al.*³⁷ evaluated JobTIPS, an online tool designed to improve job interview skills. This intervention includes virtual reality practices with avatars remotely controlled by an experienced therapist. This trial demonstrated significant improvement in the verbal content of responses and improvement in non-verbal language.

CONTACT (Conflict Orientation and Negotiation Training Among Children and Teens) is a computerized application developed by Hochhauser *et al.*³⁸. It aims to improve conflict negotiation strategies in adolescents with ASD through self and others' videos. Observing their behavior in videos allows learning and improvement through imitation. These difficult-to-handle conflict situations can be managed in a less adversarial manner. Significant improvements were found in self-confidence, communication factors, and willingness to engage in cooperative negotiations.

Both interventions, JobTIPS and CONTACT, employ new technologies as a platform to create a real-life scenario in which individuals can develop and improve their skills, which is why they have been included in this group.

The Spanish group led by Olivar-Parra *et al.*³⁹ designed the Referential Communication Training Program. Additionally, this trial stands out as one of the few in which participants were not excluded based on their IO. This intervention addresses the ability to select and organize information in a communicative exchange for individuals with ASD. The results showed a significant increase in message complexity.

Computer-based Interventions

New technologies offer the possibility to expand and complement therapies for improving social skills. This approach is interesting as it allows for limiting external stimuli and providing consistent and predictable responses. We have previously mentioned the CONTACT program, but despite the opportunities offered by this approach, there are not many studies addressing this topic in adolescents with autism.

To promote the inclusive education of adolescents with ASD in regular classrooms, Fage *et al.*⁴⁰ tested an intervention using tablets and the School+ app. As a result, significant improvements were obtained in sociocognitive functioning measures that were maintained over time. Silver & Oakes⁴¹ employed the computer program "The Emotion Trainer" with positive results in recognizing emotions in drawings, but not in individuals.

Fages *et al.* found that the control group of individuals with ASD did not show significant and sustained improvements in sociocognitive functioning over time. However, these improvements were observed in both the ASD and intellectual disability (ID) cases equipped with tablets, with a greater statistical effect in the former. At the beginning of the intervention, there was an improvement in the socio-adaptive level of the autism cases compared to ID, which was not maintained at 3 months. Only individuals with ASD equipped with tablets showed better performance in the socio-adaptive condition across the three dimensions of the l'Échelle Québécoise de comportements adaptatifs (EQCA-VS): social skills, academic skills, and leisure. The

study by Silver & Oakes⁴¹ found that the number of times the patient used the program correlated significantly with improvements in the score of recognizing emotions in drawings and Strange Stories but not in facial expression photographs.

DISCUSSION

The main objective of this systematic review was to examine and synthesize social cognition-based interventions for adolescents with ASD in the existing literature. Additionally, as secondary objectives, we aimed to provide data on their properties.

Adolescence is a period of change during which social demands increase and become more complex. Appropriate interventions improve functioning in adulthood³. The neuronal plasticity present during this time allows for improvements in emotional reactivity regulation and greater social understanding¹². It is important to implement these types of interventions during adolescence to improve both cardinal symptoms, such as anxiety, and promote appropriate integration into adulthood.

In our review, interventions were classified based on whether they were group-based, experience-based, or computer-mediated. Approximately 70% employed groupbased interventions based on cognitive-behavioral therapy. It is striking to note the scarcity of computer-mediated interventions, with the most recent one dating back to 2018. Similarly, the limited number of validated programs and the absence of new approaches development are noteworthy. The ease of access to virtual reality platforms could be an alternative for creating remote interactions between patients and clinicians with less time and resource requirements. The application in these realistic environments enhances the ecological validity of the programs. Technology, on the other hand, is very attractive to adolescents, potentially reducing rejection of these interventions and improving adherence⁴². It also allows for individualized implementation.

The most of SCI have been designed for individuals without intellectual disabilities, which means that approximately one-third of individuals with ASD are excluded. Certain research suggests that both intelligence quotient and sex have a moderating effect on the outcomes of these interventions³⁴. Therefore, these individuals require further investigation.

This review has several limitations. Among the most notable are small sample sizes and heterogeneity of designs, limiting the generalizability of the results. These limitations may be due to time and resource constraints. Several trials including adolescent populations were excluded because the intervention was not specifically focused on this age group. Most therapeutic advancements are targeted towards the pediatric population, and therefore, an extension to adolescents is made. At times, results have not been differentiated by age groups. Given the higher prevalence in males than females, the samples are predominantly male.

CONCLUSION

Among the findings of our review, the scarcity of social cognition interventions specifically designed for adolescents with ASD stands out. The neuroplasticity window between puberty and the transition to adulthood allows for improvements in the dynamic structural and functional reorganization of susceptible neurons¹³. Therefore, adolescence is a unique developmental stage, and it is justified to consider specific variables in treatment.

There are substantial potential areas for advancement in development. Several promising areas have been identified that warrant further research. Long-term follow-up of participants would help assess the duration and generalizability of therapeutic achievements. Technology-based interventions can not only improve treatment acceptance but also allow for remote access to effective interventions.

Therefore, the development and validation of social cognition-based interventions specific to the adolescent population are highly interesting. Collaboration between different centers, preferably of international origin, is crucial for the early and effective development of these interventions.

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