



Interventional practices for social deficits in ASD: A systematic literature review

Práticas interventivas nos déficits sociais no TEA: Uma revisão sistemática da literatura

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ABSTRACT

Autism Spectrum Disorder, which is characterized by repetitive, stereotyped behavioral patterns, restriction of interests, impairments in communication and social interaction, is a neurodevelopmental disorder with an undefined etiology. The present study aims to analyze the practices used for social deficits in autism in order to verify their effectiveness.

Methodologically, this is a systematic review of the literature, in the following databases: PubMed, LILACS and SCIELO, using the following descriptors: "Social skills" and "Autism" and "Autism" and "Intervention". A total of 934 articles were found, and 17 were selected for analysis, based on the analysis of the inclusion and exclusion criteria, and quality assessment by the Pedro Scale. The articles were analyzed qualitatively, through which the mean score was obtained 8, which indicates an adequate methodological quality for inclusion in this study. In conclusion, there is a massive use of behavioral interventions that seek to complement the interventions already used, aiming to enhance the results achieved, and a gap found is the absence of studies aimed at individuals with a higher level of support in ASD.

Keywords: Autism, Social deficits, Autism social skills.

INTRODUCTION

According to the Diagnostic and Statistical Manual of Mental Disorders (DSM-V), the essential characteristics of autism spectrum disorder are persistent impairments in reciprocal social communication and social interaction and restricted, repetitive patterns of behavior, interests, or activities. These symptoms are present from early childhood and limit or impair

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daily functioning (APA, 2014).

In this way, we have social interaction that encompasses language as persistent deficits in autism, which according to the literature, is linked to the skills associated with social cognition, which is characterized by the theory of mind. This ability consists of the recognition of the emotional state of the other, as well as the understanding of pragmatic constructs, which contribute to low performance in social skills (Maranhão; Pires, 2017).

Deficits in interaction with peers in ASD are associated with impairments in verbal and non-verbal communication, therefore, investigating and understanding the development of socio-affective cognition in ASD, based on the theory of mind and its implications, allows us to understand the fundamental resources that build a social life and understand others. Thus, well-targeted interventions, along with early diagnosis, are described in the literature as predictors of a good prognosis (Makiyama; Da Silva; Rodrigues, 2021).

The etiology of autism is not yet well defined, but the genetic paradigms of neurological dysfunctions and environmental factors, where external events such as chemical poisoning affect the intrauterine development of the fetus, are the main accepted theories (Fada; Curry, 2016).

Rizzolatti (1996) emphasizes the existence of a neurological substrate known as mirror neurons, which play the role of mirroring not only actions but also emotions. Our ability to reproduce these actions or emotions, whether through visualization or a verbal description, allows us to replicate other people's experiences. It is on the basis of these mirror neurons that we learn complex cognitive functions such as empathy, recognition of others, and modeling. However, individuals with autism have dysfunction in the cortical connections of their brain, with well-defined social interaction deficits (Da Silva Raposo; Freire; Lacerda, 2015).

Recent studies point to significant data on the growth of ASD diagnosis in several countries. Especially in socioeconomically vulnerable communities, the screening process is one of the points of difficulty because it is not systematized and global, causing eventual failures that make appropriate intervention impossible (Salgado; et al, 2022). Both in children and adults with late diagnosis, constant updates and revisions of the literature on the subject are necessary, as we currently have a lack of information/or management in several contexts, especially in schools that hinder inclusion (Fonseca, 2022).

One of the main signs of the presence of the disorder is the occurrence of social communication failure, which brings several losses to individuals. Thus, it is necessary to seek appropriate interventions based on scientific evidence to support the teaching of social skills. The present study is a systematic review with the objective of explaining the effectiveness of



interventions aimed at improving cognitive deficits in the autism spectrum, as well as identifying how neuroscience has advanced and its contribution of these constructs, which interventions are used and how much they impact social cognition.

CONSIDERATIONS ON THE DIAGNOSIS OF ASD.

The first mention of autism in the literature dates back to 1943, when Leo Kanner described and named the condition as "autistic affective contact disorders." It was based on observations from a case study of 11 individuals. Kanner identified an "inability to relate" that presented itself early in development. He observed repetitive motor dysfunctions, resistance to change and an insistence on monotony. Aspects of verbal and nonverbal communication, such as echolalia and confusion with pronouns, were also affected. During the 50's and 60's there was confusion about the etiology of autism, in which mistaken beliefs of causes linked to the parents, judged as emotionally distant from their children, then emerged hypotheses of the "refrigerator mother" that were disseminated over the years, however, such conceptualizations were refuted. In 1978 there was a classification by Michael Rutter who advocated a definition based on four criteria: 1) social retardation not only with the function of "mental retardation"; 2) communication dysfunctions; 3) unusual behaviors, stereotypies, and motor mannerism; and 4) age criterion starting before 30 months to 6 years of age (Klin, 2006).

The diagnostic criteria for autism have undergone numerous changes over time, being described by nosological categorization of manuals, that is, based on a categorization of signs and symptoms presented according to an individual age line. The main ones are the Mental Diagnostic and Statistical Manual (DSM) and the International Classification of Diseases and Related Health Problems (ICD), which came into force in 1980 (Maranhão; Pires, 2017).

The nosological manuals present distinction in nomenclatures, codes and characteristics for the purpose of diagnosing diseases. Its main change in the area is the abandonment of the psychoanalytic bases, where they attributed the origin of the disease to traumatic events with a focus on the structures of the personality, entering into force the biomedical model, with the grouping of signs and symptoms in a categorical way. Thus, using a multiaxial approach, it considers the organic dimension and external and social factors on behavior (Maranhão; Pires, 2017).

The DSM-V (2014) presents Autism Spectrum Disorder as a series of persistent deficits in a dyad in social interaction/communication, such as deficits in emotional reciprocity and in both verbal and non-verbal communication, and standard behaviors that can be drivers of



repetition as well as inflexibility in routine and interests, which are restricted. The severity will be based on the impairments present in the various areas of the individual's life, always having as a factor to be considered the previous life history, which covers from the beginning of the presentation of signs and symptoms to the current context.

ASD may have the following comorbidities: intellectual disability, concomitant language impairment and association with some medical condition, genetic or environmental factor and differential specifications, such as Rett Syndrome, which is characterized as a disruption in social communication between the first years of life, with progressive improvement in social communication no longer meeting the criteria for the nosological classification of autism (APA, 2014).

There are three levels of support based on the specificities of each case, it is qualified according to the support that the individual needs according to the differences in behavioral and social communication impairments. Level 1 is configured as "requires support" in communication. Despite having the ability to speak in complete sentences, there are notable impairments since there is difficulty in initiating and maintaining social interaction. In behavior, they have inflexibility, interfering in the functioning in one or more contexts, such as problems for the organization (APA, 2014).

Level 2 "requires substantial support", the individual has significant deficits in verbal and non-verbal communication, can speak simple sentences, but in a manner limited to their focal interests. In behavior we have repetition/restriction with the existing inflexibility in a marked way. At level 3, the individual has severe language deficits, may have incomprehensible or few-word language, and difficulty initiating social interactions. In behavior, there is repetition/restriction in a way that compromises general functioning as well as inflexibility in change, causing suffering (APA, 2014).

The ICD-11 (2018), in its most recent update, points out that autism spectrum disorder is characterized by the existence of deficits in the ability to initiate and maintain interaction and social communication in a reciprocal way, which persist throughout the individual's development and concomitantly there is a repetitive series of restricted and inflexible patterns in behavior. The interests or activities that the individual focuses on are atypical and occur in excess for the individual's age group and sociocultural context. In this way, the damage caused is serious and can significantly interfere in the social, educational, personal and work areas. These characteristics are present in a widespread way in the individual functioning of those affected in all the contexts in which they are inserted, although there are variations depending on the



sociocultural characteristics of their experience.

Through the revision of the transition from ICD-10 to ICD-11, there were pertinent changes with regard to signs and symptoms in ASD. Language functionality becomes central to the diagnosis to the detriment of structured language, i.e., the functionality of pragmatic communication becomes the focus of the process. As well as the subdivisions where intellectual disability becomes a criterion for subdivision, framed as autism with or without intellectual disability, therefore the different diagnoses will be based on the levels of impairment of these cognitive abilities. Rett syndrome was excluded because it did not meet the criteria for autism after the new review, but remains classified as a neurodevelopmental disorder (Fernandes; Tomazellit; Girianelli, 2020).

Although the etiology of autism is not fully defined, the genetic and environmental paradigms are the most accepted theses in the scientific community in general, therefore, the sets of environmental factors that are associated with chemical exposures of toxins, infections during pregnancy and complications in the neonatal period, are linked to genetic ones, causing a neurological dysfunction that interferes with brain functioning. Therefore, its main objective is to demonstrate the interaction between genes and environmental factors in order to understand the neural network that produces the behavior of autistic people (Fada; Curry, 2016).

BROKEN MIRRORS IN TEA.

The construction of culture takes place through the ability of human beings to transfer their knowledge to others. This skill has been honed over the years and is understood as social cognition. Between the aspects of replication coexists a very complex and refined ability of our species, the ability to adopt another person's point of view, known as theory of mind. In this sense, we have four essential phenomena for the reproduction of knowledge and, consequently, for the perpetuation of the human species at an intellectual level: culture, language, learning and imitation. These phenomena, which are configured as interdependent, potentiate rational life (Da Silva Raposo; Freire; Lacerda, 2015).

In pioneering studies, Rizzolatti et al. (1996) discovered for the first time in the premotor cortex of a monkey (area F5) the existence of a specific type of neurons (mirror neurons) that were activated every time the monkey performed a motor action or when it observed an individual performing a similar action. Based on this finding, it has been hypothesized that imitation transforms an observed action into an internal motor representation of that action (Khalil et al., 2018).



In ASD, most individuals have a deficit in the development of cognitive processing called "Theory of Mind". This causes a difficulty in inferring the mental state, ideas, feelings of others, and understanding from the point of view of other individuals. Thus, there are impairments in the comprehension and mentalization of these processes, such as the comprehension of non-literal constructs, which impairs the ability to represent goals (Makiyama; Da Silva; Rodrigues, 2021).

The theory of "broken mirror neurons" has received attention in the literature regarding possible connections between autistic traits and discrepancies in mirror neuron (MN) function. It is hypothesized that the dysfunction of mirror neurons is one of the factors responsible for the weakening of TOM (Theory of Mind) in individuals with autistic traits and is linked to the interpretative neurocognitive theory of social and communication impairments in ASD (Andreou; Skrimpa, 2020).

The impoverishment of the acquisition of theory of mind causes limitations in the attribution of meanings to emotions due to the difficulty of identifying the mental states of other individuals. The brain areas do not communicate effectively mainly in the prefrontal cortex and temporal lobe, so the deficits in these areas may explain the perceptual, emotional and cognitive dysfunctions in autism, which makes individuals unable to easily express their feelings, making it necessary to intervene aiming at social and self-perceptual skills in order to generate learning so that they perceive and recognize such feelings (Makiyama; Da Silva; Rodrigues, 2021).

Studies have shown the relationship between the activation of mirror neurons and the development of theory of mind, which contribute to the severity of autistic symptoms (Maranhão; Pires, 2017). The activation of mirror neurons occurs through the observation of the action, thus allowing the observed meaning to be understood automatically, which may or may not occur consciously. This enables a comprehensive understanding of phenomena through higher-order cognitive mechanisms. This activation can also occur through forms of communication, whether verbal or non-verbal. This function is directly linked to the learning of skills such as reading, theory of mind, and social interaction. Thus, this dysfunction of imitation linked to mirror neurons present in autism spectrum disorder could be directly linked to the genesis of ASD (Geremias; Abreu; Romano, 2017).

According to the literature, there are two types of mirror neurons that are made up of two networks that make up the brain: the mirror motor neurons responsible for motor actions essentially related to imitation, and emotional mirror neurons responsible for converting visceromotor responses arising from emotional behaviors, that is, they are responsible for the recognition of primary emotions, as well as more complex cognitive constructs, such as



symbolic representations of empathic behavior, values, beliefs, and awareness of the feelings of others, so there is the emotional "mirroring" of other individuals (Da Silva Raposo; Freire; Lacerda, 2015).

According to Lameira, Gawryszewski and Pereira Jr (2006):

Autistic behavior reflects a picture compatible with the failure of the mirror neuron system. The understanding of actions (essential for taking action in dangerous situations), imitation (extremely important for learning processes) and empathy (the tendency to feel the same as a person in the same situation feels, which is fundamental in the construction of relationships) are functions attributed to mirror neurons and it is exactly these functions that are altered in autistic people (Lameira, Gawryszewski, Pereira Jr, 2006, p.130).

Dapreto et al. (2006) conducted a study using the Functional Magnetic Resonance Imaging technique, aiming to analyze the possible dysfunctions in the activation of mirror neurons in 20 children aged 12 years. The participants were divided into two groups: a group of 10 children diagnosed with ASD, with high-functioning children diagnosed with Asperger's syndrome (level 1 support according to the update) and 10 with typical development for their age.

In the study, 80 pictures of people who showed five different emotions were presented: sadness, anger, fear, happiness and neutrality. Each figure was displayed at a time of two seconds randomly in the presence of null stimuli, such as blank screens with crosses, to provoke fixation at eye level. In two separate machines, the children were asked to imitate the expressions after observing the stimuli. The results revealed that both groups performed well, however it was observed that children with ASD did not demonstrate the activation of mirror neurons in some areas of the brain such as the inferior frontal gyrus (area related to language), so this research resulted in the understanding of some dysfunctions in this system that may be the basis for the impairment of social behaviors. the hypothesis was supported by the assessment tools the ADOS-G (Observation Scale for the Diagnosis of Autism) and the ADI-R (Interview for the Diagnosis of Autism, revised version). Research in this field is still scarce in the national scenario, but it is of fundamental importance to explore in order to conceive new possibilities for more assertive interventions (Da Silva Raposo; Freire; Lacerda, 2015).

SOCIAL SKILLS AND EXECUTIVE FUNCTIONS IN ASD

One of the first concerns of caregivers of autistic children is the development of communication and social interaction. Studies have shown the impairment of executive functions, linking this condition to the development of the "theory of mind" (Bosa; 2001).



Executive functions comprise a set of skills that work in an integrated way, allowing the individual to direct his/her behavior and goals, analyzing the efficiency and adequacy of these behaviors (Maranhão, 2014). Among these skills, we have planning, which consists of a complex operation in which a sequence of planned actions is evaluated, monitored and updated according to the context and its eventual changes in the environment. Inhibitory control is the ability to inhibit responses to distracting stimuli that may interrupt ongoing responses. Cognitive flexibility is the ability to alternate between different thoughts or actions in line with the context or environment. Working memory is a temporary information storage system that allows the manipulation of a certain amount of information to perform present actions, such as problem solving (Bosa; Czermainkic; Salles, 2013).

It is often questioned that in order to perform adequately in theory of mind, it is essential to have executive functions as a foundation, or whether they are involved in the conceptual development that makes it possible to understand the representation of the mind. The research done in this area is dissonant, however, it is necessary to advance in the issues of brain functioning in a systemic way, as the complexity and dynamism of the constructs are necessary to understand the ontogenetic neurodevelopment of neuropsychological functions (Maranhão, 2014).

Children on the autism spectrum have difficulties in social management, which can lead to social isolation from peers. This lack of assertiveness in social interactions is linked to the dysfunction in the dynamics required in the contexts of the theory of mind (Maranhão; Pires, 2017). According to Rao, Beidel, and Murray (2008), deficits in the socialization of children with Asperger's syndrome (Level 1 support according to the new update) begin as early as preschool age, in which a lack of social skills results in a distinction among their typically developing peers. In adolescence, these deficits persist and can result in rejection and ridicule by the group, in addition to the difficulty of sharing affective experiences to develop friendships and social reciprocity. In adulthood, there may be an improvement in aspects of social isolation, but deficits in social skills persist. The neurophysiological dysfunctionality of individuals with ASD leads to changes in social and emotional behavior abilities. These deficits in social skills are aggravated by multiple factors, including behavioral rigidity, cognitive functioning, language expressiveness, and severity of stereotyped behaviors (CARVALHO; 2012). It is hypothesized that the impairment of executive functions, such as a deficit underlying autism, is based on the behavioral dysfunction of individuals with cortical, prefrontal impairments. These characteristics were subsequently proven by the results of the performance of individuals with autism on tests designed to measure executive functions, such as the Wisconsin Card Sorting Test in 1981



(Sella; Brook; 2018).

METHODOLOGY

This is an exploratory applied research that uses the systematic literature review method, following the guidelines of the PRISMA method (Main Items for Reporting Systematic Reviews and Meta-analyses) (Liberati et al., 2009). In order to answer the following research question: What interventions are used to improve social cognition in autism? And the following guiding questions: How much do interventions improve social cognition in ASD? How has neuroscience helped improve social cognition in autistic individuals?

For this review, a search was used based on secondary sources in the electronic databases: PubMed (National Library of Medicine of the United States), LILACS (Latin American and Caribbean Health Sciences Literature) and SCIELO (Electronic Scientific Library Online). The choice of databases occurred as a result of the great notoriety and great use by the scientific community in general. During the searches, the Boolean operator "AND" was used in the combinations of the descriptors in English and Portuguese: "Social skills" and "Autismo" ("autism") and "Autismo" ("autismo") and "Intervention" ("intervention").

The inclusion criteria were: clinical trials, articles available in full in the databases or in printed versions, in English and Portuguese, doctoral or master's theses, and studies of interventions with autistic individuals, with a time frame of 10 years, which have been approved by the scientific community. The exclusion criteria did not include: studies that were 10 years old, studies that were not fully available in the databases, studies that did not address similarity functions, studies that did not detail practical experiments carried out to test their hypotheses, articles from theoretical or bibliographic reviews, and articles that did not present the diagnosis of autism in a clear way.

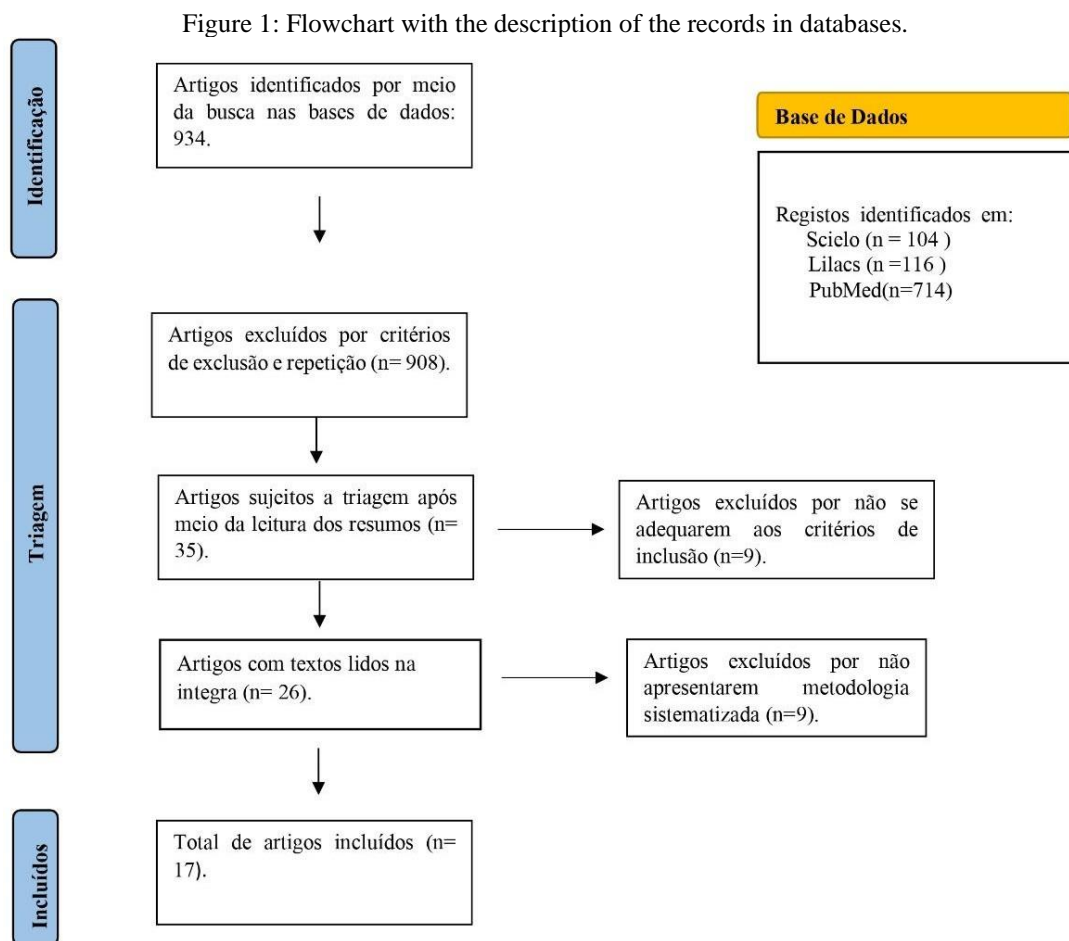
The quality of the articles was assessed using the Physiotherapy Evidence Database (PEDro). The PEDro scale is an instrument for assessing the methodological quality of studies in the area of health. This intervention protocol presents well-defined eligibility criteria, which are: 1. eligibility and origin of the study participants; 2. random distribution of study participants; 3. Secret allocation; 4. similarity to the starting point of the study; 5. Blinding of subjects; 6. Blinding of therapists; 7. blinding of evaluators;

8. Intention-to-treat analysis; 9. intergroup statistical analysis; and 10. measures of accuracy and variability. The total score is the sum of criteria 2 to 10. Criterion 1 is related to the external validity of the study, i.e., if it is not contemplated, the study is already discarded. This

scale indicates which trial has the best methodological quality (9-10 = excellent, 6-8 = good, 4-5 = fair, and < 4 = poor) (Maher et al., 2003).

RESULTS AND DISCUSSIONS

The initial search of the databases identified 934 articles. After screening, 26 full-text articles were analyzed. Of these, a total of 17 articles that met the eligibility criteria for this review were considered. As described in the following flowchart:



Source: Prepared by the authors, based on a search in the databases.

Based on the results of the selected studies, methodological quality was assessed using the PEDro scale. The mean score obtained was 8, which indicates an adequate methodological quality for inclusion in this study. Of the seventeen selected studies, five are clinical trials, six are randomized trials, and six are non-randomized studies, with one before-and-after study and one comparative study. These studies presented well-defined intervention protocols, addressing aspects such as sample and eligibility criteria, recruitment process and controlled randomization, types of intervention used, and the respective methods of efficacy evaluation. This shows that



there was a concern to follow appropriate methodological procedures to ensure the validity of the results obtained. All seventeen selected articles met the eligibility criterion and twelve of them were randomly allocated. Six studies did not include blinded allocation, and only one did not present an initial comparison. Three studies were able to perform the interventions blinded, and eight did not have blinded evaluators. However, all studies met the requirements for outcome measurement, final comparison, statistics, and precision measurement. Only two studies did not include blinded participants.

When considering the interventions performed in the selected studies, strategies, protocols, social skills training, peer training, group interventions, and the use of technological resources aimed at children and adolescents diagnosed with ASD, of both sexes and aged between 2 and 17 years, were applied. The studies examined the effects of different interventions, techniques, or methods and focused primarily on improving patients' development and social participation. The main results are shown in the table below:

Table 1 - Description of the studies:

Study	Population	Methods	Results
1. Beaumont, et al (2021)	Seventy children aged between seven and 12 years old.	This study was a randomized controlled trial with an active comparator condition.	The results suggest that the intervention may be a therapeutic approach convenient and economical.
2. Corbett, et al (2016)	Thirty children from 8 to 14 years old.	Experimental method, intervention NO SENSE Theatre.	The results of this pilot clinical trial provide initial support for the effectiveness of theatre-based intervention.
3. Covers, et al (2014)	One hundred and twenty participants, aged 10 to 12 years old.	The OSH (Social Training and Skills) consists of 18 group sessions of 1.5 hours for the children. In the OSH-ITP condition, parents additionally participate in 8 parent sessions and parents and teachers are actively involved in homework.	The primary outcome is socialization, as an aspect of adaptive functioning. Secondary outcomes focus on the specific social skills that children learn during HRT and on the more general social skills related to home and community environments, from a multi-stakeholder perspective. Informants.
4. Covers, et al (2021)	Ninety-eight children aged 9 to 12 years.	The children in both training conditions participated in a manualized HRT, based on behavioral therapeutic principles and the Social Learning Theory.	The lower performing subgroup that did not improve participated more frequently in OSH without parent/teacher involvement, compared to all other subgroups.
5. Dolan, et al (2016)	Fifty and eight participants with ASD, aged between 11 and 16 Years.	The present study sought to examine the effectiveness of PEERS in improving social skills among adolescents with ASD, using a Vivoparadigm of social	The results revealed that adolescents who received PEERS exhibited significant improvements in vocal expressiveness and a tendency toward better vocal expressiveness.



		interaction with a typically developing adolescent.	Overall relationship quality.
6.Guivarch,et al (2017)	Six patients aged between 9 and 10 years	A before-and-after study of children with ASD without intellectual disability was conducted at a child psychiatry day hospital, where they participated in an implicit group with cooperative games. Their social skills were assessed using the Social Emotional Profile (SEP), the Childhood Autism Rating Scale (CARS) and the Empathy Quotient (EQ) before and after 22 weeks.	A significant increase in global adaptation and social skills (median 8 and 7.7 points) was demonstrated in the SEP, as well as a significant reduction in the CARS score (median: 4 points), including in the social relationships domain. The EQ has increased twofold.
7.Hollander, et al (2022)	Three hundred and thirty-nine participants aged between 5 and 17 years.	Participants were randomized to receive either 4 mg or 10 mg of adult equivalent balopoptan daily or placebo, until the 4 mg group was Discontinued.	Phase 2 RCT did not meet its primary efficacy endpoint of improvement in change from baseline in the Vineland-II 2DC score with balovoptan treatment.
8.IDRIS, et al (2022)	One hundred and six teenagers, aged between 12 and 18 years.	They were randomly assigned to one of two interventions in group: the experimental condition (PEERS;® n=54) or the condition of active control of the treatment (Didactics of Regulation, Organization and Autonomy; ROAD; n=52).	The results of the observational measurement of Social competencies revealed improvements in positive affect, overall relationship quality, as well as at the beginning and end of a conversation, regardless of the condition.
9.MIZAKHANI,et al.(2022)	Sixty children with ASD. are in the age group of 6 to 8 years.	They were selected by the convenience sampling method and randomly distributed into three groups. groups (Son- Rise intervention, Floor- Team and control group with routine occupational therapy interventions).	The results showed that all multivariate tests are the main reason for this is the existence of the main related to the repetition factor (pre-test, post-test). The effect of Son-Rise and Floor-Time programs on social interaction skills and stereotyped behaviors.
10.Mössler, et al (2020)	One hundred and one participants, aged 4 to 7 years.	Participants were randomized to two levels of music therapy intensity (low intensity versus high intensity) in a 1:1 ratio. Randomization for these conditions was administered centrally and concealed from physicians performing outcome assessments.	The results suggest that the severity of symptoms is associated with the therapist's ability to tune in to the child. They also raise questions about the selection of results and the involvement of users.
11.Olsson,et al (2017)	Two hundred and ninety-six, from 8 to 17 years old with ASD without intellectual disability.	This pragmatic 12-week randomized controlled trial of HRT is compared to standard care only. Twelve sessions of manual HRT ("KONTAKT") were delivered by the team regular clinic.	HRT for children and adolescents with ASD in regular mental health services is feasible and safe. However, the modest and inconsistent effects underscore the importance of continued efforts to improve HRT beyond current standards.
12.Santos,et al (2015)	Seven children with autism, aged between 47 and 67	The interactions of seven dyads were videotaped before, during, and after the intervention in	The results of the post-intervention assessment indicate that caregivers were able to significantly increase



	months.	order to record the duration of eleven states of children's attention engagement, coded as social engagement (SE) or nonsocial engagement (SES).	the duration of social involvement (SE) states and also significantly decrease non-social involvement (SES) attention states in your children.
13. Soorya, et al (2015)	Sixty-nine children with ASD, aged 8 to 11 years.	They participated in a randomized comparative trial to examine the effectiveness of NETT in relation to a facilitated play group.	The results of this study are consistent with a growing body of literature indicating positive effects of OSH groups on prosocial behavior in school-age children with ASD.
14. Valadão, et al (2016)	Ten children, five with ASD, aged 7 to 8 years.	A mobile robot with a special suit and monitor for displaying multimedia content was designed to interact with children with ASD. Interaction is assessed using the Goal Achievement Scale and the escala Likert.	A study indicated that the robot stimulated social skills in 4/5 of children with ASD, which shows that its concepts are useful for improving socialization and quality of life.
15. Voss, et al (2019)	Seventy-one children, 6 to 12 years.	The Superpower Glass intervention, implemented through Google Glass (worn by the child) and a smartphone app.	The observed average gain of 4.58 points on the socialization subscale of the Vineland Adaptive Behaviors Scale is comparable to the gains seen with therapy standard of care.
16. Wetherby, et al (2014)	Eighty-two children, between 16 and 20 months of age.	The children were matched at the pre-treatment level of non-verbal development and the Pairs were loyally assigned to the treatment condition. The Results of children included measures of social communication, autism symptoms, Adaptive and developmental level	Children in the individual ESI showed differential changes in an observational measure of standardized social communication administered by the examiner, as they improved at a faster rate than children in the group ESI.
17. ZHAO, et al. (2022)	Forty-four children aged 5 years.	Incorporating conventional rehabilitation strategies, virtual reality technology was used with the intervention group to conduct rehabilitation training in areas including cognition, imitation and social interaction.	After the intervention, the developmental abilities of both groups of children in the areas of cognition, imitation, and social interaction were improved relative to their abilities measured before the intervention.

Source: Prepared by the authors, based on the analysis and synthesis of the studies found.

According to the results obtained in this review, there was a great use of resources based on ABA (Applied Behavior Analysis) therapy, that is, of a behavioral nature, seeking ways to complement what is already used, seeking new stimuli in order to obtain better socio-emotional results. The interventions addressed in the selected studies were: use of technological resources such as video games, virtual reality, robot, ABA (Applied Behavior Analysis) instructional therapy, theatrical intervention, music therapy, pharmacological therapies, parental and teacher training. Currently, there are several studies that seek to provide new stimuli to children with ASD in order to promote better cognitive and social development. The diagnostic differentiations scored



were the presence of comorbid conditions, so nine articles specified as an inclusion criterion IQ above 70, i.e., without the presence of intellectual disability. Four articles made no distinction about the diagnosis. Only one article established children with severe sensory disorders as an exclusion criterion. There were two articles that considered level 1 of support as an inclusion criterion, and one article that emphasized high functioning as a criterion for inclusion in their research sample.

NEW TECHNOLOGIES TO HELP WITH ASD

In the study conducted by Valadão et al. (2016), a playful mobile robot was used, equipped with a multimedia display monitor developed with the objective of interacting with children. During the interactive sessions, a mediator controls the robot's movements in a room specially prepared for this purpose. Although children with ASD have difficulties with looking, touching, imitating, and other social skills, this study demonstrated that interacting with a robot can stimulate them in a positive way. In 4 out of 5 children assessed using a Likert scale questionnaire, the use of the robot resulted in moderate to positive improvements in their social skills. Therefore, the results of this study indicate that the goal of developing a robot to stimulate social skills in children with ASD has been achieved, as the robot has been shown to be a repeatable and effective tool to improve children's social skills with each session. In the field of robotics, this equipment is described as social assistance robots, developed with the aim of helping with the ability to express emotions, and is used as a mediator of human-robot interaction (Valadão et al, 2016).

According to Zhao *et al.* (2022), clinical treatment may have disadvantages, as it has long and complex rehabilitation or therapy protocols, which may not be easily generalized in other settings. Therefore, it is necessary to search for additional methodologies that are convenient and accessible to meet the individual needs of each patient, such as the use of assisted technologies, online therapies or the combination of different approaches are more flexible and adaptable treatment options.

The possibilities of learning based on new technologies create perspectives of accessible therapies outside the doctor's office, generalizing to the natural environment, where social skills are employed, and work as a bridge of care while children await standard therapy, since with the increase in the prevalence of ASD it has exceeded the availability of behavioral therapists, creating a waiting list of up to 18 months in the United States (Voss et al., 2019).

Virtual Reality (VR) technology can be used to create controlled virtual environments for rehabilitation, providing safe training methods. In the study conducted by Zhao et al (2022), VR



was incorporated into the intervention group for rehabilitation training, covering areas such as cognition, imitation, and social interaction. The control group received conventional clinical rehabilitation training. The Psychoeducational Profile, Third Edition (PEP-3) was used to evaluate the impact of rehabilitation on children with ASD before and after the intervention. The results of the research indicate that rehabilitation training based on VR technology is effective in stimulating cognitive and social communication skills in children with ASD. These findings offer an innovative and meaningful rehabilitation approach to the ongoing clinical treatment of children with ASD, combining VR with conventional rehabilitation, enhancing the effects of rehabilitation. It was developed by Voss et al. (2019) a wearable social learning device aimed at children with ASD, to promote facial engagement by offering feedback during social interventions in the home environment. Using Google Glass, a computer vision system is run and connected wirelessly to a smartphone app, providing intervention directly to the glasses used by the child. The feasibility of the augmented reality fit and format has been confirmed in a laboratory feasibility study and in a field test during home use by children with ASD. Overall, these results support the hypothesis that the OS (SuperPower Glass) intervention can improve the social skills of children with ASD between the ages of 6 and 12 years as an adjunct to standard of care therapy.

Another technology-assisted study was conducted to examine the effectiveness of a variant of the parent-supported Secret Agent Society (SAS)-based computer game-based social-emotional skills training program that could be accessed remotely by families. In summary, the results of the present study build on the existing HRT (Social Skills Training) evidence base for children with ASD, demonstrating significant effects of the use of a parent-assisted computer game-based intervention in relation to an active control condition (versus the no-treatment comparison group), with some signs of generalization of social skills to the school setting. The interventions also provided better individual quality time between parents and children, which may influence parents' perceptions of their children's social-emotional functioning (Beaumont et al., 2020).

BEHAVIORAL INTERVENTIONS AND THEIR SPECIFICITIES

From the identification of inconclusions of long-term results from social skills training (HRT), which is widely used to assist in the development of social and communication skills in children with ASD. Decker et al. (2014) consider the involvement of parents and teachers in HRT as a factor to improve the effectiveness of treatment in order to facilitate the generalization of learned skills for daily living.



Based on the deficit of children engaging in states of social engagement with their caregivers, Santos et al. (2015) verified the effectiveness of a short-term intervention aimed at caregivers in order to promote social engagement with their autistic children. Initially, a booklet was made available summarizing the main points of each module that were worked on in the meetings, facilitating the clarification of possible doubts. The post-intervention results indicated that caregivers were able to significantly increase the duration of engagement states (SE) and significantly decrease nonsocial engagement attention (SES) states in their children.

Wetherby et al. (2014), in their study, compared two interventions implemented by parents lasting nine months in the Early Social Interaction (ESI) Project. The individual ESI was offered 2 or 3 times a week at home, or in the community, the group ESI was offered once a week in a clinic, with the aim of teaching strategies to support communication and socialization throughout daily activities. As a result, they obtained differential efficacy on a measure of communication, daily living, and parent-reported social skills in the individual ESI, while the group ESI led to worsening or no significant change in these skills. Finally, the individual ESI showed differential changes in the receptive language skills measures administered by the examiner, as children in the individual ESI improved significantly, while the group ESI showed no change.

Idris et al.(2022) examined the effectiveness of the culturally adapted Dutch version of the Programme for Relational Skills Education and Enrichment (PEERS),[®] using a randomized controlled trial (RCT) with an active treatment control condition, with a population of 106 adolescents with ASD, aged 12 to 18 years, who were randomly assigned to one of two group interventions: the experimental condition (PEERS;[®] n=54) or the condition of active control of the treatment (Didactics of Regulation, Organization and Autonomy; ROAD; n=52).

The effects of interventions on social skills were mainly assessed through an observational measure (CASS – Contextual Assessment Social Skills). Secondary indices of social skills were given from questionnaires reported by parents and teachers (i.e., Social Responsiveness Scale; SRS and Social Skills Improvement System; SSIS). Results of the observational measure of social competencies revealed improvements in positive affect, overall relationship quality, as well as the beginning and end of a conversation, regardless of condition. This study reveals promising indications that the Dutch version of PEERS[®] improves social skills in adolescents with ASD.

The aim of the study by Mirzakhani et al. (2022) was to investigate the effect of Son-Rise and Floor Time programs on social interaction skills and stereotyped behaviors in children with ASD. The study was conducted as a Clinical Trial with the participation of 60 children with ASD,



selected by convenience and randomly assigned to three groups: Son-Rise intervention, Floor Time intervention, and control group that received routine occupational therapy. For data collection, the Autism Spectrum Screening Questionnaire, the Gilliam Autism Rating Scale and the Autism Social Skills Profile were used.

Data analysis was performed using repeated measures analysis of variance (bidirectional between and within subjects). The results showed that both the Son-Rise program and the Floor Time program had a positive effect on social interaction skills and reduced stereotyped behaviors in children with ASD. In addition, a significant difference in the effectiveness of the Son-Rise and Floor Time programs was observed on social interaction skills and stereotyped behavior at post-test, with Floor Time being more effective compared to the Son-Rise program (Mirzakhani et al., 2022).

According to Olsson et al. (2019), there is a gap in the evaluation of the effectiveness of group practices widely applied for social skills training, especially social skills group training (SST). To fill this gap, a pragmatic randomized controlled trial was conducted, which compared Group Social Skills Therapy (HRT) with standard treatment in 13 outpatient child and adolescent psychiatry units in Sweden. Based on the results, we can conclude that a group HRT of 12 weeks duration was more effective than standard treatment alone, especially for female adolescents. This approach had small to moderate positive effects on social responsiveness, overall clinical severity, and adaptive functioning.

Socialization groups are a widely used modality to address major social impairments in verbal, school-aged, and older individuals with ASD.

They are considered a cost-effective method resource to facilitate social contact for those who are most at risk of social isolation and rejection. This study employed a randomized parallel-group design comparing 1) NETT and 2) facilitated play (control condition). The results of this study are consistent with a growing body of literature indicating positive effects of HRT groups on prosocial behavior in school-aged children with ASD (Soorya et al., 2015).

According to Dolan et al. (2016) in their study that aimed to analyze the effectiveness of a relationship development program to improve social skills in adolescents with ASD, using an observational consolidation system. The adolescent participants were between 11 and 16 years old, participated in a 10-minute peer-to-peer interaction in pre- and post-treatment. Although the results did not show overall improvements in all aspects of the CASS (Social Competence Assessment System) scale used, significant improvements in vocal expressiveness and a statistically significant trend towards better overall relationship quality were observed among



adolescents who received the PEERS intervention. The experimental group (EXP) also showed a greater knowledge of the concepts involved in the PEERS program after treatment, and there was a significant glow between the change in the initials of the TASSK (Social Skills Test for Adolescents with ASD) and the overall quality of the relationship.

Using Latent Class Analysis on data from 98 children with ASD aged 9 to 12 years, who participated in a specific social skills training (HRT) clinical trial, four subgroups were identified based on previous socio-communicative skills and patterns of response to training (Dekker; et al, 2020). This study aimed to contribute to the understanding of the topic by investigating whether it is possible to identify subgroups of participants who responded differently to Social Skills Training (HRT), with or without the involvement of parents and teachers, and to relate these subgroups to several dimensions, such as characteristics of the participants and the intervention. Two of these subgroups showed improvements after HRT. The characterization of these subgroups based on the characteristics of the participants and the intervention revealed that an improvement was associated with a lower difficulty perceived by parents in relation to socio-communicative skills at the beginning, greater verbal ability, younger age, and symptoms plus levels of ASD and anxiety. These results suggest that the response to HRT in ASD may vary depending on the characteristics of the participants. (Dekker et al., 2020)

DIFFERENTIAL THERAPEUTIC STRANDS

Currently, there are no approved drugs in the literature that are specifically effective for socialization and communication difficulties. According to Hollander et al. (2022), there is a need to be met for approved pharmacological therapies that aim to treat the underlying biological pathways associated with the main symptoms of ASD. In their study, they sought to evaluate the efficacy and safety of balavantán, a selective oral vasopressin receptor 1a antagonist, compared with placebo in children and adolescents with ASD.

The study was a randomized, double-blind, 24-week, parallel-group, placebo-controlled phase 2 trial. Subjects were randomly selected and assigned to treatment groups. This multicenter trial was conducted at 41 sites in the U.S. With a final sample of a total of 599 subjects, 339 participants were screened and randomized to receive an equivalent dose of balopoptan of 4 mg, an adult equivalent dose of 10 mg of balopoptane, or placebo. In this randomized controlled trial, balopoptan did not demonstrate efficacy in improving socialization and communication in this population with pediatric ASD (Hollander; et al, 2022).

Corbett et al. (2016), bring a therapeutic approach to changes in social skills in



participants with ASD who experience NO SENSE Theatre, in order to evaluate and amplify the impact of a peer-mediated and theatre-based intervention in children with ASD, using a randomized experimental design that measures social ability before and after treatment at various levels of analysis, including neural, cognitive, and behavioral. This study was based on the hypothesis that children with ASD in an experimental group would show greater improvement in social ability in all aspects of the social competence framework when compared to a control group on a waiting list.

In a preliminary report, improvement in theory of mind competencies was demonstrated in participants exposed to the treatment. Secondary analyses, which measured the effects of time, revealed changes in the EXP group in social cognition (MFI, MFD), differences in brain amplitude (ERP incidental memory), and social functioning (ABAS). However, these time effects were not observed in the WLC group, suggesting that there were more modest changes in skill development outside of the treatment context during this period. The results of this pilot clinical trial provide initial support for the effectiveness of theatre-based intervention (Corbett et al., 2016).

Mössler et al. (2020) worked from the perspective that music therapy with regard to musical and emotional attunement can be used to create moments of synchronization, work sensory integration and affective regulation, and promote a shared emotional connection. Successful attunement increases opportunities for the child to develop self-awareness, experience shared attention and social reciprocity, and improve communication. This study investigated whether musical and emotional attunement can predict changes in improvised music therapy in children with autism, between 4 and 7 years old, over a 12-month period. Tuning was assessed, observed in videos of the sessions, and changes in general social skills, assessed by experts and parents who were unaware of the study. Standardized tools were used, such as the Relationship Quality Assessment, Principles of Improvised Music Therapy, ADOS, and SRS. In contrast to a previous pilot study, no significant effects were found between sensation and changes in outcomes, only trends in the same direction were observed. The results suggest that symptom severity is related to the therapist's ability to tune in to a child, and also raise questions about outcome selection and user participation.

FINAL THOUGHTS

The studies show that there is currently a large use of resources based on behavioral therapies, always focusing on the search to complement this intervention already used, in order



to enhance the results, such as the use of HRT in a group, as well as the training, qualification of teachers and caregivers in order to provide support so that this individual with ASD can move through these different spaces in a functional way.

The new technologies are technological resources that help conventional therapies and subsidize the generalization of stimuli outside the office, considering that the authors brought as the main difficulty the generalization of stimuli in external environments. The differential strands bring new approaches to the insertion of these individuals in different spaces, have positive results for the improvement in socialization, and provide initial support for effectiveness, however it is necessary to expand the studies and the sample used for more robust results. It is important to emphasize that there is a lack of studies aimed at individuals with a higher level of support 2 and 3, and it is necessary to develop research that meets this specific population, as well as the use of drugs to treat this deficit.



REFERENCES

- American Psychiatric Association. (2014). *DSM-5: Manual Diagnóstico e Estatístico de Transtornos Mentais*. Porto Alegre: Artmed.
- Andreou, M., & Skrimpa, V. (2020). Theory of mental deficits and neurophysiological operations in autism spectrum disorders: a review. *Brain Sciences*, 10(6), 393. [Link](#)
- Beaumont, R., Walker, H., Weiss, J., & Sofronoff, K. (2021). Randomized controlled trial of a video gaming-based social skills program for children on the autism spectrum. *Journal of Autism and Developmental Disorders*, 51, 3637-3650. [Link](#)
- Bosa, C. A. (2001). As relações entre autismo, comportamento social e função executiva. *Psicologia: reflexão e crítica*, 14, 281-287. [Link](#)
- Carvalho, L. H. Z. S. (2012). Caracterização e análise das habilidades sociais e problemas de comportamento de crianças com autismo. [Link](#)
- Corbett, B. A., Key, A. P., Qualls, L., Fecteau, S., Newson, C., Coke, C., & Yoder, P. (2016). Improvement in social competence using a randomized trial of a theatre intervention for children with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, 46, 658-672. [Link](#)
- Czermainski, F. R., Bosa, C. A., & Salles, J. F. (2013). Funções executivas em crianças e adolescentes com transtorno do espectro do autismo: uma revisão. *Psico*. Porto Alegre, 44(4), 518-525. [Link](#)
- da Silva Raposo, C. C., Freire, C. H. R., & Lacerda, A. M. (2015). O cérebro autista e sua relação com os neurônios-espelho. *Revista Hum@ nae*, 9(2). [Link](#)
- Dapretto, M., Davies, M. S., Pfeifer, J. H., Scott, A. A., Sigman, M., Bookheimer, S. Y., & Iacoboni, M. (2006). Understanding emotions in other people: Mirror neuronal dysfunction in children with autism spectrum disorders. *Neuroscience of Nature*, 1, 28-30. [Link](#)
- Dekker, V., Nauta, M. H., Timmerman, M. E., Mulder, E. J., Hoekstra, P. J., & Bildt, A. (2021). Applying latent class analysis to identify subgroups of children with autism spectrum disorders who benefit from social skills training. *Journal of Autism and Developmental Disorders*, 51, 2004-2018. [Link](#)
- Dekker, V., Nauta, M. H., Mulder, E. J., Timmerman, M. E., & Bildt, A. (2014). A randomized controlled study of a social skills training for preadolescent children with autism spectrum disorders: generalization of skills by training parents and teachers? *Psiquiatria BMC*, 1, 1-13. [Link](#)
- Dos Santos, A. C., Garotti, M. F., & Ribeiro, I. F. (2015). Intervention in Autism: Social Engagement Implemented by Caregivers. *Paidéia (Ribeirão Preto)*, 25(60), 67-75. [Link](#)
- Dolan, B. K., Van Hecke, A. V., Carson, A. M., Karst, J. S., Stevens, S., Scholz, K. A., & Hummel, E. (2016). Assessment of intervention effects on in vivo peer interactions in adolescents with autism spectrum disorder (ASD). *Journal of Autism and Developmental Disorders*,



- 46, 2251-2259. Link
- Fadda, G. M., & Cury, V. E. (2016). O enigma do autismo: contribuições sobre a etiologia do transtorno. *Psicologia em Estudo*, 21(3), 411-423. Link
- Fernandes, C. S., Tomazelli, J., & Girianelli, V. R. (2020). Diagnóstico de autismo no século XXI: evolução dos domínios nas categorizações nosológicas. *Psicologia USP*, 31. Link
- Fonseca, C. C. P. (2022). Transtorno do Espectro Autista (TEA): as dificuldades e desafios na atualidade. Link
- Geremias, A. O., Abreu, M. A. B., & Romano, L. H. (2017). Autismo e neurônio-espelho. *Revista Saúde Foco (Impr, Rio J.)*, 171-76. Link
- Guivarch, J., Murdymootoo, V., Elissalde, S. N., Salle-Collemiche, X., Tardieu, S., Jouve, E., & Poinso, F. (2017). Impact of an implicit social skills training group in children with autism spectrum disorder without intellectual disability: A before-and-after study. *PloS one*, 12(7), e0181159. Link
- Hollander, E., Jacob, S., Jou, R., McNamara, N., Sikich, L., Tobe, R., & Veenstra-Vanderweele, J. (2022). Balovaptan vs placebo for social communication in childhood autism spectrum disorder: a randomized controlled trial. *JAMA Psychiatry*, 79(8), 760-769. Link
- Idris, S., Van Pelt, B. J., Jagersma, G., Duvekot, J., Maras, A., van der Ende, J., & Gresnigt-Lord, K. (2022). A randomized controlled trial to examine the effectiveness of the Dutch version of the Program for the Education and Enrichment of Relational Skills (PEERS®). *BMC psychiatry*, 22(1), 1-16. Link
- Khalil, R., Tindle, R., Boraud, T., Moostafa, A. A., & Karim, A. A. (2018). Social decision making in autism: On the impact of mirror neurons, motor control, and imitative behaviors. *CNS neuroscience & therapeutics*, 24(8), 669-676. Link
- Klin, A. (2006). Autismo e síndrome de Asperger: uma visão geral. *Brazilian Journal of Psychiatry*, 28, s3-s11. [Link](<https://doi.org/10.1590/S1516-44462006000500002>)
- Lameira, A. P., Gawryszewski, L. G., & Pereira Jr, A. (2006). Neurônios espelho. *Psicologia USP*, 17(2), 123-133. Link
- Liberati, A., Altman, D. G., Tetzlaff, J., Mulrow, C., Gøtzsche, P. C., & Ioannidis, J. P. (2009). A declaração PRISMA para relatar revisões sistemáticas e meta-análises de estudos que avaliam intervenções de saúde: explicação e elaboração. *PLoS Med*, 6(7), 1-28. Link
- Makiyama, B. Y., da Silva, J. F., & Rodrigues, P. A. (2021). A teoria da mente e os processos neuropsicológicos de crianças autistas. *Revista Científica UMC*, 6(2). Link
- Maher, C. G., Sherrington, C., Herbert, R. D., Moseley, A. M., & Elkins, M. (2003). Reliability of the PEDro scale for rating quality of randomized controlled trials. *Physical therapy*, 83(8), 713-721.
- Maranhão, S. S. D. A. (2014). Caracterização de aspectos da cognição social, habilidades sociais



- e funções executivas de crianças diagnosticadas com Transtorno Autista e Transtorno de Asperger. Link
- Maranhão, S. S. D. A., & Pires, I. A. (2017). Funções executivas e habilidades sociais no espectro autista: um estudo multicasos. *Cadernos de Pós-Graduação em Distúrbios do Desenvolvimento*, 17(1). Link
- Mirzakhani, N., Asadzandi, S., Ahmadi, M. S., Saei, S., & Pashmdarfard, M. (2022). O efeito dos programas Son-Rise e Floor-Time na interação social e comportamentos estereotipados de crianças com Transtornos do Espectro Autista: um ensaio clínico. *Cadernos Brasileiros de Terapia Ocupacional*, 30. Link
- Mössler, K., Schmid, W., Aßmus, J., Fusar-Poli, L., & Gold, C. (2020). Attunement in music therapy for young children with autism: revisiting qualities of relationship as mechanisms of change. *Journal of autism and developmental disorders*, 50(11), 3921-3934. Link
- Olsson, N. C., Flygare, O., Coco, C., Gorling, A., Rade, A., Chen, Q., & Bolte, S. (2017). Social Skills Training for Children and Adolescents With Autism Spectrum Disorder: A Randomized Controlled Trial. *Journal of the American Academy of Child and Adolescent Psychiatry*, 7, 585-592. Link
- Rizzolatti, G., Fadiga, L., Gallese, V., & Fogassi, L. (1996). Premotor cortex and the recognition of motor actions. *Cognitive Brain Research*, 3(2), 131-141. [https://doi.org/10.1016/0926-6410\(95\)00038-0](https://doi.org/10.1016/0926-6410(95)00038-0)
- Salgado, N. D. M., Pantoja, J. C., Viana, R. P. F., & Pereira, R. G. V. (2022). Transtorno do Espectro Autista em Crianças: Uma Revisão Sistemática sobre o Aumento da Incidência e Diagnóstico. *Research, Society and Development*, 11(13). <https://doi.org/10.33448/rsd-v11i13.35748>
- Sella, A. C., & Ribeiro, D. M. (2018). *Análise do comportamento aplicada ao transtorno do espectro autista*. Curitiba: Appris editora e livraria.
- Soorya, L. V., Siper, P. M., Beck, T., Soffes, S., Halpern, D., Gorenstein, M., & Wang, A. T. (2015). Randomized comparative trial of a group of social cognitive skills for children with autism spectrum disorder. *Journal of the American Academy of Child and Adolescent Psychiatry*, 3, 208-216. <https://doi.org/10.1016/j.jaac.2014.12.005>
- Valadão, C. T., Goulart, C., Rivera, H., Caldeira, E., Bastos Filho, T. F., Frizera-Neto, A., & Carelli, R. (2016). Analysis of the use of a robot to improve social skills in children with autism spectrum disorder. *Research on Biomedical Engineering*, 32, 161-175. <https://doi.org/10.1590/2446-4740.01316>
- Voss, C., Schwartz, J., Daniels, J., Kline, A., Haber, N., Washington, P., Wall, D. (2019). Effect of wearable digital intervention for improving socialization in children with autism spectrum disorder: a randomized clinical trial. *JAMA Pediatrics*, 173(5), 446-454. <https://jamanetwork.com/journals/jamapediatrics/article-abstract/2728462>
- Wetherby, A. M., Guthrie, W., Woods, J., Schatschneider, C., Holland, R. D., Morgan, L., & Lord, C. (2014). Parent-implemented social intervention for toddlers with autism: An RCT.



Pediatrics, 134(6), 1084-1093.
<https://publications.aap.org/pediatrics/article/134/6/1084/33191/Parent-Implemented-Social-Intervention-for>

World Health Organization. CID-11 for Mortality and Morbidity Statistics.
<https://www.who.int/classifications/classification-of-diseases>

Zhao, J., Zhang, X., Lu, Y., Wu, X., Zhou, F., Yang, S., & Fei, F. (2022). Virtual reality technology enhances the cognitive and social communication of children with autism spectrum disorder. *Frontiers in Public Health*, 10, 1029392.
<https://www.frontiersin.org/articles/10.3389/fpubh.2022.1029392/full>