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WHAT IS THE ROLE OF BEHAVIOURAL INTERVENTIONS TO ADDRESS THEORY OF MIND DEFICITS AND SOCIAL COGNITION IN INDIVIDUALS WITH AUTISM SPECTRUM DISORDERS?

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Alla mia famiglia,
agli amici, colleghi e professionisti che mi hanno sostenuto
a mia moglie che ogni giorno non abbassa mai lo sguardo su di me
è a loro che dedico ogni cosa.

Chi salva un bambino e la sua famiglia,
salva il mondo intero.

Abstract

The concept of the Theory of Mind assumes a scientific concern for all those experts engaged in the study of autism treatment because many researchers have highlighted that people diagnosed with autism spectrum disorder have difficulties with social cognition that regards inferring other's state of mind, desires, preferences, thoughts, beliefs, intentions, and other social behaviors. The current thesis offers an overview of behavior-analytic intervention, clarifying the differences with comprehensive treatment reported in the literature, such as social skill training, cognitive-behavioral approach, and neuropsychological interventions. Diverse revised training based on Applied Behavior Analysis and Relational Frame Theory show evidence of increasing focused social skills in such clinical samples, shedding light on the generalization of teaching strategies and response behaviors to social cues.

Keywords: autism spectrum disorders; applied behavior analysis; social cognition; theory of mind; perspective taking; false beliefs.

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Autism Spectrum Disorders

CHAPTER 1

1.1 Clinical description, history and diagnosis

Autism Spectrum Disorder (ASD) is currently considered a complex neuropsychiatric disorder shown by persons during developmental age, which has a variable clinical expression in the same subject over time. Consequently, autism is considered a chronic disability that accompanies the subject throughout his life cycle, even if the characteristics of the social deficit assume various expressiveness over time. Currently, autism is considered a biologically determined neurodevelopmental disorder with onset in the first three years of life characterized by impaired communication and social interaction skills and the presence of repetitive and stereotyped behaviors, activities, and interests. [1] Generally, symptoms appear in the young childhood but they may not be manifest until social difficulties increase and surpass the partial socio-communication abilities of the person with ASD. Symptoms start in the first year of life, or the child shows a typical development up to 18-24 months, after which he loses the learned communication and social abilities (regression). The DSM-5 (current classification of mental disorders) emphasizes the heterogeneity and continuity of the clinical features. For example, there are children who lack any form of social reciprocity and verbal and non-verbal communication whose behavior is characterized by repetitive and stereotyped movements. On the other hand, children where symptoms are less severe, and the child's general adaptation is less impaired. the definition between "low functioning" and "high functioning" refers to the severity of the symptoms and the language skills present in the child [2]. Children with "low functioning" autism typically have a significant delay in verbal communication, while those with "high functioning" autism usually have normal or superior intelligence and fluent language. Symptoms may appear as poor eye contact, delayed or absent language, and social difficulties. Autistic children may exhibit repetitive behaviors, vocal or motor stereotypies, and hyperactivity or passivity during play activities. They may also have exclusive interests in certain topics or activities.

Autism was originally thought to have a psychosocial origin. In 1911, Bleuler used the term "autistic" to refer to mentally disturbed people who lacked real-life approach and had narrow relationships, displaying a behavior of self-disclosure or autoeroticism. Bleuler's contribution eliminated the sexual connotation and emphasized psychological dissociation as a fundamental aspect. Bleuler also observed that children with autism did not have contact with their surroundings and were absorbed by their perceptions. In the early 20th century, Hans Asperger and Leo Kanner independently conducted studies on autism. Kanner, an Austrian psychiatrist who founded the first child psychiatry clinic, published the first textbook on child psychiatry in 1935. He became best known for his work on diagnosing autism, which he distinguished from childhood-onset schizophrenia. Kanner's observations on 11 children formed the initial criteria for autism diagnosis, which included social dysfunction, a need for sameness, excellent rote memory, mutism, and overstimulation. Autistic patients were happiest when left alone, indifferent to visiting relatives, and had inflexible language. Kanner, who first identified autism in 1943, observed various sensory peculiarities in his patients, including problems with lights and sounds. He noted that many patients had skill with objects but often used them without a meaningful purpose. He proposed three criteria for the diagnosis of autism, including extreme isolation, insistence on sameness, and an onset before 2 years of age. In Kanner's view, autism fundamentally described a disorder of social understanding. Nevertheless, the idea that individuals with autism have superior rote memory has been challenged by recent studies. Idiot-savants, who have exceptional skills in specific areas, are rare in individuals with autism. Autism is also associated with medical illnesses such as epilepsy, hearing and vision deficits, and genetic conditions. Early theories about autism responsible parents, but advanced research rejected the theory that dysfunctional child-parent relationships caused autism.

Despite some of his original observations, autism is now understood to be a complex neuropsychiatric condition associated with central nervous system dysfunction and multiple medical conditions. Asperger identified a variance in autistic children ranging from near-normality to severe cases, with Asperger's syndrome now referring to the few cases of autistic children with usual intellectual skills but significant relational difficulties. The concept of autism is considered a Generalized and Pervasive Developmental Disorder.

Autism and schizophrenia

Schizophrenia and autism are clinically connected, as both disorders share similar social dysfunction symptoms and abnormalities in certain brain regions. Individuals with autism are also at a higher risk of developing psychotic symptoms. Long-term outcomes and gene associations suggest a common neurodevelopmental pathway or disease process [3]. Differentiation between the disorders includes concrete thought processes in autism and the absence of hallucinations and delusions. Autism and schizophrenia are both neurological disorders with some functional similarities, but notable structural differences have been identified through neuroimaging studies. Other differences include genetic factors, cognitive functioning, comorbid conditions, gender distribution, and disease course. Sir Michael Rutter published an article in 1972 defining these differences, noting that parents of children with autism are often highly functional and of higher social class, while schizophrenia is highly hereditary. Individuals with autism are more likely to have intellectual disability and epilepsy, while individuals with schizophrenia are more likely to suffer from cognitive decline and experience symptom remission.

Autism Diagnosis in the DSM-V

Given the difficulty in differentiating autistic disorder from Asperger's disorder, and PDD NOS (previously DSM edition) and given the questionable utility in using these categories to describe what many feel is a spectrum of related disorders, Asperger's disorder and PDD NOS have been excluded from the newest version the DSM [4]. The requirement for speech delay has been removed as a specific requirement, though it is explained that failure in back-and-forth conversation can be evidence of lacking social-emotional reciprocity. In the stereotypic behaviours category, an additional item has been included to describe hyper-or hypo-reactivity to sensory input. Like previous definitions, onset must be in early childhood and the disorder must be severe enough to impair functioning.

Autism Spectrum Disorder (American Psychiatric Association 2013)

a. Persistent deficits in social communication and social interaction across multiple contexts, as manifested by the following, currently or by history:

1. Deficits in social-emotional reciprocity, ranging, for example, from abnormal social approach and failure of normal back-and-forth conversation; to reduced sharing of interests, emotions, or affect; to failure to initiate or respond to social interactions.

2. Deficits in nonverbal communicative behaviours used for social interaction, ranging, for example, from poorly integrated verbal and nonverbal communication; to abnormalities in eye contact and body language or deficits in understanding and use of gestures; to a total lack of facial expressions and nonverbal communication.

3. Deficits in developing, maintaining, and understanding relationships, ranging, for example, from difficulties adjusting behaviour to suit various social contexts; to difficulties in sharing imaginative play or in making friends; to absence of interest in peers.

b. Restricted, repetitive patterns of behaviour, interests, or activities, as manifested by at least two of the following, currently or by history:

1. Stereotyped or repetitive motor movements, use of objects, or speech (e.g., simple motor stereotypies, lining up toys or flipping objects, echolalia, idiosyncratic phrases).

2. Insistence on sameness, inflexible adherence to routines, or ritualized patterns or verbal nonverbal behaviour (e.g., extreme distress at small changes, difficulties with transitions, rigid thinking patterns, greeting rituals, need to take same route, or eat food every day).

3. Highly restricted, fixated interests that are abnormal in intensity or focus (e.g., strong attachment to or preoccupation with unusual objects, excessively circumscribed or perseverative interest).

4. Hyper or hypo reactivity to sensory input or unusual interests in sensory aspects of the environment (e.g., apparent indifference to pain/temperature, adverse response to specific sounds or textures, excessive smelling or touching of objects, visual).

c. Symptoms must be present in the early developmental period (but may not become fully manifest until social demands exceed limited capacities, or may be masked by learned strategies in later life).

d. Symptoms cause clinically significant impairment in social, occupational, or other important areas of current functioning.

e. These disturbances are not better explained by intellectual disability (intellectual developmental disorder) or global developmental delay. Intellectual disability and ASD frequently co-occur; to make comorbid diagnoses of ASD and intellectual disability, social communication should be below that expected for general developmental level.

In addition, there is a new diagnostic category in the new version of the DSM, social communication disorder, which may also absorb some of the individuals previously considered to be on the mild side of the autism spectrum (American Psychiatric Association 2013). Specifically, this disorder may come to describe individuals who are currently diagnosed with Asperger's disorder or PDD NOS but have milder social dysfunction. Individuals who are diagnosed with social communication disorder must have difficulty with the social aspects of both verbal and nonverbal communication and this must impair their ability to be understood, causing significant limitations in social participation, academic achievement, or occupational performance. These individuals will have difficulty with the practical or pragmatic use of language, as opposed to the structure and grammar associated with language.

In the following table, we display three severity levels suggested by DSM-5 in order to classify a client into a profile of minor or major assistance, as symptoms have an influence on daily autonomies of autistic persons.

Picture 1. Table displays the levels of severity and assistance needs included in DSM-5.

Severity level	Social communication	Restricted, repetitive behaviors
Level 3 "Requiring very substantial support"	Severe deficits in verbal and nonverbal social communication skills cause severe impairments in functioning, very limited initiation of social interactions, and minimal response to social overtures from others. For example, a person with few words of intelligible speech who rarely initiates interaction and, when he or she does, makes unusual approaches to meet needs only and responds to only very direct social approaches	Inflexibility of behavior, extreme difficulty coping with change, or other restricted/repetitive behaviors markedly interfere with functioning in all spheres. Great distress/difficulty changing focus or action.
Level 2 "Requiring substantial support"	Marked deficits in verbal and nonverbal social communication skills; social impairments apparent even with supports in place; limited initiation of social interactions; and reduced or abnormal responses to social overtures from others. For example, a person who speaks simple sentences, whose interaction is limited to narrow special interests, and how has markedly odd nonverbal communication.	Inflexibility of behavior, difficulty coping with change, or other restricted/repetitive behaviors appear frequently enough to be obvious to the casual observer and interfere with functioning in a variety of contexts. Distress and/or difficulty changing focus or action.
Level 1 "Requiring support"	Without supports in place, deficits in social communication cause noticeable impairments. Difficulty initiating social interactions, and clear examples of atypical or unsuccessful response to social overtures of others. May appear to have decreased interest in social interactions. For example, a person who is able to speak in full sentences and engages in communication but whose to- and-for conversation with others fails, and whose attempts to make friends are odd and typically unsuccessful.	Inflexibility of behavior causes significant interference with functioning in one or more contexts. Difficulty switching between activities. Problems of organization and planning

Diagnosing ASD in Very Early Childhood

The formal diagnosis of ASD is not usually made until children reach the age of 3 or 4, even though most parents recognize the signs and symptoms during the first or second year of life. However, behavioral markers of ASD can be detected before the age of 2, and diagnoses made at 2 years old are stable and have been found to persist a year later in 90% of cases studied. Factors contributing to the delay in formal diagnosis include a lack of knowledge and experience in parents and professionals, as well as the heterogeneity in symptom presentation and onset in children with ASD. Lack of information about autism may also contribute to professional hesitation in addressing concerns about child development. The mean age of autism diagnosis differs based on the subtype, with autistic disorder being diagnosed at a younger age than PDD-NOS and Asperger syndrome. However, diagnosing very young children with ASD can be challenging due to the limited behavioral repertoire of infants and toddlers. Over 40% of parents of children with ASD are unsatisfied with the diagnostic process, which can delay early intervention services. Early intervention before age 3.5 has been shown to have a greater benefit than after age 5. Improving the diagnostic process is essential for bettering the prognosis for children with ASD and their families. Researchers and clinicians are studying the emergence of ASD in infants and toddlers to develop early diagnostic measures [5]. Concerning retrospective studies, research on early autism emergence often relies on parent report and home videos. Parent report provides efficient collection of early history, but is subject to limitations such as memory errors, limited parental knowledge, and bias. Home videos allow for more objective assessments by trained viewers, but concerns regarding representativeness and standardization have been raised. Despite limitations, both methods have shown moderate consistency with observed behaviors and symptoms. Home videos may not be the most reliable method of collecting data regarding ASD-specific behaviors due to the variability across families in terms of content and quality. Additionally, parents may stop filming when children behave undesirably. However, home video analysis has led to significant findings regarding the early distinguishability of ASD symptoms in infants and is viewed as a valid and reliable method of studying ASD emergence in infancy and toddlerhood [6]. Regarding prospective studies, multiple assessments are conducted over a long period on the same infants and toddlers, comparing the developmental progression of high-risk and low-risk children. Prospective designs provide data collection across participants, allowing for improvement in the understanding of developmental trajectories of individuals with ASD. Studies on high-risk siblings can begin as early as prenatal periods, offering unique opportunities to study neurobiological underpinnings of ASD. However, studying siblings is not without limitations, as the characteristics of the older sibling with ASD may influence participation likelihood [7]. To sum up, studies have shown that parents become aware of atypical symptoms in their child with ASD during the first two years of life, with most concerns arising between the first and second year. A later diagnosis is associated with increasing concerns from 12 to 18 months, but not at 6 months of age. Infants and toddlers later diagnosed with ASD show deficits in socialization, repetitive behaviors, and communication at specific ages.

Early signals: crying and movement in children with autism

A study was conducted on 48 mother-infant dyads to compare crying behavior and mother-infant interactions of children with autism, developmental delays, and typically developing children [8]. It was found that children later diagnosed with autism had a different pattern of cry at 1 year of age, with less waveform modulation and more dysphonation. Maternal reactions to their crying were also different. Another study investigated how acoustical features of crying episodes influenced the perception of infants with autism compared to those with typical development and developmental delay. The results showed that differences in structural parameters of the cry lead parents and non-parents to perceive an episode of crying as more aversive, and at 18 months of age, episodes of crying of children with autism had a higher fundamental frequency. These findings suggest that acoustic characteristics of episodes of crying may account for mental states of anxiety in the listener [9]. General movements (GMs) are unstimulated

movements that occur in foetuses from 9 weeks to 21 weeks after birth. They help diagnose an impaired central nervous system and predict neurological deficits. Studies have shown that children with ASD have motor development disorders. A retrospective study was conducted to determine if abnormalities in spontaneous motor activity could be observed in infants with ASD. The study found that infants with ASD had fewer variable sequences, amplitude, and speed of writhing GMs and abnormal or absent fidgety movements compared to healthy control infants. The study supports further research using more family videos (https://flore.unifi.it/handle/2158/1180812 accessed date, 26/03/2024).

1.2 Comorbidities

Autism Spectrum Disorders overlap with other disorders like intellectual disability (ID), attention deficit hyperactivity disorder (ADHD), language disorders, and psychiatric disorders such as oppositional defiant disorder (ODD), obsessive-compulsive disorder (OCD), anxiety, depression, and schizophrenia. ID, ADHD, and language disorders are comorbid with ASD more often than expected by chance. The overlap between these disorders suggests that they should be examined for the nature of their relationship with ASD [10].

Autism and Intellectual Disability

Intellectual Disability (ID) is a developmental disorder characterized by deficits in cognitive functioning and adaptive skills. The severity of ID is categorized based on IQ levels. The prevalence of ID is estimated at 1-3% of the population. The causes of ID can be genetic, environmental, or unknown. ID is often comorbid with other conditions, including ASD and ADHD. Individuals with ID have a high prevalence of ASD compared to the general population. Likewise, many individuals with ASD meet criteria for an ID [11]. Individuals with ASD may have varying degrees of intellectual disability (ID), but ID is more common in ASD than in the general population. There is a correlation between autism symptom severity and ID. Common autism symptoms, such as language and communication delays, attention and sensory issues, and social impairments, can make learning and development more difficult. Likewise, individuals with ID may have difficulty developing communication and socialization skills requiring higher cognitive abilities, which are necessary for social competency. Individuals with severe or profound ID may not exhibit prototypically autistic features like echolalia, stereotyped language use, or poor use of language for communication, and may have severe social deficits.

Autism and Attention Deficit Hyperactivity Disorder (ADHD)

Attention Deficit Hyperactivity Disorder (ADHD) is a developmental disorder that is characterized by inattention, hyperactivity, and impulsivity. There are three subtypes of ADHD: Predominantly Inattentive Type, Predominantly Hyperactive-Impulsive Type, and Combined Type. The onset of attention symptoms must be present before the age of 7. ADHD is comorbid with other disorders, including ODD, Conduct Disorder (CD), ID, depression, anxiety, and ASD. Individuals with ADHD often have significant difficulties with social interaction, conversation, and communication, which are core deficits seen in individuals with autism. Attention problems are frequently present in individuals with ASD even though they may not meet diagnostic criteria for ADHD [12]. Research has shown that differentiating between ASD and ADHD based on ADHD symptoms is difficult. According to parent reports, attention symptoms displayed by the ASD group were similar to those of the ADHD-C group. Individuals with autism may have difficulty filtering out external stimuli, leading to behaviors associated with inattention. They may also struggle to shift attention from one target to another and have deficits in visual and auditory attention. Impulse control may be more difficult for children with ASD than for those with ADHD. Individuals with ASD tend to hyper focus and concentrate on minute details, while having difficulty inhibiting attention to irrelevant stimuli. They may also display “social inattention” due to general deficits in attentional processing. These deficits may be related to sensory anomalies. The executive functioning abilities of individuals with ASD and ADHD are

impaired, with difficulties in inhibiting responses, shifting attention, and working memory. Cognitive flexibility and inhibition are among the most severely impaired factors. Research suggests that there may be differential executive functioning profiles in AS and ADHD. Executive functioning deficits may explain some of the common deficits seen in ASDs, such as theory of mind development. Research has shown a possible link between ASD and ADHD since family members of individuals with autism having ADHD, and vice versa. Studies have also found shared genes and genetic overlap. Dopamine and serotonin transporter genes are of particular interest as dysregulation of these genes has been associated with both ASD and ADHD [13]. Behavioral questionnaires have limitations in identifying the underlying reasons for specific behaviors, particularly in individuals with autism and ADHD. Symptoms of ASD and ADHD can change with age, making diagnosis more complicated. A subset of children with ADHD later meets criteria for ASD, and vice versa. Attention problems are considered part of the autism phenotype, and they may persist even as other autism symptoms subside. Several hypotheses have been proposed regarding the relationship between ASD and ADHD. One hypothesis suggests that ASD-ADHD is a specific subtype of ASD with more marked attention symptoms. Another hypothesis proposes that ASD and ADHD are comorbid, with ADHD symptoms becoming more prominent as ASD features decrease.

Autism and Language Disorders

The DSM-V proposes a new diagnosis of language impairment (LI), which is characterized by language abilities that are significantly below age expectations. The proposed subcategories include specific language impairment (SLI), social communication disorder, late language emergence, and selective mutism. Communication impairment is a significant component of the ASD diagnosis, and most individuals with autism acquire language late. SLI is characterized by delayed language not attributable to other factors, such as ID, hearing loss, or physical limitation. In high-functioning ASDs, there are language deficits that are more likely to not be present or to resolve, including deficits in phonetics, morphology, syntax, and concrete vocabulary. Semantic and pragmatic abilities are more persistent, and by definition, people with ASD have pragmatic language deficits. Children with language disability display sorts of language impairment, including mixed receptive/expressive disorders and higher order processing language disorders. ASD and SLI have overlapping symptomatology. Children with language disability try to compensate for their difficulties by using nonverbal communication, while individuals with autism are less likely to do so. Social difficulties in individuals with language disability are secondary to language deficits, whereas they are a core part of autism symptomatology. Autistic people also use stereotyped language, display repetitive behaviors, and have pragmatic language deficits. Although some children with language impairment have pragmatic language difficulties, they are still motivated to engage in social interaction unlike individuals with autism. This subgroup is characterized as having pragmatic language impairment, a subtype of specific language impairment. Research indicates that there is a genetic link between autism and language impairment [14]. Children with speech and language disorders are more likely to display autism symptoms, and family members of those with autism are more likely to have a history of language delay. Studies have found that genes associated with language impairment are also linked to autism. However, some researchers suggest that the language deficits seen in these conditions have different causes. A study comparing the social and language abilities of parents of children with SLI and ASD concluded that the language deficits observed in individuals with ASD have a different cause from those observed in individuals with SLI.

Prevalence of comorbid psychiatric disorders among people with ASD

The prevalence of comorbid disorders among people with ASD varied across reviews [15]. Studies showed that there was a high prevalence of at least one psychiatric disorder among participants with ASD. The prevalence rates varied based on population subgroups and the methodologies and instruments used to assess those disorders. Moreover, different psychiatric disorders had different prevalence rates. Several

reviews have reported varying prevalence rates of anxiety disorders among individuals with ASD, ranging from 1.47% to 54%. For example, a review found a pooled prevalence of 39.6% and 34.8% among children and adolescents with ASD, respectively. Another review reported a pooled prevalence of 42% among adults with ASD. Several reviews have reported the prevalence of depressive disorders in individuals with ASD, ranging from 2.5% to 47.1%. Two reviews investigated the co-occurrence of bipolar and mood disorders in individuals with ASD. Prevalence rates of bipolar disorders ranged from 5% to 21.4% across studies, while mood disorders ranged from 4.4% to 37%. A meta-analysis found that the prevalence of schizophrenia spectrum disorders in participants with ASD was 11.8%. Several reviews have reported varying prevalence rates of sleep disorders among individuals with ASD. One meta-analytic review found that individuals with ASD had impaired objective indices of sleep disorders, such as reduced total sleep time, longer sleep onset latency, and lower sleep efficiency. Another review found that the prevalence of sleep-wake disorder was 13% among individuals with ASD. Several reviews have investigated the co-occurrence of obsessive-compulsive disorder (OCD) in individuals with autism spectrum disorder (ASD). The prevalence of OCD in this population ranges from 9% to 22%. For example, one study found a lifetime prevalence of 22% among people with ASD. Several reviews have reported the prevalence of disruptive, impulse-control, and conduct disorders among individuals with ASD, ranging from 12% to 48%. Several reviews have reported the prevalence of ADHD among people with autism, which ranged from 25.7% to 65%. Research shows that individuals with ASD often have comorbid psychiatric disorders such as eating disorders, substance use disorder, personality disorder, Tourette syndrome or tic disorders, and posttraumatic stress disorder. Prevalence rates vary across studies, with eating disorders ranging from 1.4% to 7.9% and substance use disorder ranging from 0.7% to 36%. The prevalence of personality disorder was reported as 12.6%, Tourette syndrome or tic disorders ranged between 2.6% and 36%, and posttraumatic stress disorder prevalence varied from 1% to 5%.

1.3 Epidemiology

The prevalence of ASD has increased significantly in recent years. Accurate estimates are important to allocate funding and resources for those with ASD and their families, as well as to understand disparities in healthcare access. However, prevalence rates vary due to differences in case definition and identification methods. Studies using administrative databases can help identify cases but caution is advised when claiming an "autism epidemic". A recent review of studies on autism spectrum disorder (ASD) prevalence worldwide revealed that various factors can affect prevalence estimates, such as the geographical setting, case-finding procedure, sample size, and case definition. Some studies use a multistage approach, while others rely on surveys based on interviews with parents or teachers. Additionally, changing definitions and labelling practices can result in different prevalence estimates. Cultural influence can also affect prevalence estimates in different ethnic or cultural groups [16]. Numerous prevalence studies worldwide since 1966 have examined ASD and related disorders, resulting in a wide range of prevalence estimates. Methodological differences and varying diagnostic criteria contributed to the large range of estimates. The median prevalence for Autistic Disorder (AD) was 1.00/1000, with estimates ranging from 0.19/1000 in Germany to 7.26/1000 in Sweden. The median prevalence for Pervasive Developmental Disorder (PDD)/ASD was 6.16/1000, with estimates ranging from 3.00/1000 in Denmark to 11.6/1000 in the UK. A prevalence study was conducted in Sweden in 2011 using the Stockholm Youth Cohort (SYC). The study shows a significant increase in ASD prevalence from 4.20/1000 in 2001 to 14.4/1000 in 2011. The increase was mainly due to the rise in ASD prevalence in children without intellectual disability. In Poland, two regions had similar estimates of ASD prevalence in children aged 0 to 16 years. The highest prevalence was observed in children from 4 to 7 years of age. In Germany, a study estimated the administrative prevalence of ASD in individuals aged up to 24 years. Children from 6 to 11 years old had the highest prevalence. The European project "autism spectrum disorders in Europe (ASDEU)" involved 14 countries, aiming to estimate the prevalence of ASD in children aged 7-9 years in 2015. Four countries used nationwide registry data or

regional statistics to estimate the prevalence, while eight countries conducted ad hoc studies following a shared protocol that involved questionnaires and clinical assessments. Only Italy's ad hoc study has been published, yielding a prevalence estimate of 7.99/1000 when using certified children with ASD or other neurodevelopmental disorders in comorbidity with ASD. This estimate was higher than those based on regional administrative databases. A more recent regional estimate in 2018 from Abruzzo region yielded a higher prevalence estimate of 7.98/1000 in the age class 6-8 years [17]. The use of registries for administrative purposes may result in lower estimates of ASD prevalence compared to ad hoc studies, particularly when a two-phase screening and diagnosis confirmation approach is used. UK data shows that estimates from administrative data are consistently lower than those from population-based studies. A study in Spain found high ASD prevalence estimates in children aged 3-12 years, based on administrative data. However, estimates based on administrative data are generally lower than those from ad hoc studies.

1.4 Causes of autism

Autism is a complex condition caused by both genetic and environmental factors. Over 100 genes have been identified as risk factors. Environmental factors are also associated with ASD, but research in this area delays behindhand genomics research. Prenatal events are found to be the primary cause of autism, even if symptoms do not appear until several years after birth.

Twin Studies

In 1977, Folstein and Rutter conducted a twin study to reject the concept that autism is caused by neglectful parenting. The study found that monozygotic twins had a higher concordance rate for autism and other cognitive impairments than dizygotic twins, indicating a strong genetic component. However, environmental factors were also noted as contributing to autism. For discordant twin pairs, brain damage during the perinatal period was found to strongly predispose to autism. Since then, there have been many twin studies on autism. One study found that shared environmental factors account for a large proportion of autism responsibility, while another found that genetic effects are the largest contributor. A meta-analysis concluded that strong genetic effects are the main cause of autism [18]. Twin studies show that monozygotic twins have a higher concordance rate than dizygotic twins, but environmental factors may also play a role. It is important to search for environmental factors that can increase autism risk in individuals with a genetic predisposition.

Maternal infection and maternal antibodies

Rubella infection during pregnancy is the strongest example of environmental causes of autism. In the 1960s, rubella pandemics were widespread, and getting infected with the virus during pregnancy resulted in thousands of foetal or infant deaths, birth defects, and neurodevelopmental disorders. A study conducted by Stella Chess found that 37 percent of children exposed to rubella during pregnancy had intellectual disability, and some were diagnosed with autism. However, the widespread use of rubella vaccines has ended the epidemics. A Danish study found no association between maternal bacterial or viral infection during pregnancy and ASD diagnosis in children, although viral infection during the first trimester or admission to the hospital due to infection during the second trimester were associated with the diagnosis [19]. Another California-based study found that maternal bacterial infections during the second and third trimesters were associated with a double increase in ASD risk. Further studies combining epidemiology with genomic analyses may provide more conclusive evidence. Autoimmune diseases affect up to 9% of the world's population, and there is evidence linking autoimmunity to neurological and psychiatric disorders. Research suggests immune dysfunction may be present in patients with schizophrenia. Autoimmune disorders with antibodies directed at the NMDA receptor share similarities with schizophrenia in their early stages. There is growing evidence suggesting that circulating antibodies

may be associated with some forms of autism. The research is promising as it suggests potential therapeutic targets, but there are still many unanswered questions.

Drugs

The use of certain drugs during pregnancy has been linked to an increased risk of ASD. Thalidomide, a sedative used for nausea relief in the 1960s, has been associated with autism. A study of Swedish patients whose mothers took thalidomide found that at least four had autistic characteristics. Valproic acid, a drug used for epilepsy and other ailments, has also raised concerns as a teratogen. An epidemiological study found that children of mothers who took antiepileptic medication during pregnancy had a higher risk of neurodevelopmental disorders, including autism. The use of serotonin reuptake inhibitors (SSRIs) for depression during pregnancy has also been a recent concern, as dysregulation of serotonin during foetal life can negatively impact brain development. A study found that taking selective serotonin reuptake inhibitors (SSRIs) during pregnancy increases the risk of ASD in offspring, especially during the first and second trimesters. Pre-conceptual exposure to SSRIs and use of non-SSRI antidepressants were also linked to higher ASD risk. However, it is unclear whether the effect is due to the drugs or the maternal condition that requires them. Untreated maternal depression may also pose risks to pregnancy. Further evaluation of drug safety during foetal development is necessary [20].

Environmental Toxicants and Postnatal Factors

Researchers are investigating environmental toxicants, such as air pollution, cigarette smoke, heavy metals, and pesticides, as potential factors contributing to autism. Studies have shown a slight increase in autism risk if a family lives closer to a freeway or an agricultural area during pregnancy. The field of autism environmental epidemiology is still in its early stages, and techniques to fully identify all environmental factors affecting a foetus during pregnancy are still being developed. Strategies for exploring gene-by-environment interactions must be improved quickly. Vaccines, such as the MMR vaccine, have been feared to cause autism, but this has been invalidated by numerous studies. The only other postnatal experience linked to autism is social isolation in institution-reared children. Romanian orphans showed signs of autism, but their symptoms improved by age six. This demonstrates the potential of severely abnormal rearing practices to influence the brain but does not provide evidence for the postnatal genesis of autism.

1.5 Psychological and neurocognitive theories

Autism diagnosis relies on behavioral criteria due to unknown biological causes. The autistic triad of impairments consists of social development disorders, limited communication skills, and repetitive behaviors and restricted interests. Therefore, deficits in theory of mind, executive function, and central coherence are contributing factors to functional difficulties for individuals with autism.

Theory of mind deficits

Individuals with autism experience difficulties in social interactions and communication due to deficits in theory of mind, which impair their ability to intuitively understand mental states. This term refers to the ability to predict behavior by hypothesizing on the thoughts, feelings, and goals of others. Individuals with autism struggle to recognize mental states and use this information to interpret social situations. These deficits are associated with the ability to form mental representations and meta-representations. The Sally-Anne Test is a classic diagnostic tool used to assess theory of mind deficits. Typically developing children can solve the problem, but only 20% of children with autism can. These deficiencies are combined by a low preference for social stimuli, such as the human face. Eye tracking studies show that individuals with autism tend to focus more on the movements of mouths and hands and less on the eyes during conversations [21]. Psychophysiological data also confirms atypical functioning in face processing processes. The ability of children with autism to track biological motion may be a vital factor in understanding their difficulties with

social cues and theory of mind. While individuals with autism can recognize basic emotions, they struggle with more complex states that require interpretation of social context. This difficulty extends to identifying and naming their own emotions. The ability to read emotions is associated with brain activity in the anterior insula region. Introspection activates the same brain regions in individuals with autism as in typically functioning individuals during self-reflection and attribution of mental states, but the activity is significantly weaker [22]. Neuroimaging studies have identified regions of the brain involved in attributing mental states, including the medial prefrontal cortex, temporal-parietal junction, and temporal poles. Individuals with autism showed less activation in these regions when performing tasks involving inference of mental states. The ability to recognize mental states based on observable cues is associated with the orbitofrontal/medial temporal circuit, while inferring about others' mental states is associated with left medial frontal regions. The study sought to find links between social difficulties, language impairments, and neurocognitive deficits related to the theory of mind since scores obtained in theory of mind tasks were found to be correlated with performance in executive function tasks.

Executive Function

Executive function deficits refer to a range of neuropsychological processes that affect self-control, such as action planning, maintaining cognitive stimulation, focusing on tasks, monitoring performance level, and using feedback. People with autism may have difficulty with goal-directed behavior planning and execution due to a lack of flexibility in thinking and behavior, a tendency to focus on details while ignoring context, impulsiveness, and difficulty in switching to a new task [23]. They may also have disorders involving response inhibition, maintaining and shifting attention, and working memory. Some development of executive function occurs between childhood and adolescence, but differences in functioning compared to typically developing individuals persist at all ages. Attention shift and response inhibition problems may be associated with ritualized and rigid behavior. Understanding executive function deficits in individuals with autism is crucial for creating a suitable living environment and support strategies. These deficits affect social interactions and are linked to irregularities in brain systems, such as the anterior cingulate cortex and corpus callosum. Although some studies suggest impairments in response inhibition, others have found no deficits in high-functioning adults with autism. Executive function deficits may have underlying genetic causes and are also present in individuals with ADHD. However, planning and flexibility problems are consistently observed in individuals with autism. The term "executive functions" involves a wide range of difficulties and symptoms, making it difficult to identify exact patterns of deficits in autism.

Central Coherence

The weak central coherence hypothesis suggests that individuals with autism have difficulty integrating information into a whole or gestalt, focusing on details rather than context. This type of processing affects perception, language, and concept formation. While local processing skills may be useful in some tasks, they can cause problems in social situations. While not all individuals with autism have this issue, it is more prevalent in this population than in typically developing individuals [24]. Individuals with autism may be capable of processing information globally if properly instructed, but without direction, their processing is predominantly local. Performance is dependent on the type of task. Findings of studies on the relationship between central coherence and rigid behavior patterns are inconsistent. Poorly developed global processing of information may be associated with reduced structural or functional connectivity between various regions of the brain. The neural mechanisms underlying weak central coherence in individuals with autism are not yet known. Impaired global processing of information may also have a significant impact on communication. The right hemisphere of the brain is implicated in global processing and integration of information, and there is a preference for local vs. global processing of information that may be determined genetically. Reduced central coherence is seen both as a deficit and a feature of information processing. However, there is inconsistency in the results of studies on the abilities of individuals with

autism. The social and emotional difficulties experienced by people with autism cannot be solely attributed to deficits in theory of mind. Joint-attention and executive functions are precursors to theory of mind, and impairments in these areas can affect mental state attribution. The relationship between executive functions and weak central coherence is unclear. It is unknown whether autism can occur without deficits in theory of mind, executive function, or central coherence. Investigating the relationships between these deficits may provide new insights into autism.

Screening and assessment of ASD

CHAPTER 2

Screening is the process of identifying previously unrecognized disorders by administering screening instruments or procedures to a large group of individuals and subsequently following up with a diagnostic method when the screen is positive. Early screening for ASD has been recommended for 18 and 24-month-olds by the American Academy of Paediatrics due to improved outcomes with early intervention. Screeners do not provide diagnostic decisions but identify individuals who may be at risk for a disorder. Level I screeners are designed for general population use and should be convenient, inexpensive, and easy to administer, while Level II screeners are used for individuals who have already come to the attention of professionals. Ideal screening instruments are brief, inexpensive, and demonstrate strong psychometric properties. Screening measures should also demonstrate evidence of reliability and validity. Screening measures must demonstrate consistency and stability in their results. Psychometric validation involves evaluating the screener's accuracy in predicting diagnostic outcomes.

2.1 Autism screening measurements

The Checklist for Autism in Toddlers (CHAT) is a screening tool for autism that can be administered by a clinician with minimal training. The CHAT consists of two parts and takes 10-15 minutes to complete. Part 1 includes nine items answered by the parent, with five key items indicating a likely presence of ASD if failed. The second part is an observation completed by the clinician. Studies have shown that the CHAT accurately identifies children at high risk for ASD, but has lower sensitivity. It also struggles to distinguish between autistic disorder and PDD-NOS. The Modified Checklist for Autism in Toddlers (M-CHAT) is a revised version of the CHAT screening tool. The M-CHAT has an extended age range of 16-30 months and eliminates the observational component to make it more feasible across cultures. However, this also makes the parent report questions broader. The screener consists of 23 yes/no questions and takes about 5 minutes to administer. The child fails the screener if they fail two of the six critical items or three of the 23 items. Studies show fair to excellent internal consistency but lacking specificity. It should be used with the understanding that a false positive is relatively high and a thorough diagnostic workup should be completed to confirm diagnoses.

Screening Tool for Autism in Two-Year-Olds

The Screening Tool for Autism in Two-Year-Olds (STAT) is a Level 2 screening tool designed for children aged 24-35 months. It consists of 12 items and takes 15-20 minutes to complete. The tool examines several domains of behavior, including play, imitation, and attention, with each area having its own cut-off score. If two of the three scored areas are failed, the total screen is considered to be failed. The sensitivity and specificity of the tool vary depending on the scoring criteria used, and the tool should be used with caution for children aged 12-13 months. Further studies are needed to support the use of the tool in clinical settings.

Social Communication Questionnaire

The Social Communication Questionnaire (SCQ) is a formal screening tool that assesses children for autism spectrum disorder (ASD) through a 40-item parent-report questionnaire. It takes only 10 minutes to administer and has different forms to evaluate behavior over different periods. The SCQ has three subscales and a score of 15 or above indicates the need for a more comprehensive assessment. Different cut-off points may be useful depending on the assessment's purpose and sample. The SCQ shows promising results in measuring ASD, correlating highly with the ADI-R [25]. However, caution is advised due to methodological flaws. Sensitivity and specificity between ASD and non-ASD were acceptable in several

studies, with sensitivity ranging from 0.71 to 0.90 and specificity ranging from 0.54 to 0.86. The measure may be useful for screening, but further evaluation of its reliability is necessary.

First Year Inventory

The First Year Inventory (FYI) is a screening tool designed to assess children starting at 12 months of age, with a focus on identifying those at risk for atypical development and ASD characteristics. Created from a pool of items based on current theories and literature reviews, the FYI measures social-communication and sensory-regulatory functions, as well as general developmental problems and autism-associated problems. The measure includes 63 items and has been shown to be useful in discriminating among children with ASD, other developmental disorders, and typical development. However, its length may limit its utility in clinical settings. The FYI is typically used more often in research.

2.2 Assessment of core symptoms

No universal biological or behavioral marker has been found to detect autism accurately. A combination of surveillance and screening practices is suggested to identify ASD in children. Parents often notice the first signs of ASD in the child's language development within the first two years of life. Early social-communicative behaviors are consistent predictors of ASD diagnosis in young children. The diagnosis of autism is based on specific behaviors, including social communication impairments and restricted and repetitive behaviors. These symptoms can vary in severity and diversity, and early diagnosis is crucial for effective intervention. Cognitive ability and language skills can indicate prognosis, and delays in communication may be an early indicator of ASD. Recognizing and evaluating restricted and repetitive behaviors can also aid in diagnosis. Overall, early recognition and intervention are essential for improving outcomes in individuals with ASD.

Autism Diagnostic Observation Schedule, Second Edition

The ADOS-2 is a standardized assessment for diagnosing ASD that takes at least 45 minutes to administer. It includes five modules and should always be used in conjunction with other testing and clinical observation. The Toddler Module is specifically designed for children between 12 and 30 months without consistent phrase speech. Items are rated on a scale and a total score is calculated to determine range of concern. The ADOS-T appears to distinguish between ASD and non-ASD with good inter-rater reliability. However, it is limited in its ability to assess development over time.

Picture 2. Table explains the modules of ADOS-2

Expressive language level	Age (range)	Module ADOS-2
Absence of language, single word or inconsistent phrases	12-30 months	Module-T
	> 31 months	Module 1
Language with phrase but not fluent	All the ages	Module 2
	<30 months	
Fluent Language	Children/Young adolescents	Module 3
Fluent language	Last adolescents/Adults	Module 4

Module T. After the semi-structured observation, the trained professionals assign a code for each task. Successively the results are grouped in two domains as social affect and retractive and repetitive behavior. The sum of these two factors provides a total score referring to tree risk ranges: Low risk: the child has shown a behavioral profile as peers without ASD. No follow-up recommended; Few-moderate risk: the child has shown behaviors similar at ASD, follow-up recommended; Moderate-severe risk: high-probability with a diagnosis of ASD, early intervention is recommended with follow-up.

Picture 3. Table explains the activities of ADOS-T

MODULE TODDLERS-T	
Activity	Focus of observation
Free play 1a. ball	Tentative of involving others. Showing/offering play to adult. Communication. Expression of affect. Exploration of objects. Response when introducing ball.
2. blocking the access to the game	Response to disguised social situations. Ability in using eye contact to infer intensions or in communicating an uncommon situation. Using the body of others.
3. reply when asked.	Response to hierarchy of stimuli.
4. Play with bubbles 4a. provide a joke	Expression of affect, spontaneous initiative of joint attention. Sharing fun, requests. Response to disguised social situations.
5. Prevent routines with objects 5a. stopped a game	Expression of affect, spontaneous initiative of joint attention. Sharing fun, requests. Response to disguised social situations.
6. Prevent a social routine	Expression of affect trying to start a social routine.
3. Reply to joint attention	Following eye gazing or pointing.
8. Replay to social smile	Replay to social smile as priority
9. baby bath 9a. Ignoring	Interest in taking part. Active initiation or imitation. Sharing fun. How does he engage in something when ignored? Initiative to social interaction.
10. functional and symbolic imitation	Using objects through imitation for symbolic play
11. Snack	Preference selection. Showing/offering food.

Concluding, The ADOS-2 diagnostic algorithm categorizes subjects into autism, spectrum, or no-spectrum based on social affect and restricted and repetitive behavior. However, it is not sufficient for a diagnosis, and a clinician should perform a comprehensive evaluation considering DSM-5 criteria. Comparison scores can also be provided to assess the severity of symptoms. Hence, it is recommended to combine ADOS-2 with other clinical instruments for a more accurate evaluation. Moreover, ADOS-2 scores reflect the current period, and some behaviors may not be observed during the assessment.

The Autism Diagnostic Interview-Revised (ADI-R)

ADI-R is a semi-structured interview for caregivers to evaluate behaviors related to the three diagnostic domains of ASD. It takes approximately 90 minutes to administer and asks 94 questions about the individual's current functioning. Questions focus on behaviors displayed between the ages of 4 and 5 years, the most pronounced period for these behaviors. When used in combination with the ADOS, the ADI-R yielded the strongest accuracy in classification of ASD, particularly for children older than 3 years old with symptomology indicative of autistic disorder.

Recommendations by the Italian guidelines for assessment of ASD

The Guideline for the diagnosis and treatment of autism for children and adolescents was updated in October 2023 (https://www.iss.it/-/raccomandazioni-lg-diagnosi-trattamento-di-bambini-adolescenti-con-asd, accessed date 15/12/2023). Diagnostic tools are limited to the few with scientific evidence. Much emphasis is placed on the expert's clinical observation to identify the main symptoms. Concerning the indirect evaluation, The Panel of Experts of the Guideline does not suggest using semi-structured interviews with parents, which are currently very widespread, such as the Autism Diagnostic Interview-Revised (ADI-R), the Diagnostic Interview for Social and Communication Disorder (DISCO) and the 'Autism Spectrum Rating Scales (ASRS). The Panel believes that observation and clinical interview represent the privileged reference for collecting the nuclear symptoms necessary to make a diagnosis of autism according to the criteria established by international classification systems. It also suggests using the Checklist for Autism Spectrum Disorder (CASD) as an indirect tool to support the diagnostic process. On the other hand, among the structured and standardized tools aimed at children/adolescents, the Panel suggests using the Autism Diagnostic Observation Schedule (ADOS-2) for the support of the diagnostic process. ADOS-2 is preferable to CARS as the latter presents a greater number of false negatives. The Childhood Autism Rating Scale (CARS, Schopler 1980) is a 15-item observation-based rating scale designed to accurately differentiate children with autism from those with developmental delays without features of autism. Finally, the Panel does not suggest using the Gilliam Autism Rating Scale (GARS).

2.3 Assessment of related disorders

Autism is a disorder that shares characteristics with other neurodevelopmental and psychiatric disorders. The DSM-5 diagnostic criteria for ASD includes specifiers for associated features of ASD, allowing clinicians to provide information regarding other disorders that may also be present. Differential diagnosis should include assessment for commonly occurring comorbid diagnoses such as intellectual disability (ID), language disorders, genetic conditions, and other neurodevelopmental or behavioral disorders.

Intellectual Impairment

The assessment process should also include an appropriate measure of cognitive functioning, with an evaluation of both verbal and nonverbal intelligence. Although, science has indicated that the majority (62 %) of children identified as having ASD did not have co-occurring intellectual disability (ID), ID and ASD do covary at high rates. Those with ASD and ID showed greater deficits in adaptive behaviors, social skills, challenging behaviors, and comorbid mental health disorders. Furthermore, Ben Itzchak et al. found that young children with ASD who also had IQs below 70 presented with greater deficits in social, play, and stereotyped behaviors than children at the borderline or average intellectual functioning level [26]. Cognitive deficits represent a critical factor in prognosis; however, early intensive treatment has been associated with improved outcomes for children of varying cognitive levels with ASD. Assessing adaptive functioning is crucial to identify strengths and weaknesses in individuals with ASD and ID. The Vineland Adaptive Behavior Scales—Second Edition is a semi-structured parent interview that evaluates adaptive functioning in four domains: communication, daily living skills, socialization, and motor skills. It provides an overall Adaptive Behavior Composite score and is useful for determining individualized educational and vocational planning. Both individuals with ASD who use fewer than five words and those who use more than five words exhibit significant deficits in adaptive skills, with interpersonal relationships, play and leisure time, and expressive subdomains being the most affected areas.

Language Impairment

Language development is often one of the first signs of ASD. Although not a criterion for diagnosis, the presence or absence of accompanying language impairments should be specified. The language profiles of individuals with ASD are highly variable, with approximately 25% remaining nonverbal. Children with ASD may also exhibit additional speech and communication difficulties. A comprehensive assessment by a qualified speech-language pathologist is essential, with audiological evaluation conducted prior to language evaluation. Standardized testing and parent report are primary approaches to assessing communication skills in children with ASD. Mainly, nonverbal cognitive ability and use of gestures predict early language development.

Neurodevelopmental, Mental, or Behavioral Disorders.

Assessing comorbid psychiatric or behavioral difficulties in individuals with ASD is challenging due to overlapping symptoms, impaired communication, and lacking diagnostic tools. Clinical judgment informed by various sources is typically used, but instruments such as PAC (psychopathology) and ASD-CA (comorbidities in adult) are being developed for assessment. Identifying comorbid diagnoses is crucial for treatment planning. However, comorbidity is more difficult to detect among younger children. Several instruments exist to assess comorbidity among children with ASD, including the BISCUIT (The Baby and Infant Screen for Children with Autism Traits), ASD-CC (Comorbidity for Children), and ACI-PL (Autism Comorbidity Interview - Present and Lifetime). Studies have shown that comorbid psychopathology is common in ASD, with varying rates of prevalence depending on the age range and assessment method. Adolescents and adults with ASD have higher rates of comorbid conditions, including depression, anxiety disorders, ADHD, intellectual disabilities, and language disorders. Moreover, cchallenging behavior is defined as abnormal behavior that puts the physical safety of a person or others in threat, or behavior that

limits access to community facilities. It can be difficult for family, staff, society, and the individual themselves. Challenging behaviors include self-injury, repetitive behaviors, aggression, destructive behaviors, toileting difficulties, and feeding problems. These behaviors can severely impact an individual's quality of life and self-esteem. They can interrupt one living an independent life and may be caused by pain or environmental events. Challenging behaviors in individuals with ASD may be caused by physical pain from medical issues such as gastrointestinal symptoms or epilepsy. Identifying the source of challenging behavior is crucial for pain relief. Comorbid psychopathology can also contribute to challenging behaviors, which may include aggression, self-injurious behavior, or stereotyped behavior. Nonverbal individuals may communicate through challenging behaviors, which should be interpreted as a form of communication. Functional assessment is an effective way to investigate the variables maintaining a challenging behavior and determine the most effective treatment intervention.

Functional Assessment of Challenging Behaviors

There are various measures to determine the maintaining variables of challenging behaviors, which must be established before designing an effective treatment plan. Behaviors can be maintained by positive, negative, or automatic reinforcement, access to tangible items, or escape from aversive situations. Some challenging behaviors may have multiple functions. Different functional assessment measures can be used with individuals with ASD who display problem behavior. All instruments and procedure in order to address functional analysis of behavior require a specific training in behaviour analytic treatments, for gather more information please see the https://www.bacb.com/ (accessed date 29/03/2024).

Autism Spectrum Disorders Behavior Problems for Children (ASD-BPC) and for Adults (ASD-BPA)

The Autism Spectrum Disorders-Behavior Problems for Children (ASD-BPC) and ASD-Behavior Problem for Adults (ASD-BPA) are scales used to assess behavior problems in children and adults with ASD. The ASD-BPC has 18 items with two dimensions: externalizing and internalizing. The ASD-BPA has 19 items with four subscales: Aggression/Destruction, Stereotypy, Self-Injurious Behavior, and Disruptive Behavior [27].

Aberrant Behavior Checklist (ABC) and Child Behavior Checklist (CBCL)

The Aberrant Behavior Checklist is a 58-item scale used to rate problem behaviors on a scale of 0 to 3. The five subscales are Irritability, Lethargy, Stereotypy, Hyperactivity, and Inappropriate Speech. The scale has been shown to have high internal consistency and reliability. However, its factor structure may need to be revised for children under the age of 5. Aberrant behavior patterns are associated with severity of autism symptoms and lower adaptive behavior. The Child Behavior Checklist (CBCL) is a measure for children aged 1.5-18 years that helps identify Internalizing and Externalizing problems. The CBCL 1.5-5 has six syndrome scales, while the CBCL 6-18 has eight empirically derived Syndrome Scales.

Anxiety Disorders and Obsessive-Compulsive Disorders (OCD)

Anxiety disorders and OCD are common among people with ASD, both in youth and adults. The prevalence of anxiety disorders is significantly higher in individuals with ASD compared to the general population. Anxiety can exacerbate core ASD symptoms and trigger disruptive behaviors. Unfortunately, anxiety and OCD often go unnoticed or misdiagnosed in individuals with ASD, highlighting the importance of routine assessments. Assessing anxiety can be challenging due to overlapping symptoms that make it difficult to distinguish between anxiety/OCD and ASD behaviors. This is known as diagnostic overshadowing and can lead to a lack of recognition for co-occurring psychiatric disorders. Additionally, atypical presentations of anxiety/OCD in individuals with ASD are often missed due to current assessment tools not capturing certain behaviors. However, with thorough evaluation and sound clinical judgment, it is possible to distinguish between these disorders. Accurately identifying co-occurring anxiety/OCD is important for

effective treatment planning and can have implications for social skill interventions. Despite the challenges, there is a lack of guidance and agreement on how to best assess anxiety/OCD in this population.

Attention deficit hyperactivity disorder (ADHD)

The diagnosis of ADHD requires clinicians to use their clinical judgment based on DSM-5 criteria, considering the presence, duration, and impact of symptoms. Diagnosis should be based on a detailed developmental and clinical history with parents, and the use of multi-informant standardized behavior rating scales. It is crucial to compare symptom severity to same-aged peers and determine if the symptoms are pervasive and impairing. ADHD is often identified in school-aged children, with inattention symptoms becoming more observable as academic demands increase. Diagnosis should not be based solely on parent or teacher reports, and clinical practice guidelines exist worldwide to improve diagnosis and standardize clinical management. Also, specific assessment for comorbid developmental, medical, and mental health conditions can be included. When diagnosing ADHD, factors such as behavior, impact on classroom functioning, academic performance, interaction with peers and teachers, and implemented strategies should be considered. Medical, psychological, or neuropsychological tests are not necessary, but a physical examination should be done to rule out medical causes. Standardized tests may be used for comorbidities or general abilities, but they cannot confirm or disconfirm ADHD. Children with ADHD may have a positive illusory bias, so adolescent self-reports are important. Diagnosis should not rely solely on observations in a clinical environment, as symptoms may not be present in that setting. A diagnosis should only be made if the child meets the full criteria, including a minimum number of symptoms and evidence of inattention, hyperactivity, and impulsivity symptoms. Assessments should also consider developmental and mental health comorbidities, as these predict poorer functioning over time. A comprehensive ADHD assessment is recommended for children with ASD if ADHD symptoms persist after implementing educational, speech/language, and behavioral supports [28]. ADHD-Specific Assessment Tools include the Conners Rating Scale/Conners 3, Brown ADD Scales, and ADHD Rating Scale IV. There have only been a few studies which have attempted to determine whether these questionnaires can differentiate ASD from ADHD.

Major Depressive Disorder (MDD)

Depression is a prevalent psychiatric disorder in individuals with ASD, with estimates suggesting between 1.4 and 24% of this population have comorbid depression. This condition is often underdiagnosed, and researchers believe it occurs at higher rates in individuals with ASD compared to the general population or those with intellectual disabilities. Comorbid depression in children with ASD varies greatly. Depression can be diagnosed using various methods, including structured and semi-structured interviews, behavior checklists, and unstructured interviews. However, the assessment of depression in children and adults with ASD is not well-established. The standard method for assessing depression in ASD involves a thorough history and clinical interview, relying on self-report of symptoms and behavior. Secondary reports from parents and caregivers can provide valuable information about changes in behavior, such as depression mood or anhedonia. Attention should be given to recent changes in behavior, restricted interests, stereotypies, ritualistic behaviors, sleep disturbances, changes in appetite, increased social withdrawal, and crying spells. It is crucial to consider changes in behaviors related to ASD in the context of an individual's general temperament and behavioral history. Major depressive disorder (MDD) symptoms must persist over a 2-week period and represent a change in previous functioning. Diagnosis should consider individual differences and include a depressed mood, loss of interest, or pleasure in previously enjoyed activities. Symptoms may be self-reported or supported by behavioral observations. In typically developing children, depressed mood may be expressed as irritability. Observable symptoms include significant weight loss or gain, sleep difficulties, psychomotor agitation, and fatigue. Individuals with low-functioning ASD and intellectual disability may experience similar symptoms, but cognitive symptoms may be harder to assess due to deficits in verbal communication. High-functioning ASD individuals may

experience greater difficulty in expressing sadness and may experience more commonly associated symptoms. High IQ individuals with ASD may be at risk for depression due to perceived lower self-worth or better self-assessment abilities. Assessing depression in individuals with intellectual disability requires a combination of specific measures and psychopathology. For lower-functioning individuals, psychopathology measures may be more useful, while standard measures like the Beck Depression Inventory or Children's Depression Inventory may be more appropriate.

Food selectivity in ASD

The DSM-5 includes nutrition and eating disorders during childhood, including pica, avoidant/restrictive food intake disorder, and rumination disorder. These disorders can lead to reduced food consumption, affecting physical health and psychosocial functioning. Clinicians must distinguish between organic and behavioral aspects before treatment, as symptoms may be due to bio-medical factors or dysfunctional behaviors. Both medical and behavioral dimensions can coexist during the same period. Food selectivity in children with ASD has been found to be more prevalent than in typically developing children. Children with ASD reject more food, prefer certain foods, and assume less of certain foods, such as fruits, dairy products, vegetables, proteins, and starch. Studies have shown that children with ASD are more reticent to try new foods and have a restricted variety of food. Over time, problems related to food selectivity may persist in adolescence and adult life, and early clinical intervention is necessary to address these developmental problems. Overweight and obesity are more associated with psychiatric disorders in children, such as ADHD and ASD. Children with ASD often consume excessive snacks and high-calorie foods, leading to a higher incidence of obesity. The relationship between autism and unhealthy weight is heterogeneous, with some studies showing a significantly lower body mass index (BMI) in children with ASD compared to controls. Food selectivity can also be associated with Pica disorder, atypical use of tools, preferences regarding food preparation, and food preferences based on texture, colour, or temperature [29]. Food selectivity in children with ASD can be attributed to various factors, including motor conditions, gastrointestinal complications, repetitive behavior, and restricted interests. Some researchers argue that the cognitive level and severity of autism are not significantly associated with food selectivity. Food selectivity can be a manifestation of altered sensory responses and behavioral rigidity, manifesting through preferences regarding consistency, appearance, taste, smells, temperature, and sensory stimuli. Sensory processing anomalies common in individuals with ASD may be part of the mechanisms underlying food selectivity. Children with ASD often display hypersensitivity to various sensory stimuli, affecting mealtimes. Other challenging behaviors, such as aggression, choking, internalizing and externalizing problems, rejection of food, and repetitive and restricted behaviors, have also been associated with food selectivity [30]. Nutrition assessment for children with ASD involves identifying causal nutritional inadequacies linked to restricted intake, as children often choose diets limiting fruits and vegetables. Clinicians should gather anthropometric data, current diet, and related eating history to assess feeding issues. A comprehensive feeding diary should be used to compare the child's current food categories with well-known dietary recommendations. Gastrointestinal issues should be excluded to explore possible organic pathologies. Sensory stimuli affecting feeding behaviors should be investigated. Before implementing an educational intervention, clinicians should address intersectional aspects such as GID, assumed foods, and growth curves. The Body Mass Index (BMI) should be calculated to monitor the target child's eating habits. Families should also investigate if the child is on a gluten/casein-free diet and refuses certain ingredients. The Food Frequency Questionnaire (FFQ) can be used to gather information about the child's current diet and related nutritional deficiencies. The assessment is the first phase of a clinical evaluation process, focusing on cognitive, emotional, and behavioral functioning.

Assessing Sleep Problems, Prevalence of Sleep Problems in Individuals with ASD

Children with ASD are more likely to develop sleep problems than their typically developing peers, with approximately 50-80% experiencing cooccurring sleep disturbances. The association between age and cognitive level of cognition and sleep difficulties is different for individuals with ASD compared to those with other developmental disorders. Research shows that parents of children younger than 8 years of age report more severe sleep concerns than those of older children. Sleep difficulties are present in high-functioning adolescents and adults with ASD, with older children and adolescents experiencing more nighttime issues, while younger children exhibit greater bedtime resistance, sleep anxiety, parasomnias, and night waking. Sleep problems can have significant impacts on individuals and families, including children with developmental disabilities. Poor sleep-in children with developmental disabilities can lead to cognitive, mood, attention, and behavior issues. Negative mood, irritability, self-injury, and aggression are also linked to poor sleep-in children. Disruptions in parental sleep and higher maternal stress are also linked to sleep problems. Children with ASD and sleep problems have more severe symptoms, hyperactivity, mood and aggressive behavior, inattention, activity level, repetitive behavior, self-injury, and affective difficulties. Sleep problems also lead to greater internalizing and externalizing behavior problems and poorer adaptive skill development [31]. Sleep surveys and questionnaires are used to evaluate a child's sleep habits, difficulties, and medical concerns. The Children's Sleep Habits Questionnaire (CSHQ) is a useful screening device for children with ASD, assessing sleep difficulties in toddlers, preschoolers, and adolescents. The CSHQ consists of 45 items that ask parents to report their children's sleep behaviors over the past month. The Sleep Committee of the Autism Speaks Autism Treatment Network developed a practice pathway for identifying, evaluating, and managing insomnia in children and adolescents with ASD (www.autismspeaks.org/tool-kit/strategies-improve-sleep-children-autism, accessed date 29/03/2024). Practitioners are advised to screen all children for insomnia by asking questions from the CSHQ and determining if the parent considers these issues a problem. The practice pathway also emphasizes the importance of addressing any medical issues impacting sleep, with a questionnaire to help identify underlying conditions. Sleep diaries and homework sheets are tools used to gather information about a child's sleep patterns. These measures are typically completed before bed and first thing in the morning, and can include information about daytime habits, evening habits, sleep setting, bedtime routine, use of visual supports, bedtime, sleep resistance, night wakings, and wake time. The information collected can be used for initial assessment and evaluation of intervention effectiveness.

Neuropsychological Assessment

Neuropsychological assessment is a crucial tool for diagnosing ASD, assessing cognitive functions such as verbal and visuospatial reasoning, attention, memory, processing speed, learning, memory, and motor functioning. It is important as these domains are commonly associated with functional outcomes in ASD. Neuropsychological functioning is also related to symptoms of ASD and may suggest underlying impairments related to symptom expression. However, many areas of functioning often show little or no deficits when studied at a group level. For example, normal performance has been found in memory functioning, attention, phonological processing, and syntax in individuals with ASD without language impairment. In intellectual performance, visuospatial reasoning may be intact with concurrent verbal impairments. Likewise, ASD is associated with impairments in executive functioning, such as set shifting and inhibition, and is associated with symptoms of repetitive behavior and restricted interests. Memory deficits in ASD have been found on tasks of working memory, short-term memory, and long-term memory, with poor spatial working memory being a significant factor in distinguishing between individuals with and without ASD. The core neuropsychological deficit in ASD is a generalized deficit in processing and integrating complex information, which contributes to real-world functional impairment. Regarding Executive Functions and Theory of Mind, EF abilities are believed to play a key role in the emergence of ToM, and studies have shown predictive relations between EF and ToM in both typically developing

individuals and individuals with ASD/HFASD. ToM falls on a continuum of increasing complexity, with first-order ToM involving considering another person's mental state, second-order ToM requiring children to predict a main character's behavior based on their understanding of a secondary character's mistaken understanding, and more advanced levels of ToM involving examining naturalistic conversations where the speaker's intentions are ambiguous or inconsistent with their true intentions. Training EF could lead to ToM improvements and enhance social communication for those with ASD. Research shows that spatial and verbal abilities significantly predict students' performance on social communication tasks (ToM). Emotional processing (EF) can impact ToM in two ways: through the expression account, where children possess ToM abilities but struggle to demonstrate them due to EF demands, and the emergence account, where EF is essential for developing ToM. Studies show that individual differences in EF predict later ToM abilities. Interventions targeting EF abilities may facilitate the development of ToM in children with ASD [32].

Expressive and receptive language issues in ASD

Language deficits in individuals with ASD can vary in severity, with some developing language and others struggling with higher order pragmatics. Functional imaging studies involving higher functioning adults with ASD have shown that individuals with ASD are less attentive to human voices and speech, and do not show enhanced activation of the superior temporal sulcus in response to voice-related sounds [33]. This abnormal pattern of neural activity is associated with impaired ability to recall voice sounds. Semantic processing is spared in many high functioning adults with ASD, but certain deficits in memory have been shown in both behavioral and functional imaging studies. Participants with ASD do not display a memory benefit when learning semantically related words or using semantic knowledge. Comprehension in individuals with ASD shows less activation in the left inferior frontal gyrus (Broca's area) and decreased connectivity between language-related areas. This suggests that typical language-related regions might not be as specialized for language processing in ASD as they are in healthy individuals [34]. Pragmatic language involves using extra lingual cues to understand and use language in context, including irony, sarcasm, metaphor, and puns. In individuals with ASD, right inferior frontal gyrus activation is increased, affecting inferences about speakers based on context and interpretation of ironic statements. This increased right hemisphere processing is hypothesized to reflect more effortful processing of pragmatic language. Prosody, or the rhythm and intonation of language, can carry meaning beyond the content of speech. Research suggests that understanding prosodic cues is impaired in ASD, leading to more nonspecific activation in both grammatical and emotional forms [35]. Laterality in language processing is reduced in ASD compared to healthy participants, with evidence suggesting this alteration occurs early in development. Children with ASD have reduced left temporal laterality and increased right hemisphere activity to speech, with disruptions more pronounced in older children. Early connectivity disruptions may lead to reduced functional specialization of language-related brain regions, including comprehension and semantic processing. Research indicates a strong link between early nonverbal communication, specifically gestures, and verbal expressive and receptive language in children. Gestures are also predictive of later language outcomes in children at risk for autism. Recent neuroimaging evidence suggests that individuals with ASD may not effectively integrate multimodal communicative information in complex social situations, indicating that the production of gestures may be disrupted in ASD [36].

Social Cognition and Emotion

ASD is characterized by disruptions in social and emotional processing, which are a hallmark of the human brain. The social brain, which includes regions like the superior temporal sulcus, amygdala, orbito-frontal cortex, and fusiform gyrus, is finely tuned for recognizing and processing social stimuli. Disrupted neural structures involved in social processing may impair behavior, and lack of early experience with social interactions may impair proper functional specialization and development of neural structures. In ASD, individuals show reduced attention to human faces, which is a strong predictor of later diagnosis. The fusiform face area (FFA) is involved in face processing, but in ASD, it is reduced or lacks activation. This reduction in FFA activity may be dependent on familiarity, suggesting that social drive and motivation factors may be modulating the activity of the FFA [37]. Individuals with ASD often struggle with recognizing and understanding emotions through facial expressions or emotional body positions. This is crucial for successful social interactions and may be dependent on intellectual ability. Some studies have found intact basic emotion recognition in high-functioning individuals with ASD, but there is also a possibility that compensatory mechanisms and task cues may benefit them. Neuroimaging evidence suggests that individuals with ASD use compensatory or alternative mechanisms for facial emotion recognition, with reduced activation in the FFA and amygdala and increased activation in the anterior cingulate cortex and praecuneus. This may be related to gaze fixation on faces, which may negatively impact the neural systems involved in face recognition [38]. Nonverbal behavior, such as body posture and eye gaze, can also convey important communicative and emotional information. Understanding and interpreting others' actions is critical for normal social processing. Research suggests that ASD is a core deficit in theory of mind, which involves understanding others' thoughts and beliefs and attribution of mental states. Multiple tasks have been used to study neural processes involved in theory of mind, including verbal and non-verbal tasks. Participants with ASD show reduced ability to attribute mental states to others, associated with reduced activation in areas like the medial prefrontal cortex, superior temporal sulcus, and temporal parietal junction. A study found reduced temporal parietal junction and inferior frontal gyrus activity in participants with ASD when making intentional attributions, as well as reduced white matter integrity of the superior temporal cortex using DTI [39]. Research suggests reduced connectivity between frontal regions involved in theory of mind and posterior regions like the temporoparietal junction in autism. The Mirror Neuron Hypothesis suggests that dysfunction of mirror neurons may be at the heart of the disorder. Mirror neurons were first discovered in monkeys and fire both when performing an action and when observing another person or monkey performing the same action. Research in humans supports the general idea of a "mirror neuron system," where the same brain involves areas in both the observation and execution of actions. The most commonly found brain regions with these properties include the inferior frontal gyrus and inferior parietal lobule. Some evidence of an extended mirror neuron system involved in emotion processing, somatosensory stimuli, and language processing. However, there is little clear fMRI evidence of a mirror neuron dysfunction in ASD. The general idea of a "broken" mirror neuron system has been met with resistance, and until more is understood about the nature and existence of the human mirror neuron system, it is premature to use it as an explanatory mechanism of ASD [40].

Evidence-based interventions

CHAPTER 3

Commentary of National Guidelines of 2023

Let's get to the heart of the matter: educational interventions. Some will sound completely new than the past, given the limited availability in different countries or of training opportunities and effective delivery. Concerning Applied Behavior Analysis (ABA): the panel suggests using comprehensive individual behavioral interventions based on the principles of ABA for children and adolescents with ASD, even if the supporting evidence in the scientific contributions chosen by the Panel (exclusively randomized control trials, RCTs) they have limited evidence and the population investigated reaches up to 7 years of age. Treatments take place over one or more years for many hours a week and aim to influence multiple objectives, such as communication, behavior, and social competence. ABA can also be designed for specific domains and focused behaviors. Although there are few randomized studies, it is illustrated that groups of children treated with ABA present a greater improvement than those treated with standard interventions.

Furthermore, two prestigious reviews that also include non-randomized studies were not considered: Reichow et al., 2012 [41], a review that analyses the results of randomized and non-randomized studies, including five trials (219 girls and boys); the review highlights that EIBI (Early Intensive Behavior Intervention), including ABA, improve adaptive behavior, IQ, expressive language and receptive language; do not significantly affect core symptoms and behavior; Makrygianni et al., 2018 [42], a review that carries out efficacy assessments based on pre-post analyses and includes 29 studies (831 children); ABA therapies are found to improve intellectual abilities, communication, expressive language, receptive language, non-verbal IQ tests, adaptive skills, socialization. Considerations for implementation: the panel considers that the extreme heterogeneity of the clinical expression of autism spectrum disorder prevents it from formulating a standardized indication of the number of hours of ABA intervention necessary for treatment but believes that there is a positive correlation between the intensity of intervention and support needs of children and adolescents with ASD. The panel underlines that the responsibility for therapeutic management must remain in the healthcare sector and be coordinated by adequately trained workers. It must be taken into account that, currently, the majority of trained operators are not healthcare professionals but educators or with other educational backgrounds, although they represent an extensive professional offering.

Treatments based on ABA principles focused on specific skills: Discrete Trial Training and Positive Behavior Support; Specific intervention strategies: Antecedent-based Interventions, Differential Reinforcement; Extinction; Functional Behavior Assessment; Modelling; Prompting; Reinforcement; and Task Analysis. These techniques, very widespread and studied [43], have an impact on specific areas of development: Core Symptoms (communication and social interaction), Core Symptoms (restricted, repetitive behavior patterns, interests or activities), Behavior, Global functioning, Language skills, Shared Attention Focused individual interventions based on ABA principles may improve expressive language skills compared to standard treatment. Regarding emotional dysregulation (irritability), individual-focused interventions based on ABA principles may not produce a reduction compared to standard treatment. The following systematic reviews were also considered: Aljehany & Bennett, 2019; Martinez et al., 2016; Qi et al., 2018; Rivera et al., 2019; and Wright et al., 2020 relating to the impact of therapeutic strategies present not only in ABA but transversal to various interventions [44-48]. In general, the therapeutic strategies considered were useful, especially in the school environment, to reduce "challenging behaviors". Specific strategies evaluated in the reviews are Prompting, and action taken to directly support the child in completing a task. The results report the video prompting intervention as effective for increasing global functioning, especially in adolescents and adults. Regarding video Modeling: a moderate or strong effect of

video modeling was shown in improving social-communication skills in participants with ASD. On the other hand, regarding Antecedent-Based Interventions; furthermore, it has been shown that behavioral intervention packages that include strategies such as video modeling are generally effective in increasing the effect of medical procedures; while the treatment with Functional Communication Training (FCT): treatment with FCT via telemedicine resulted in a significantly greater reduction in problem behaviors compared to standard treatments, we have confirmed in 2020 the efficacy of this procedure in a case report in decreasing severe behaviors [49]. Social communication and the ability to complete tasks also improved. Considerations for implementation: the Panel believes that the intervention may be more useful for certain subgroups of children. He also notes that individual interventions focused on specific behaviors based on ABA principles represent strategies that can be used for different age groups and different clinical and educational contexts.

Other interventions are considered Developmental and naturalistic interventions, where the Panel suggests using comprehensive and individualized Naturalistic Developmental Behavioral Interventions (ICEN) for children and adolescents with ASD. The main clinical models are the Early Start Denver Model (ESDM), Social Communication Emotional Regulation Transactional Support (SCERTS), and Pivotal Response training (PRT). Focused courses such as Joint Attention-Symbolic Play Engagement and Regulation (JASPER) and Reciprocal Imitation Training (RIT) are also suggested for ICEN. Regarding the individual comprehensive educational interventions: the clinical model regarding the organization of the corresponding services is TEACCH (Schopler et al., 1971). This is an intervention that modifies and structures the environment to cope with the difficulties related to autism. The tests examined relate to children aged between 2 and 14 years. Likewise, the Individual comprehensive developmental interventions: Developmental, Individual-Difference, Relationship-based (DIR) – Floor time (Greenspan & Wider, 1999); Relationship Development Intervention (RDI); More Than Words R - The Hanen Program. Developmental approaches differ from behavioral approaches because they are generally based on a theory of typical child development. The developmental approach underlines the importance of the affective and emotional experience in which the child is immersed and of early interventions that can reorient his developmental trajectory. From this perspective, the use of strategies to promote and develop communication and social interaction skills aimed at structurally modifying the organization of functions and not just behaviors are fundamental. The evidence in favour is still uncertain.

Moreover, the Panel suggests using Cognitive Behavioral Therapy (CBT) in children and adolescents with ASD and anxiety disorder without significant cognitive impairment. Also, the Picture Exchange Communication System (PECS) in children and adolescents with ASD is recommended. Communication interventions involving speech-generating devices: The panel suggests using these techniques for children and adolescents with ASD. The intervention should be considered particularly for children with reduced or no functional language levels.

Social Skills Group: The panel suggests using the intervention for children and adolescents with ASD. The effect could be greater in the subgroup with a high level of intellectual functioning. Furthermore, he suggests using and including the Theory of Mind (TOM) intervention, also using technological devices.

Finally, regarding interventions for parents, the panel agrees on the usefulness of the practice of informing parents/caregivers on ASD, on the specific needs and peculiarities of the functioning of the child/adolescent with ASD, on the rights of the person, on the network of services available in the area and on the need to build a personalized life plan early. Individual and group interventions and training interventions are suggested.

Concluding, the updates underline that the educational intervention can be varied. Currently, the choice of one approach over the others depends almost exclusively on the availability of professionals in the area and on the training provided by public and private forms. The decision regarding the intensity of treatment

provision appears to be deferred to the local health institutions. The Guideline makes no mention of the presence of the supervisor for the implementation of the services. In daily experience, the quality of treatment is strongly conditioned by this presence [50]. The staff currently carrying out treatments may not meet the health requirements indicated by the panel, despite having great clinical expertise and being of great help to families. The provision of services should be also regularly monitored, as well as, cross-section and longitudinal studies on the effectiveness of public and private provision measured on children and adolescents are essential.

3.1 Early intensive behavioral intervention

Recent scientific literature on behavioral intervention programs for children with ASD has shown effectiveness in improving communication, social skills, and problem behavior. Early Intensive Behavioural Intervention (EIBI) involves a tailored educational plan applied by trained therapists in multiple settings, following principles of ABA, developmental psychology, social neurosciences, and special education. The UCLA Young Autism Project uses the Lovaas method of intervention, focusing on imitation, interaction, play, and basic requests. The Denver model, known as the ESDM, is based on a developmental model, focusing on positive affect, pragmatic communication, and interpersonal interactions in a structured environment. The effectiveness of Early Intervention is well-established, with behavioral interventions increasing language, cognitive, and adaptive skills in children and adolescents. However, research results are often cautious due to the heterogeneity of children's responses to treatment. Factors such as age at initiation, cognitive ability at intake, and language skills at intake can affect a child's response to treatment [51]. Also, autism symptom severity has been found to account for additional explanations for different child outcomes. Parent training is considered a good practice, but the current evidence base is insufficient. Studies have shown short-term improvements in language, social, and adaptive skills for children whose parents received training [52]. Research also shows a relationship between parental stress and staff treatment fidelity, which interferes with treatment planning and positive behavior outcomes. Psychological support and supervision are crucial, and case managers must balance families' needs and personal resilience during intervention time [53]. The rapid brain development in the first years of a child's life offers an opportunity for optimal intervention timing. The brain's ability to change in response to environmental stimuli is greatest in most individuals early in life, which may account for the ease with which children of typical development acquire language during early childhood. Learning new skills may allow children to experience a wider variety of learning opportunities, such as social interaction and question-asking skills. The impact of the environment on early child development is undeniable, with exposure to spoken language in homes during early childhood potentially leading to better academic gains and better receptive and expressive vocabularies later in life. Recent research involving children referred for autism supports this, suggesting that children with autism may experience the same period of sensitivity to language-rich environments as children of typical development. These findings have implications for the timing of intervention initiation and the use of strategies designed to increase exposure to language during early interventions for children with autism. Interventions for children with autism are generally more effective when they are intensive, with intensity typically measured in hours per week. A study by Lovaas (1987) found that the 40-hour intervention group experienced significantly more improvement in IQ than the 10-hour group. Recent studies have found that different intervention dosages yield better outcomes, with 30 hours per week yielding statistically better outcomes than 12 hours per week. However, there is debate about whether more intervention is better for a child, as it may be counterproductive and cause children to burn out. Parents often ask for more intervention hours, but child outcomes were not better when intervention was implemented by parents with high stress levels. Fava and Strauss (2014) suggest considering intervention intensity in terms of active involvement of the child and implementer, setting (e.g., home and community), and treatment fidelity variables.

Behavioral Intervention

An intervention can be considered behavioral when it involves the intentional use of operant principles (Skinner, 1988) via ABA in an effort to improve observable and measurable skills (Baer, Wolf, & Risely, 1968). Hence, behavioral interventions focus on changing the interaction between the child and the child's immediate environment in order to provide specific types of learning opportunities. Several meta-analyses and systematic reviews have attempted to replicate Lovaas' findings, with four of the five meta-analyses concluding that EIBI was an effective approach to the treatment of children with autism. However, some reviews have concluded there was insufficient evidence to consider EIBI empirically-validated. Various variations in EIBI have emerged since Lovaas' (1987) study, emphasizing natural environments and routines, involving parents as interventionists [54], focusing on specific target behaviors, and following the child's motivation. Different specific interventions share common core components (as reinforcement) and have been demonstrated to be effective in various research designs, including RCTs and SCDs as Discrete Trial Training. Discrete Trial Training (DTT) is a teaching procedure that has been proven effective in resolving social, communication, academic, and self-help difficulties associated with ASD. Originating from Lovaas' work at the University of California, DTT is a structured model and curriculum for EIBI, often embedded within other approaches like natural environment teaching and verbal behavior teaching [55]. DTT models focus on establishing early learning repertoires, such as imitation, to facilitate fluency in skill acquisition. The goal is to teach the child to respond to language and social stimuli meaningfully, involving repeated presentations of a discriminative stimulus, a structured prompt sequence, the target behavior, a reinforcer, and an intentionally short interval before the next trial. DTT is a teaching method that involves prompt fading, reinforcement, measurement, and procedural variations. Prompts are antecedent stimuli that increase the probability of correct responses in the presence of the stimulus (SD). They can be combined with the SD at the start of the discrete trial to ensure a learner responds without error. Prompts can also be delivered as part of an error correction procedure when the learner responds incorrectly or fails to respond to the SD [56]. The contingent delivery of prompts is intended to evoke the correct response within the same instructional trial or increase the likelihood of the learner emitting the correct response on the next trial. Research has shown the effectiveness of most-to-least prompting (MTL), least to-most prompting (LTM), graduated guidance, and prompt delay [57]. Correct responses are followed by brief praise or access to a preferred item (selected via stimulus preference assessment). Differential consequences following prompted versus unprompted responses are also recommended. Task interspersal procedures improve performance by functioning as a motivational operation (MO). DTT is a structured approach to learning that involves trial-based recording of performance. Therapists record the outcome of every learning trial, summarize it across blocks, and examine the data frequently. Continuous recording is an alternative, but discontinuous recording may alter the accuracy or sensitivity of measurement [58]. DTT programming is structured, rapidly paced, and contrived in the initial learning environment, which is distraction-free to promote attention. It emphasizes intensive intervention with teaching occurring across a large number of hours and a high density of learning units. The initial sessions often occur at a small table or with the adult and child sitting face-to-face. As the child develops attending skills and compliance, teaching begins across settings in more natural contexts to facilitate generalization of newly learned skills.

Early educational planning focuses on establishing critical learning repertoires to facilitate later skills acquisition and accelerate developmental progress. Children learn to attend, imitate sounds and movements, match objects and pictures, and comply with basic directions. The curriculum is hierarchical, with early skills mastered before moving up to more difficult skills. Establishing DTT services requires several preparatory steps, including orienting families to basic information about DTT programming, providing general information about autism, and establishing rapport with the child through "pairing" (adult applies conditioning to person, materials and settings). Instructional demands are gradually introduced and interspersed with ongoing pairing activities to ensure a rich and positive interaction

schedule. Assessment activities are used to select a reasonable array of programs, and families can be involved in services from the beginning by participating in pairing sessions and providing information about preferred items and activities. A successful program for children with language, motor, and adaptive skills involves a partnership between the family and the provider team. The family plays a crucial role in determining the specific items to target and enhancing the program's relevance for their lives. Data on the learner's progress is used to evaluate the effectiveness of the program. The goal is to teach children a variety of skills consistent with those exhibited by same-age peers. A strong focus on generalization of skills in naturally occurring situations is necessary. DTT should be implemented by both specialized behavioral therapists and parents, teachers, and other care providers responsible for the child's social, educational, and behavioral development. Studies showing good outcomes with DTT have included a caregiver training component, suggesting that outcomes may be similar regardless of whether parents or trained professionals serve as the children's primary therapist.

Behavioral Skill Training and Tele medicine

Behavioral skills training (BST) is an effective method for teaching behavioral interventions to teachers, parents, and staff. It consists of four components: instructions, modeling, rehearsal, and feedback [59]. BST is considered the gold standard for training others, but it can be expensive, time-consuming, and requires expert availability. Alternative training modalities, such as written manuals, videos, and computer-based instruction, have been developed to enhance efficiency, cost, and availability. However, written instructions alone may not be a viable substitute for live BST, as it requires the availability of a trainer. Video models can supplement written instructional manuals for some individuals, potentially eliminating the need for live trainers. Studies show that video modeling with voiceovers can teach direct service staff to implement behavioral therapy (DTT) with integrity. Computer-based instruction, which includes written text, videos, and quizzes with feedback, can also be effective. However, the lack of rehearsal in computer-based instruction may compromise its effectiveness. Videoconferencing can also increase accessibility for staff and caregivers, reaching individuals far from qualified trainers. Research suggests videoconferencing is a promising approach for teaching behavioral assessments and interventions. In Esposito and colleagues (2020), the authors argued that the availability of empirically supported behavioral interventions, internationally is scarce [60]. One of the barriers to implementation of empirically supported interventions is the lack of trained specialists especially in underserved areas. The limited access to effective behavioral treatment often results in long delays and additional travel costs for families to obtain services from centers with appropriate expertise. Telehealth (also known as tele practice or telemedicine) uses communication technologies (e.g., computer-based videoconferencing) that allow specialists to consult or deliver services in real-time over a geographical distance. Increasing the availability of empirically-supported, time-limited and cost-effective interventions for children with ASD through the use of telehealth may be a way to close the gap between service demand and availability in rural and underserved areas. The application of these technologies to deliver health services across a range of conditions is growing at a rapid pace, with services increasingly migrating from hospitals and satellite clinics to the home and mobile devices. The aim of the current research is to explore the Evidence-Based teaching strategies and clinical models applied to enhance social and personal skills of children with ASD and to develop and to assess the effectiveness of a multilingual telehealth system able to support the implementation of parent and staff mediated interventions in comparison to early standard behavioral programs. In some cases, training via telehealth was found to produce comparable results to traditional in-person training and resulted in behavioural change or useful assessment outcomes for clients. Furthermore, telehealth training was rated as highly socially valid and, in preliminary analyses, resulted in significant financial savings for organizations and reduced travel burdens for trainees. Providing training via telehealth may therefore be a promising method of supporting behavioural change for clients and increasing access to behavioural support. Due to the low number of articles utilizing a group design and other methodological procedures as

stable data in the baseline, experimental control, replication of independent variable manipulations, or a lack of adequate data to evidence an effect, it is necessary to extend the research studies in this area. Firstly, the vast majority of research was conducted by research teams located primarily in the USA; therefore, it could be useful to deliver these systems in other countries. In addition, there are only a few direct comparisons of training provided via telehealth. Concerning a recent review [61], telehealth methods used different characteristics of training (e.g., methods and technology used, dosage of training, format of training), various behavioural focus of the training (e.g., type of assessments, skills, or interventions used), and outcomes (for trainer, trainee, client, social validity, obstacles experienced). As reported, 20 articles were identified which focused on using telehealth methodology to train stakeholders in behavioural techniques. Across these 20 articles, 113 agents were trained in behavioural techniques via telehealth and 104 children with intellectual or developmental disabilities, most commonly ASD, received support from someone who had been trained via telehealth. In some cases, additional individuals were also trained including control groups and assistants which supported the families or professionals during the implementation of the intervention. In most cases, training was focused on assessments such as functional analyses or preference assessments. Fewer studies focused on training for specific intervention strategies: in some cases, trainees were supported to develop and implement FCT or differential reinforcement interventions and in one case, trainees were taught to implement Reciprocal Imitation Training, or mand and echoic training. Three studies focused on improving trainee's skills relating to implementing behavioural teaching techniques such as discrete trial teaching or incidental teaching. Generally, training was provided via videoconferencing (e.g., real-time communication across a distance using an internet connection with video and audio facilities) with the trainer providing training and/or coaching from a different location, using a computer, webcam, and microphone. Some researchers provided direct instruction, modeling, or role-playing. In other cases, trainees undertook self-instruction using online modules or videos, or written explanations of the techniques and individual practice. However, it is possible to provide a delayed feedback based on videos made during clinical sessions. In addition to these methods a supplemental training could be delivered as homework, funny learning activities, simple questionnaires, virtual reality solutions, and so on. Generally, it should be considered as a good practice to provide an assistant manual containing information about the techniques, data recording forms and videos as tutorial tools as well as written protocols for trainers to use during coaching/training.

3.2 Evidence-based practices for children, adolescent and adult with ASD.

The purpose of this section is to report a comprehensive review of the best practices for children, adolescent and youth adults with ASD. Comprehensive and focused intervention have furnished empirical evidences of this list applying group or single designs [62]. Twenty-seven practices met the criteria for being evidence based. The evidence-based practices consist of interventions that are fundamental applied behavior analysis techniques (e.g., reinforcement, extinction, prompting), assessment and analytic techniques that are the basis for intervention (e.g., functional behavior assessment, task analysis), and combinations of primarily behavioral practices used in a routine and systematic way that fit together as a replicable procedure (e.g., functional communication training, pivotal response training). Also, the process through which an intervention is delivered defines some practices (e.g., parent-implemented interventions, peer mediated intervention and instruction, technology-aided interventions). The study reviewed the effectiveness of various interventions for students with ASD using structured case-based design (SCD) methodologies. Some practices, such as antecedent-based intervention, differential reinforcement, prompting, reinforcement, and video modeling, had strong support from studies. Other practices, such as parent-implemented interventions, social narratives, and technology-aided instruction and intervention, also had strong support. The current set of EBPs includes six new focused intervention practices, including cognitive behavioral intervention, exercise, modeling, scripting, and structured play groups. Most EBPs produced outcomes across multiple developmental and skill areas, with the most disseminated outcomes

being prompting, reinforcement, technology, time delay, and video modeling. The least number of practices were associated with vocational and mental health outcomes. Some practices were not identified as EBPs due to insufficient evidence of efficacy.

Table 1. Evidence based practices in autism (until 2011), by Wong and colleagues (2015)

Practice	Description
Antecedent-based intervention (ABI)	Arrangement of events or circumstances that precede the occurrence of an interfering behavior and designed to lead to the reduction of the behavior.
Cognitive behavioral intervention (CBI)	Instruction on management or control of cognitive processes that lead to changes in overt behavior.
Differential reinforcement of alternative, incompatible, or other behavior (DRA/I/O).	Provision of positive/desirable consequences for behaviors or their absence that reduce the occurrence of an undesirable behavior. Reinforcement provided: (a) when the learner is engaging in a specific desired behavior other than the inappropriate behavior (DRA), (b) when the learner is engaging in a behavior that is physically impossible to do while exhibiting the inappropriate behavior (DRI), or (c) when the learner is not engaging in the interfering behavior (DRO)-
Discrete trial teaching (DTT)	Instructional process usually involving one teacher/service provider and one student/client and designed to teach appropriate behavior or skills. Instruction usually involves massed trials; each trial consists of the teacher's instruction/presentation, the child's response, a carefully planned consequence, and a pause prior to presenting the next instruction.
Exercise (ECE)	Increase in physical exertion as a means of reducing problem behaviors or increasing appropriate behavior
Extinction (EXT)	Withdrawal or removal of reinforcers of interfering behavior in order to reduce the occurrence of that behavior. Although sometimes used as a single intervention practice, extinction often occurs in combination with functional behavior assessment, functional communication training, and differential reinforcement.
Functional behavior assessment (FBA)	Systematic collection of information about an interfering behavior designed to identify functional contingencies that support the behavior. FBA consists of describing the interfering or problem behavior, identifying antecedent or consequent events that control the behavior, developing a hypothesis of the function of the behavior, and/or testing the hypothesis.
Functional communication training (FCT)	Replacement of interfering behavior that has a communication function with more appropriate communication that accomplishes the same function. FCT usually includes FBA, DRA, and/or EX.
Modeling (MD)	Demonstration of a desired target behavior that results in imitation of the behavior by the learner and that leads to the acquisition of the imitated behavior. This EBP is often combined with other strategies such as prompting and reinforcement.
Naturalistic intervention (NI)	Intervention strategies that occur within the typical setting/activities/routines in which the learner participates. Teachers/service providers establish the learner's interest in a learning event through arrangement of the setting/ activity/routine, provide necessary support for the learner to engage in the targeted behavior, elaborate on the behavior when it occurs, and/or arrange natural consequences for the targeted behavior or skills.
Parent-implemented intervention (PII)	Parents provide individualized intervention to their child to improve/increase a wide variety of skills and/or to reduce interfering behaviors. Parents learn to deliver interventions in their home and/or community through a structured parent training program.
Peer-mediated instruction and intervention (PMII)	Typically developing peers interact with and/or help children and youth with ASD to acquire new behavior, communication, and social skills by increasing social and learning opportunities within natural environments. Teachers/service providers systematically teach peers strategies for engaging children and youth with ASD in positive and extended social interactions in both teacher-directed and learner-initiated activities.
Picture Exchange Communication System (PECS)	Learners are initially taught to give a picture of a desired item to a communicative partner in exchange for the desired item. PECS consists of six phases which are: (1) ''how'' to communicate, (2) distance and persistence, (3) picture discrimination, (4) sentence structure, (5) responsive requesting, and (6) commenting.
Pivotal response training (PRT)	Pivotal learning variables (i.e., motivation, responding to multiple cues, self-management, and self-initiations) guide intervention practices that are implemented in settings that build on learner interests and initiative.
Prompting (PP)	Verbal, gestural, or physical assistance given to learners to assist them in acquiring or engaging in a targeted behavior or skill. Prompts are generally given by an adult or peer before or as a learner attempts to use a skill.
Reinforcement (R)	An event, activity, or other circumstance occurring after a learner engages in a desired behavior that leads to the increased occurrence of the behavior in the future.
Response interruption/redirection (RIR)	Introduction of a prompt, comment, or other distracters when an interfering behavior is occurring that is designed to divert the learner's attention away from the interfering behavior and results in its reduction.
Scripting (SC)	A verbal and/or written description about a specific skill or situation that serves as a model for the learner. Scripts are usually practiced repeatedly before the skill is used in the actual situation.
Self-management (SM)	Instruction focusing on learners discriminating between appropriate and inappropriate behaviors, accurately monitoring and recording their own behaviors, and rewarding themselves for behaving appropriately.
Social narratives (SN)	Narratives that describe social situations in some detail by highlighting relevant cues and offering examples of appropriate responding. Social narratives are individualized according to learner needs and typically are quite short, perhaps including pictures or other visual aids.
Social skills training (SST)	Group or individual instruction designed to teach learners with autism spectrum disorders (ASD) ways to appropriately interact with peers, adults, and other individuals. Most social skill meetings include instruction on basic concepts, role-playing or practice, and feedback to help learners with ASD acquire and practice communication, play, or social skills to promote positive interactions with peers.
Structured play groups (SPG)	Small group activities characterized by their occurrences in a defined area and with a defined activity, the specific selection of typically developing peers to be in the group, a clear delineation of theme and roles by adult leading and/or prompting or scaffolding as needed to support the students' performance related to the goals of the activity.
Task analysis (TA)	A process in which an activity or behavior is divided into small, manageable steps in order to assess and teach the skill. Other practices, such as reinforcement, video modeling, or time delay, are often used to facilitate acquisition of the smaller steps.
Technology-aided instruction and intervention (TAII)	Instruction or interventions in which technology is the central feature supporting the acquisition of a goal for the learner. Technology is defined as any electronic item/equipment/application/or virtual network that is used intentionally to increase/maintain, and/or improve daily living, work/productivity, and recreation/leisure capabilities
Time delay (TD)	In a setting or activity in which a learner should engage in a behavior or skill, a brief delay occurs between the opportunity to use the skill and any additional instructions or prompts. The purpose of the time delay is to allow the learner to respond without having to receive a prompt and thus focuses on fading the use of prompts during instructional activities.
Video modeling (VM)	A visual model of the targeted behavior or skill (typically in the behavior, communication, play, or social domains), provided via video recording and display equipment to assist learning in or engaging in a desired behavior or skill.
Visual supports (VS)	Any visual display that supports the learner engaging in a desired behavior or skills independent of prompts. Examples of visual supports include pictures, written words, objects within the environment, arrangement of the environment or visual boundaries, schedules, maps, labels, organization systems, and timelines.

Note. These procedures can be more effective in a specific developmental area and established age. For more information, please see the updated review.

A professional who trains through behavior analysis comes into contact with more than half of EB techniques which aim to increase children's skills and reduce problem behaviors. Currently offering only a structured approach would not only have generalization problems in different environments or with different materials and people, but research has shown that a more flexible and naturalistic approach can increase social and playing skills even in groups of only autistic children [63]. Naturally, both in structured and natural settings, external or internal motivation respectively is preliminary to attention towards the play activities or tasks. In addition to approaching the child through a basic curriculum that includes a detailed educational program, a direct and indirect assessment of the child's preferences is necessary to understand both the potential reinforcers to be used and to increase attempts at requests related to functional communication opportunities [64]. On the other hand, autism includes a strong narrowness of interests, consequently it is also very common for children with autism to spend time seeking sensory stimulation or avoiding social interaction and adult requests. Therefore, wherever a therapist or parent finds no useful preferences that motivate the child, he or she can apply conditioning principles to increase the value of a stimulus to have a greater range of preferences [65]. Finally, in addition to the narrowness of interests in autism, ritualistic or repetitive behaviors are often associated within the play activities or other developmental domains. As a result, the functional analysis of behavior, also here direct, indirect or experimental, is a practice within EBP that allows the professional to address problem behaviors in a functional and tailored manner. Mostly, the challenging behaviors that negatively influence the learning tasks and daily living behaviors of autistic people are denied access to reinforce, attention seeking, avoidance of requests or self-stimulation, such as boredom. Also, stereotypies can often affect learning as well as sensory anomalies associated, as such as interventions that aim to replace vocal and motor stereotypies with socially functional behaviors must be taken into consideration as soon as possible within therapy [66]. Successively, when during the first steps of a behavioral therapy preference assessment and management of behavior are both well addressed, teaching will appear easier to implement.

Evidence-based practices (EBPs) are essential tools for creating individualized intervention programs for children and youth with ASD. Practitioners' expertise plays a significant role in this process, as they integrate individual clinical experience with external clinical evidence. A "technical eclectic model" is proposed, where practitioners establish goals for the learner and use their professional expertise to select EBPs that produce desired outcomes. This model requires professional development and intentional decision-making to support implementation. Future research should employ knowledge from systematic reviews and prepare practitioners to use their judgment effectively. Most studies have been conducted with preschool-age and elementary school-age children, and there is a need to expand the intervention literature to adolescents and young adults with ASD. Few studies have addressed vocational and mental health outcomes, and fewer studies have identified infants and toddlers with ASD and their families. Future research should include an ethnically diverse sample and include information about children's or their families' socioeconomic status. In the 2021, Kara Hume and colleagues proposed an upgrade of these review on EBPs, publishing the Evidence-Based Practices for Children, Youth, and Young Adults with Autism: Third Generation Review. The majority of studies were conducted with preschool and elementary-aged children, with a slight increase in the youngest age category and the oldest age category. Gender/sex data was reported in 93% of studies, with 84% of participants being male. Race/ethnicity data was not extracted in the previous review, so data only reflects the 2012-2017 review period. Single case design studies made up 83% of articles, while group design made up 17%. The primary group design employed was a randomized control design, followed by quasi-experimental design and one sequential multiple assignment randomized trials design. Implementation characteristics were only extracted from the 2012-2017 review period. Interventions took place in educational settings, university clinics, home settings, and community clinics. The review found that 28 practices met the criteria for being evidence-based. Five new EBP categories were introduced (Table 2), including Behavior Momentum Intervention, Direct Instruction,

Music-Mediated Intervention, Sensory Integration, and Augmentative and Alternative Communication (AAC).

The review also identified 10 Manualized Interventions Meeting Criteria (MIMCs) that fit EBP categorical definitions but had sufficient evidence to be classified as an EBP. These MIMCs were grouped within six EBP categories (Table 3). The outcomes addressed by studies in the review were communication, social, challenging/interfering behavior, academic, mental health, and vocational, self-determination, challenging behavior, joint attention, play, and school readiness. Most EBPs have at least some evidences of impact across a wide variety of ages and outcome categories, with 23 EBPs impacting seven or more and 16 impacting nine or more.

Table 2. Additional Current Evidence-Based Practices (2021)

Practice	Description
Augmentative and alternative communication (AAC).	Interventions using and/or teaching the use of a system of communication that is not verbal/vocal which can be aided (e.g., device, communication book) or unaided (e.g., sign language)
Behavioral momentum intervention (BMI).	The organization of behavior expectations in a sequence in which low probability, or more difficult, responses are embedded in a series of high probability, or less effortful, responses to increase persistence and the occurrence of the low probability responses
Direct instruction (DI).	A systematic approach to teaching using a sequenced instructional package with scripted protocols or lessons. It emphasizes teacher and student dialogue through choral and independent student responses and employs systematic and explicit error corrections to promote mastery and generalization.
Music-mediated intervention (MMI).	Intervention that incorporates songs, melodic intonation, and/or rhythm to support learning or performance of skills/behaviors. It includes music therapy, as well as other interventions that incorporate music to address target skills.
Sensory integration (SI).	As originated by A. Jean Ayres interventions that target a person's ability to integrate sensory information (visual, auditory, tactile, proprioceptive, and vestibular) from their body and environment in order to respond using organized and adaptive behavior.

The current report reviews evidence-based, focused intervention practices, extending the work from 1997 to 2017 and adding 567 articles. The five new practices include Augmentative and Alternative Communication (AAC), Behavior Momentum Intervention, Direct Instruction, Music-Mediated Intervention, and Sensory Integration. Sensory Integration refers to the classical sensory integration model developed by Jean Ayres. Some EBP categories were reclassified into other categories, and a new classification of interventions was introduced as MIMC. Ten interventions met the criteria for MIMC and have sufficient evidence to meet EBP criteria. These interventions have clearly established manualized procedures or software, often including training protocols, which may facilitate their uptake and implementation. The MIMC classification does not convey that the interventions are less strong or efficacious than previously indicated, as they both have extensive research supporting their efficacy.

Table 3. Manualized interventions meeting criteria (MIMCs)

handbook Title
Picture exchange communication system® (PECS)
Augmentative and alternative communication Frost and Bondy (2002)
JASPER Naturalistic intervention Kasari et al. (2014)
Milieu Teaching Naturalistic intervention Kaiser and Roberts (2013)
Pivotal Response Training Naturalistic intervention Koegel and Koegel (2006)
Project ImPACT Parent-implemented intervention Ingersoll and Dvortcsak (2019)
Stepping stones triple P Parent-implemented intervention Turner et al. (2010)
Social stories™ Social narratives Gray (2000)
PEERS® Social skills training Laugeson and Frankel (2010)
Face Say ® Technology-aided instruction and intervention Hopkins et al. (2011)
Mindreading Technology-aided instruction and intervention Golan and Baron-Cohen (2006)

There were notable increases in studies targeting academic skills, vocational skills, and mental health, but their frequency remains low. The review also identified demographic findings, such as a need for increased research with infants/toddlers, adolescents, and young adults with autism. Most studies were conducted with male participants, and information about differential effects for female participants with autism remains under-examined. There were gaps in reporting, inclusion, and analysis of participants with co-occurring conditions, and the race/ethnicity/nationality of autistic participants was not examined. Socioeconomic class (SES) of participants was rarely described for autistic participants, making it difficult to determine how SES affects treatment outcomes. The review highlights the importance of integrating evidence-based practices (EBPs) into effective programs for autistic children and youth. Practitioners can match EBPs to specific learning goals, similar to how medical practitioners match treatments to patients' health needs. This approach builds a technical eclectic program, ensuring strong program quality, individualized goals, and efficacy. The updated review identified nearly 1,000 studies, with SCD studies being the typical form of research. Future directions include intervention effects related to race, ethnicity, and gender, as well as research for both infants and young adults with autism.

3.3 Parent Training

Interventions addressing any part of the family unit, such as parent or child skill acquisition, can result in more positive child outcomes and improved parent and family outcomes. Therefore, family-centered early Intervention that includes parent education has been linked to improved child outcomes, more positive parent perceptions of child behavior, and greater perceptions of parental self-efficacy [67]. Early treatments for young children with or at risk for autism includes family-centered capacity building and help-giving practices in natural contexts such as family homes. Consequently, EIBI and focused interventions, often involve parents as interventionists. However, outcomes of parent-mediated intervention may suffer from a parent's lack of time to implement and manage the intervention, barriers to accessing resources and technical knowledge, and difficulties adapting to the teacher role. Parenting a young child with ASD can be potentially more stressful than a typical developing child, and high levels of parent stress can interfere with treatment adherence, reduce the likelihood of the parent using new skills, and decrease positive child outcomes. Generally, parents have been involved in various aspects of EI and EIBI, including implementing interventions, providing input on procedures, collaborating on behavior intervention plans, informing functional behavior assessments, taking data, answering questions about the feasibility and acceptability of goals, procedures, and outcomes, and teaching others intervention strategies. However, few parent-implemented interventions exist outside of EIBI programs in areas such as functional life or self-help skills, feeding, toileting, and sleep. Group-based parent education is more commonly used than one-to-one parent training, and the use of online technology is rapidly growing. Obviously, occasionally it is necessary including both interventions aimed at teaching parents' new skills and decreasing stress and depression of parents [68]. Parents of children with ASD have successfully implemented individualized and packaged interventions to improve their child's social communication, decrease challenging behavior, and teach adaptive behavior skills. Research focuses on increasing parent skill acquisition, with three main categories: group-based parent education and training, individualized parent education and coaching, and internet-based parent training. Group-based interventions deliver manualized material based on social learning principles to small groups of parents over weekly sessions, using randomized control group trials with wait-list control groups to evaluate outcomes. These programs aim to normalize parenting experiences, break down parents' social isolation, increase social and emotional support, and validate the importance and difficulties of parenting. Group-based programs are cost-efficient and have been adapted from research-based programs for parents of children with developmental disabilities. Additionally, Behavioral Parent Training (BPT) is a widely used approach for one-to-one parent education and coaching. BPT is based on behavior modification and social learning theory principles and is a successful and well-researched approach for treating and preventing child problem behavior. It involves defining behavior problems accurately, implementing assessment measures, and teaching parents the appropriate treatment plan for their individual context. BPT can increase the likelihood of behavior change, generalize, and maintain treatment gains. It also decreases parental stress and increases parental confidence in managing the child. Studies have focused on challenging behavior, social communication, pivotal response training, functional assessment, and early intervention [69]. For example, Park, Alber Morgan, and Cannella-Malone (2011) conducted a study on training parents to teach their child with ASD independent communication using Picture Exchange Communication (PECS). The study involved a preference assessment and training sessions at home. The mother was trained to serve as the communication partner, initiating each trial by presenting preferred items and pictures, providing appropriate consequences, and ending the trial. The mother was provided with written guidelines, modelled procedures, and video clips. The parents implemented the procedures with high fidelity, and all three children successfully acquired independent picture exchanges [70]. Also, Parent training in PRT has also been shown to enhance communication skills in children with autism. In a study, children's functional words increased following training, and parents' fidelity in implementing PRT techniques improved. These changes were generally maintained at follow-up [71]. Moreover, Rogers et al. (2012) examined the efficacy

of the Parent-delivered Early Start Denver Model (P-ESDM), a 12-week, low intensity intervention, for toddlers at risk for ASD. Both groups of parents improved interaction skills and children demonstrated progress. Both groups of parents were able to learn how to implement FA and generalize it with their child in the home environment [72]. Finally, a study compared two parent-mediated interventions on joint attention in children with ASD. The intervention was a naturalistic, developmental behavioral intervention called JASPER focused on sustaining periods of joint engagement and increasing joint attention gestures and play skills [73]. As Aforementioned, Telehealth is a cost-effective service model for providing parent-mediated intervention for children with ASD. Currently, studies show that parents can implement intervention strategies with fidelity and alter their engagement styles. Behavior consultants can use telehealth to coach parents to conduct functional analyses (FA) and FCT, resulting in substantial reductions in problem behavior. Conversely, some reviews on telehealth and ASD have demonstrated an efficacy also for cognitive and communication skills. This suggests that telehealth can be a valuable tool for bridging the healthcare gap for ASD families.

Concerning the treatment of challenging behaviors, such as tantrums, self-injury, and aggression, which are a significant source of parental stress and impacts the quality of life for children with ASD and their families, the research has been showing progress. To address these challenges, parents should be equipped with tools to create a desirable family environment. For example, Sears et al. (2013) examined the use of the family-centered prevent-teach-reinforce (PTR) model with families of children with ASD to decrease challenging behavior [74]. Also, DTT is an important target for intervention, and several teaching strategies have been used to teach functional life skills, such as preparing meals, performing household tasks, and getting dressed. To conclude, every clinical model including families in providing the intervention for ASD should refer to EBPs and a strict approach following some good practices to teach parents, as displayed in Table 4.

Table 4. Glossary of parent education, training, and coaching terms

Practice	Description
Behavior skills training (BST)	Includes a combination of individual or group instruction with modeling, role-play or behavioral rehearsal with performance feedback, and parent demonstration of a set of skills to a specified mastery criterion.
Behavioral rehearsal	Practice of a complex skill under simulated conditions with performance feedback including praise and correction. Often includes modeling and role-play
Delayed coaching/ performance feedback	Involves a parent coach or other professional providing verbal and/or nonverbal (e.g., gestures, facial expressions) information after a parent has performed a skill. The time between the parent performing the skill and receiving feedback from a professional varies. Information includes praise for correct demonstrations of skills and correction for incorrect demonstrations. Delayed coaching and performance feedback can be delivered in different methods including in person or through teleconsultation. Delayed teleconsultation often involves a parent coach and parent viewing a video of the parent and child while the coach delivers performance feedback.
Discussion	A trainer presents information to an audience (individual or group) and guides conversation to promote learning.
Immediate coaching/ performance feedback	Involves a parent trainer or coach providing verbal and/or nonverbal (e.g., gestures, facial expressions) information during or immediately after a parent is performing a skill. The information includes praise for correct demonstrations of skills and correction for incorrect demonstrations. Coaching and performance feedback can be delivered in different methods including in person or through teleconsultation.
In vivo modeling	A teaching strategy wherein a parent trainer or coach demonstrates a skill live, often in the family's home, with the intention of the parent imitating it immediately afterward or later. Modeling is showing the parent how to perform a skill.
Lecture	Includes didactic based delivery of information in an individual or group format to promote procedural or conceptual learning.
Role play	A type of behavioral rehearsal that includes the parent practicing the targeted skill with a confederate.
Video modeling	Video demonstrations of a skill intended to teach or cue a parent to perform/imitate the skill. Video modeling can include another person performing the skill or the parent performing the skill, which would be video self-modeling.

Note. Definitions include information from "Behavior Analysis for Lasting Change" by G. R. Mayer, B. Sulzer-Azaroff, and M. Wallace [75]

Outcomes of behavioral interventions for social cognition

CHAPTER 4

4.1 Social Cognition

Recent research on infant social cognition has been inspired by the 1970s experimental results and the question of precursors to understanding false beliefs shown by 4 and 5-year-olds. The detection of goal-directed agency starts with the extent that human beings move autonomously, infants are in a position to distinguish them from inanimate objects. This is particularly obvious in the case of hand and arm movements. Recent research has actively focused on such targeted movements with a view to diagnosing the extent to which infants interpret them as goal-directed. A study by Woodward (1998) offers an illustrative example of how infants of 5 and 9 months were habituated to the sight of a human hand and arm reaching toward and grasping one of two objects. Subsequently, infants treated the change of target object as more novel, as indexed by an increase in looking times. By the end of the 1st year, infants encode the object that a movement is directed toward and generally anticipate that a movement will be direct and efficient rather than indirect [76]. Baldwin et al. (2001) conducted a study on how infants parse the stream of action, showing that they recognize subunits within a normally continuous action sequence. They found that infants spent longer looking at the interrupting video than the completing video, suggesting that infants recognize that actions can be embedded in an organized hierarchy. However, it is unclear whether infants' parsing into subunits is guided by a "top-down" appreciation of sub-goals completed in a larger hierarchy or by a "bottom-up" processing of cues that correlate with such subdivisions. Evidence for top-down processing has emerged from first studies by Sommerville and Woodward (2005), and Carpenter, Call, and Tomasello (2002). For example, when 11-month-olds watched an agent produce a single ambiguous single action, they showed no signs during a test phase of being able to decide whether the reach was aimed at the box itself or the toy inside the box. However, if they had previously seen the agent not simply touch the box lid but go on to extract the toy, they interpreted subsequent reaches to the box lid as directed at the contents of the box and not just at the box itself. Hence, a previous indirect communication could influence the interpretation itself [77]. Support for this interpretation came from several other conditions where children were first made aware of the adult's goal and then copied her much more successfully.

In addition, emotion understanding is a crucial aspect of a child's mental state understanding, with sensitivity to other people's emotional states being a more precocious aspect. Infants can read emotional states through their expressive signature, which can be read even by infants during the first year of life. Darwin's writings on facial expressions led to a systematic research program endorsing his claim that there is a universal, innate basis to the production of a small set of facial expressions. In recent years, studies have shown that young infants do respond appropriately to adults' facial expressions, with different reactions for different stages of development [78]. Infants also develop expectations of responsiveness and expressiveness from their caregivers. By the age of 2 to 3 months, infants show considerable sensitivity to the contingent relationship between their expressive movements and those of an adult partner. They also develop a more specific expectation guided by the expressive style of their primary caregiver. Attachment theorists argue that infants are sensitive to the responsiveness and availability of a caregiver, with characteristic modes of interacting with a caretaker identifying by the age of 12 months. Infants quickly distinguish positive and negative emotional expressions, respond appropriately, expect caregivers to be expressive, and attune their expressive behaviors to their caregivers' styles, despite the uncertainty of Darwin's innate interpretive mechanism for emotion expression [79].

Regarding the Gaze Following and Social Referencing, at around 9 months, infants start to follow and direct the attention of a caregiver. This phenomenon was first identified by Scaife and Bruner (1975), who found that when an adult turned to look either to the right or to the left, there was an increasing tendency with age for the infant to turn to look in the same direction. By 15 months, babies are able to differentiate not only one side from another but also the adult's direction of gaze within a side. The caregiver's facial expression might serve as a mood-changing signal that shifts the baby toward either confident exploration or care. The second interpretation builds on the gaze-following competence just described: the infant might encode the expression as a predicate or comment that refers to the object in question. For example, they appropriately interpreted the adult's emotional signals as commentaries on the contents of the boxes and appropriately distinguished between the signals directed at each [80].

Regarding Comforting and Helping, infants also offer consolation in response to overt distress, based on sympathy rather than low-level pressure. These apparent acts of consolation are difficult to explain as mere teaching, as the child makes obvious efforts to reduce the distress of the other person. A longitudinal study of such comforting behaviors in the 2nd year of life found that older toddlers frequently offer comfort in the absence of any overt signs of distress, especially true when toddlers have not been the cause of the other person's distress. This emerging pattern of concern strongly suggests that toddlers appreciate the emotional state of the other person and feel concern, even if they are not yet engaging in any sophisticated form of mind reading [81]. Looking forward to developments in the 3rd and 4th year of life, it seems highly likely that this capacity for concern feeds into young children's moral judgment. Evidence indicates that 3 and 4-year-olds regard various moral breaches (e.g., hitting another child or taking another child's toy) as more serious than conventional breaches. One possibility is that they are guided by adult feedback. In fact, offering help and cooperation, toddlers exhibit a different ontogenetic and phylogenetic pattern when compared to comforting, as they are triggered by evident distress on the part of the comforted. They can analyse an agent's goal-directed action more effectively if the goal is made salient to them. Toddlers are remarkably willing to offer assistance to someone whose action sequence needs a helping hand. Research has shown that even 18-month-olds offer help for more than half of the tasks carried out by adults, rising to almost 90% by 30 months. This cooperative attitude can be interpreted as either low-level imitation or children figuring out the adult's overall goal and seeing themselves as contributing to that goal [82]. Collaborative acts cannot be reduced to imitation, as children take on complementary activities in pursuit of a common goal. It is evident that toddlers are disposed to cooperate, either spontaneously offering help to a parent, unfamiliar adult, sibling, or peer. However, it is worth underlining the possibility that this cooperative activity is a uniquely human trait. Young children recognize others' distress and develop strategies to alleviate it in their second year of life. They can intentionally tease, upset, frustrate, and provoke, with increased frequency of comforting and teasing. Sibling relationships often involve a mix of teasing and comforting, with the older sibling often being the prime instigator of hostile interactions. However, there is variation in the proportion of mutually hostile and friendly encounters across sibling pairs. Abused children often display more aggression and less helping and sharing compared to children from the same social class background but with no known history of abuse. The pattern of concern for other children's distress is disrupted, with abused toddlers responding negatively to distress in day-care settings. These observations suggest that gestures of comfort and concern are not irreversibly wired into a child's social cognitive repertoire. Active and benevolent concern for distress is a relational mode experienced less often by abused children with their abusive parents.

Mental State understanding: Goals, Desires, and Intentions

Children's social cognition development is easier to study as they begin to talk and talk about goals and desires. Studies have shown that infants can diagnose the direction or goal of an ongoing action without understanding the mental state of desire that initiates and guides such actions or states. However, there is no straightforward test for attribution of a more mentalistic concept of desire to young children. Children begin to use desire terms from about 18 to 24 months, and between 24 and 30 months, they begin to produce various contrastive utterances. They begin to contrast what they want with what they actually get or are about to get, and they also contrast what one person wants with what another person wants. The concept of desire plays a central role in children's emerging understanding of mental states. Experimental studies support the idea that 2- and 3-year-olds understand the way that desires are linked to actions and various simple emotions. They understand that people will search for what they want and that if they obtain it, they will feel happy, and that if they do not obtain it, they will persist in searching and feel sad or angry. Also, preschool children are able to distinguish between acts that are careful as compared to acts that are intentional. However, 3-year-olds may have difficulty acknowledging the role that thinking and believing plays in the formulation of an intention. Intentions are generally formed with the belief that one's plan can be executed.

Research has focused on children's understanding of false belief, a concept that has been used to refine and test various theories. Three main tasks have been used to assess children's understanding of belief:

- unexpected displacement,
- deceptive container,
- and appearance-reality.

These tasks involve children assessing their understanding of an object or situation, determining its true identity, and diagnosing its erroneous conclusion. These tasks are designed to help children understand their own beliefs and develop a better understanding of their own theories. The research aims to provide an initial evaluation of these competing theories and provide a comprehensive understanding of children's beliefs [83]. Wellman, Cross, and Watson (2001) conducted a meta-analysis of various studies on children's understanding of false belief. They found a robust age-change between 3 and 5 years, with children performing systematically above chance at 48 months and older. The age change is stable across various testing conditions, and it is unaffected by whether children are questioned about a protagonist's belief-based behavior, whether the target person is a story character, a puppet, or a real adult, and whether the protagonist holds a false belief about an object's location or its identity. Some factors help accurate performance, such as an explicit indication of the protagonist being tricked or deceived, active participation in performing the critical object switch or change of location, or an explicit cue regarding the protagonist's belief [84]. Wellman et al. (2001) suggest that the consistent age change and failure to uncover a set of conditions under which 3-year-olds perform systematically above chance undermine theories implying children have an innate capacity to understand false belief. Nevertheless, the child's language ability and conversational environment to which the child is exposed are important factors in understanding the process of conceptual change. False-belief and appearance-reality tasks involve children realizing that perceptual access is crucial for accurate knowledge. These tasks involve identifying false beliefs, deceptive container replacements, and identifying object properties or identities without comprehensive perceptual access. It's important to consider whether children appreciate the consequences of appropriate perceptual access, distinguishing between different sources of knowledge, and trusting the judgment of someone with appropriate access. These questions contribute to understanding when and how children become insightful seekers and gatherers of information. Three and four-year-olds are well-equipped to report when an object can and cannot be seen, understand that seeing yields knowledge, and differentiate between perceptual

and no perceptual sources of information. However, children tend to confuse perceptual and no perceptual routes and fail to differentiate among particular perceptual routes, such as touching, looking, and smelling [85].

On the other hand, children between two- and three-years old start to put feelings into words and begin to interpret emotions in relation to other mental states. They refer to basic emotions such as happiness, sadness, and scared, and they also reference stuffed animals and dolls. They talk about emotion in a referential and descriptive mode, rather than an expressive mode. Also, children differentiate between the experience of emotion and the actions and expressions that frequently accompany emotion. They think of emotions as intentional states directed at an object or target, and they do not treat them as diffuse mood changes. One explanation for children's accurate descriptions of emotions is that they learn the typical script for any given emotion, which involves recognizing a standard elicitor and accompanying expressive and gestural pattern. This script-based analysis is consistent with preschoolers' ability to describe basic emotions such as sadness and fear, and as children get older, they can describe situations likely to evoke more complicated emotions [86]. The script concept, which focuses on external circumstances and observable behaviors, overlooks the subjective appraisal involved in emotions. Likewise, children are sensitive to the role of desires and beliefs in emotions, but their appreciation of beliefs improved with age. The youngest children attributed emotions to the animal's mistaken beliefs, while the oldest children attributed emotions based on the actual contents. Subsequently, children's understanding of emotion is influenced by their understanding of desires and beliefs. Children often make a mistake on both story and film tasks by incorrectly identifying the protagonist's emotion, despite correctly identifying the protagonist's belief. This appreciation of the role of beliefs in eliciting emotion is consolidated around 6 years of age. Children do not fail to understand beliefs, including false beliefs, as they do understand them. However, once children understand false beliefs, they immediately appreciate the implications for action. The key question is why children are slow to acknowledge the role of beliefs in producing emotion. Children need to consider not only a person's desires and beliefs but also the way they assess themselves and assume others will assess them in relation to various standards. Children who neglect these social considerations will fail to attribute guilt, pride, shame, and other complex emotions in an appropriate manner. The "happy victimizer" phenomenon suggests that young children are unaware to feelings of guilt, raising the possibility that attempts to prompt children to be guided by their conscience may be ineffective. Various explanations for this marked age change can be ruled out, such as the fact that developmental changes in children's moral judgment do not offer an adequate explanation for age changes in the attribution of guilt [87]. It suggests that younger children may be more aware of the distress of the victim, but this is unlikely as harm and distress are important factors leading preschoolers to judge certain actions as wrong. In conclusion, the preschool children display overt signs of guilt but cannot make sense of their feelings after a wrongdoing or accurately attribute guilty feelings to another person.

Research on stream of consciousness is beginning to gather data, with implications for introspective self-reports from children in clinical settings. Studies show that preschoolers have a different view of their inner life from adults, not only in attributing mental activity to others but also in acknowledging and expressing their thoughts. They are also often unaware of their constant inner speech and report specific thoughts when attempting to have no thoughts for a short period. Consequently, preschool children may not be providing accurate reports on their inner life, but they do show some appreciation for the quality of their mental life when asked about emotion. They acknowledge that intense emotional reactions will reduce over time and make claims about the initial emotion, whether positive or negative, and with respect to their own emotional experience as well as that of story characters. This claim is consistent across different cultures, and preschoolers might be simply espousing a folk theory [88]. In conclusion, children make rapid progress during the early school years in understanding the flow of consciousness. While preschoolers seem to have little insight into the continuous nature of the stream, older children realize that

the stream is more or less constant and that one type of mental content interrupts on another. Additionally, children's sensitivity to disagreement among individuals could provide an interpretation on how children make knowledge. Generally, young children are generally more tolerant of dissent and acknowledge that more than one position could be right. However, they may adopt two different attitudes toward uncertainty: one where they believe competing claims are equally valid and there is no way to adjudicate between them, or another where they recognize that in some domains competing claims are not equally meritorious. This understanding of debate is crucial for any genuine understanding of debate in science, politics, morality, or history.

Understanding Second-Order Beliefs and Nonliteral Utterances

Social cognition research suggests that children develop the ability to contemplate multiple perspectives, beyond the standard false-belief task. This development is particularly evident in children with autism, who often fail the standard false-belief task. In complex second-order task, children should assess what one actor would believe about the beliefs of another actor. Generally, children could solve the problem at around 6 to 7 years of age, well beyond the age at which the standard false-belief task is mastered. However, the difficulty of the second-order task is particularly evident among children with autism, who struggle with understanding ironic remarks. Starting by well-known study of Happé (1993), researchers have been proposing that success on the second-order task might be connected to the understanding of figurative speech, particularly irony. Performance on stories containing nonliteral utterances should be closely related to performance on theory-of-mind tasks, although even those who pass all the tasks could showed impairments on more naturalistic story materials [89].

4.2 Theory of mind in children with autism

So far today, research on children with autism has provided a significant increase to understanding the normal development of a theory of mind. In 1985, only 20% of children with autism passed a variant of the false-belief task compared to 80% of TDC and children with Downs's syndrome. Children with autism have a wide-ranging difficulty in grasping false beliefs. They are poor at deliberately creating a false belief by lying and show problems with emotion understanding. However, the difficulty displayed by children with autism is correlated with their language ability. Children with a verbal mental age of 6 to 7 years have a 20% probability of passing the false-belief task, while those with a verbal mental age of 11 to 12 years have an 80% probability [90]. Children with autism follow the same developmental road map as TDC but at a slower pace, resulting in an abnormally slow rate of growth in the theory of mind. This is consistent with the fact that many children with autism eventually pass the false-belief landmark and a minority even come to an understanding of beliefs about beliefs. Children with autism have no particular difficulty in talking about their own desires or those of other people. However, they display clear limitations in three areas: (1) the development of joint attention, (2) engagement in pretend play, and (3) concern for others in distress. TDC start to show joint attention behaviors in the 1st year of life, but children with autism show important restrictions in joint attention. Longitudinal research suggests that deficits in joint attention are an important early marker for a likely later diagnosis of autism. Children with autism are not completely deficient at pretend play, but they engage in simple object-directed pretence and perform competently in working out likely pretend consequences. Children with autism differ from normal children and mentally retarded children in their responses to the distress of others. They are less likely to attend to the distressed person, more likely to remain engaged in toy play, and less likely to display concern. These findings suggest that the gradual confluence of beliefs and desires in explaining behavior may bring together two initially separate ontogenetic streams. Probably, children's ability to engage in pretend play implies understanding the mentalistic nature of pretence, which sets the stage for an understanding of belief. So, young children could engage in pretence even without understanding the mental state of pretending, as there is evidence that children can hold beliefs well before they show signs of understanding beliefs as mental states.

Empirically, studies indicate that even 4-year-olds do not systematically appreciate that certain mental states are necessary for particular pretend acts [91]. Despite these objections, it is still plausible that a relationship exists between the capacity for pretend play and the eventual understanding of belief. Even if children with autism are not incapable of pretend play, they do show restrictions in generativity and a marked delay in their understanding of false beliefs. Further evidence has emerged from the study of TDC, showing that the frequency of joint proposals and role assignments in the course of pretend play correlates with children's performance on theory-of-mind tasks. However, there is no consistent evidence that the amount of pretence, the diversity of pretend themes, the impersonation of a machine, or engagement in solitary pretend play correlates with performance on theory-of-mind tasks. The relationship between pretend play and theory-of-mind understanding holds up when considering language ability. The findings suggest that pretend role-play is linked to children's performance on standard theory-of-mind tasks, supporting simulation theory. However, the link between role-play and theory-of-mind performance rests on correlational data only [92].

Research concerning high and low functioning people with ASD

This section discusses research on ToM abilities and deficits in individuals with ASD, focusing on cognitively able high-functioning individuals (HF-ASD) and less cognitively able individuals (HF-ASD). It discusses ToM development across life and its social and academic manifestations. Language skills are linked to false-belief tests in individuals with ASD/HF-ASD, with studies showing a causal relationship between language and ToM. Verbally able individuals with HF-ASD often pass false-belief tasks, but fail when expected to act spontaneously [93]. Language abilities and comprehension are crucial for evaluating ToM abilities. Research suggests that children with better language abilities may use compensatory linguistic strategies, such as understanding syntax and semantics of verbs. Spontaneous conversations between mothers and children with ASD/HF-ASD may increase ToM task success. However, this does not necessarily translate into improved performance in real life. Also, research has shown a causal relationship between executive function and ToM abilities in children with ASD/HF-ASD. Children with difficulties in executive function and cognitive shifting struggle to predict false beliefs. Early executive function and central coherence skills predict developmental changes in ToM skills, independent of age, language, nonverbal intelligence, and earlier ToM skills [94].

Concerning the life cycle, preschoolers with HF-ASD show significant changes in ToM abilities over the preschool years, similar to children with typical development. However, in comparison with elementary school-age children with typical development or intellectual disabilities, children with ASD/HF-ASD perform significantly lower on ToM tasks. According to studies of Utah Frith's (2012) meta-analysis, the average age for passing the Sally and Anne false-belief test reveals an approximate 5-year delay for children with ASD compared with TDC children (children with ASD pass the test at the age of 9 years rather than at the age of 4 years, on average) [95]. Moreover, elementary school children with ASD demonstrate impairment on advanced, second-order, explicit ToM tasks that examine the ability to recognize facial emotional expressions (e.g., the Eyes Test by Baron Cohen, Wheelwright, Hill, Raste, & Plumb,2001) and internal mental states (e.g., the Strange Stories task by Happe´, 1994). Adolescents and adults with ASD, particularly those with HF-ASD often pass explicit conceptual ToM tasks, but their performance does not predict age-appropriate social behavior in everyday settings. Studies have found that adults with HF-ASD do not spontaneously anticipate another person's actions, even when they have passed explicit false-belief tasks with effortlessness. However, some older individuals with HF-ASD seem to possess ToM skills that resemble those of typically developing adolescents and adults. In conclusion, research has yielded mixed results regarding the degree of impairment in ToM capabilities, especially within HF-ASD. In ASD, the impairment is more severe, suggesting that cognitively able individuals with HF-ASD have varying difficulties in ToM, which may become mitigated over time.

In real-life social situations, spontaneous understanding and spontaneous response are crucial. However, individuals with ASD/HF-ASD often struggle with social communication due to the need for immediate, parallel data processing. The interrelated components of ToM create notions that are combined in explanations, predictions, and justifications of behavior. Despite high verbal and intellectual levels, social adaptive behavior is lagging. Research on the relationship between ToM and social skills is limited. Pragmatic conversational skills are crucial for social development, and understanding the relationship between ToM understanding and social and conversational behaviors in spontaneous everyday life is still being investigated. A new caregiver report measure, the Everyday Mindreading Skills and Difficulties scale, was developed to examine pragmatic social and conversational difficulties in children with HF/ASD. The study found that children who passed false-belief tasks exhibited fewer everyday social and conversational difficulties than those who failed. However, even those who passed the tasks had poorer everyday skills than those with typical development. Deficits in pragmatics are evident throughout the autism spectrum, and ToM deficits intensify individuals' difficulties in considering the listener's perspective, resulting in lower quality reciprocal social discourse [96]. Also, dishonesty and ToM are crucial socio-cognitive milestones, with children with ASD/HF-ASD showing difficulties in deceiving and lying. Studies have found that children with HF-ASD can tell both antisocial and white lies of their own volition, but struggle with maintaining them. The ability to hide false denials and misdeeds is observed in the preschool years in typical development but may develop later for children with HF-ASD [97]. Likewise, studies have shown that individuals with HF-ASD generate fewer autobiographical memories than those with typical development, and ToM is related to autobiographical memory difficulties in HF-ASD. This suggests that both require parallel processing, including the capacity to be aware of and mentally represent experiences from one's past into one's future concurrently [98]. In conclusion, individuals with HF-ASD have difficulties understanding both others and their own minds, as well as the development of lying and ToM abilities.

Research has also explored the academic abilities of individuals with HF-ASD. Reading comprehension and narrative abilities are directly influenced by ToM capabilities, as well as the ability to make predictions based on others' perspectives [93]. Narratives are also challenging for children with ASD/HF-ASD at all cognitive levels. Better ToM abilities were related to better narrative abilities only within the ASD group. This is due to two basic aspects of narrative within ASD: monitoring and maintaining the listener's attention throughout the story and explaining a character's emotions, thoughts, and actions. However, the relationship between ToM and narrative ability varies throughout the spectrum. Children with HF-ASD have difficulty producing thematically integrated and elaborated narratives, and they struggle to shift between the perspectives of two interacting characters in a given story [99].

Finally, individuals with ASD often struggle with writing due to deficits in ToM. They struggle with narrative genres and invented characters' thoughts. Research by Brown and Klein (2011) found that adults with HF-ASD wrote poorer quality and structure in narrative and expository texts. Theory of mind was positively related to text length and quality composite scores. Poor social understanding makes narrative writing challenging for students with HF-ASD. There is a need for increased research on academics and ToM to develop best practices [100].

4.3 Assessment of social cognition and theory of mind

Social cognition and social behavior must be studied together to assess and intervene on social competence in ASD. Standardized instruments assess components of social cognition, but measurement of social behavior typically relies on parent-report questionnaires, which are influenced by context and caregiver bias. Laboratory-based observations of social skill are an accessible and more ecologically valid alternative to assess impaired social ability in youth with ASD.

The Contextual Assessment of Social Skills (CASS) is a laboratory-based observational measure of conversation ability used to evaluate social impairment in youth and adults with ASD. The CASS consists of two videotaped conversations between participants and two trained tutors, with the first showing interest and the second being bored. Participants' behavior is coded for quantitative and qualitative data, capturing engagement with the tutor. Individuals with ASD have shown less engagement with an interested conversation partner compared to neurotypical peers [101]. The Contextual Response Scale (CRS) was developed as a manipulation check to evaluate participants' recognition of the two conditions. Preliminary findings showed that individuals with ASD rated bored tutors as less engaged than interested ones, but the difference was smaller than in individuals without ASD. This could reflect a deficit in social cognition, where autistic youth were less perceptive of bored tutors' social behaviors. The inclusion of both conversational conditions and concurrent examination of the CRS has the potential to provide a valuable, observer-rated behavioral index and accompanying self-report measure of social cognition [101]. Additionally, the Social Responsiveness Scale, second edition. The SRS-2 is a parent-report survey designed to measure symptoms of ASD in school-age. Each of the 65 items is rated on a 4-point Likert scale, where greater scores suggest greater impairment [102]. Items cluster into five subdomains that correspond to the overarching two-factor structure of DSM-5 diagnostic domains—Social Communication and Interaction (Social Awareness, Social Cognition, Social Communication, and Social Motivation subdomains) and Restricted, Repetitive Behaviors and Interests. The four subdomains under 'Social Communication and Interaction' are defined by Constantino and Gruber (2012) as: Social Awareness – the "ability to pick up on social cues" and "the sensory aspects of reciprocal social behavior"; Social Cognition – the "ability to interpret social cues once they are picked up" and "the cognitive-interpretive aspects of reciprocal social behavior"; Social Communication – "expressive communication" and "the 'motoric' aspects of reciprocal social behavior"; and Social Motivation – "generally motivated to engage in social-interpersonal behavior; elements of social anxiety, inhibition, and empathic orientation are included" [103].

A Developmental Neuropsychological Assessment (NEPSY-II) is a collection of assessments designed to evaluate neuropsychological development in youth aged 3–16. Four assessments were used as measurements of social cognition. Subsequently, Affect Recognition Task (AR) subtest includes 33 items evaluating the ability to identify facial expressions of various emotions. Memory for Faces (MF) and Memory for Faces Delayed (MFD) subtests evaluate the ability to identify 16 recently presented images of faces immediately after presentation and after a 15–25 min delay. Theory of Mind subtest includes 28 items evaluating the ability to interpret and predict the behavior of others across a variety of scenarios and with varying information [104].

Several instruments have been developed to assess ToM or different aspects of ToM. The simplest assess how the person can read emotions from faces and include:

- the Pictures of Facial Affect test (POFA) (Ekman and Friesen 1976);
- the Face Emotion Identification Task and Face Emotion Discrimination Task (FEIT and FEDT) (Kerr and Neale 1993);
- Reading the Mind in the Eyes Test, (Baron-Cohen et al. 2001);
- Reading the Mind in the Voice Test (Rutherford et al. 2002);
- based on the evaluation of first or second order false belief stories, such as the Sally-Anne Task (Baron-Cohen et al. 1985);
- Ice Cream Van Story' (Perner and Wimmer 1985);
- Strange Stories test (Happe´ 1994);
- Stories from Everyday Life test (Kaland et al. 2002);
- Hinting Task (Corcoran 2003; Gil et al. 2012);
- Faux Pas test (Stone et al. 1998).

Most of the tools mentioned tend to focus on only one of the multiple dimensions of social cognition (e.g., recognition of facial emotion or false-belief understanding). Conversely, there is an increasing request for validated assessment tools with high ecological validity that simultaneously cover numerous dimensions of social cognition, such as facial expression, gaze, gestures, body language, pragmatic aspects of language (such as irony or sarcasm) and interpretation of contextual clues. In natural circumstances, all of these aspects occur together, and their concurrent and immediate processing is required to interpret social behaviors appropriately.

Few instruments provide an integrated evaluation of the different components of social cognition. The use of cartoons to evaluate their mental attribution in children, through a tool called the ATOMIC (Beaumont and Sofronoff 2008), has been applied to individuals with Asperger syndrome [105]. Television advertisements and extracts from films, realise face validity criteria as tools to assess ToM in close to real-life situations, and have also been used with adults. Nevertheless, only the Movie for the Assessment of Social Cognition (MASC) (Dziobek et al. 2006) has been specifically designed for this use. Thus, the MASC has the standing of humour or sarcasm potential to provide greater breadth of information on disadvantage of these tests is that they often place excessive reliance on grammatical verbal skills and not on other aspects such as prosody or social cues (e.g., gestures, facial expressions, or gaze) that usually simultaneously accompany verbal utterances; The MASC is based on a film where participants must answer 46 multiple-choice questions about the emotions, thoughts, or intentions of the protagonists. Only one answer out of four is correct, and the test evaluates understanding of non-verbal communication, irony, sarcasm, implicit social rules, blunders, and insinuations. The original MASC instrument has been validated in English and applied to individuals with Asperger syndrome, schizophrenia, bipolar disorder, stress, depressive disorder, and personality disorders [106]. Lastly, another research area has received an increment of publication either for assessment or intervention in ASD and particularly for social cognition, representing a major focus of interest, naturally the social robot interventions [107].

A quick review of a well-known test

Happe's Strange Stories Task is a reading test that requires participants to infer mental or logical-physical states from 16 stories. The test includes examples of double bluff, persuasion, irony, and white lie. Answers are scored as 0, 1, or 2, with 1 being an explicit answer and 1 being a partial or implied response. The Reading the Mind in the Eyes Test presents 36 black and white photographs of eyes expressing different mental states. Participants must select one out of four mental states based on the best adjective that matches the eyes shown. Each correct answer scores one point, and the higher the total score, the greater the mentalizing ability of the individual. The Pictures of Facial Affect Test assesses the ability to infer mental states using 60 black and white photographs of full faces. The images are part of Ekman and Friesen's battery of facial emotions, and each photograph has one correct word. Each correct answer scores one point, and the higher the total score, the greater the mentalizing ability of the individual.

The SIPI is a 20-minute structured interview based on a storybook that shows a series of vignettes where a protagonist is either rejected by two other peers or provoked by another peer. Each type of vignette is combined with each type of peer intent to generate four stories: (1) a non-hostile peer-entry rejection story, (2) an ambiguous peer-entry rejection story, (3) an accidental provocation story, and (4) an ambiguous provocation story. The scores correspond to four of the five mental steps of social information-processing proposed by Crick and Dodge's (1994) model [108]: (1) encoding, (2) interpretation of cues, (3) response construction, and (4) response evaluation. The Encoding component evaluates the level of detail that the child recalls across the four stories. The Interpretation component evaluates hostile attribution to others' behavior. The Response Generation score is derived from the child's responses to the open-ended question: "Pretend that you ask your friends if you can play with them and they say that only two can play

in the block area. What would you do?" The Response Evaluation items examine the way in which the child assesses the behavior of other people as being right or wrong.

The Cognitive Theory of Mind (CST) is a 21-item measure designed to assess three aspects of ToM: understanding Beliefs, Intentions, and Emotions. It is suitable for a wide swath of the ASD population, as it does not require verbal abilities and can be used in both younger and older children. The Eyes Task–Children's Version consists of a series of black and white photos of children's eyes, each representing either mental states or primary emotions. The task requires fewer cognitive demands and shows one eye picture with two possible responses. The Advanced Theory of Mind Task (A-ToM) is an adaptation of Strange Stories, a ToM task first proposed by Happé (1994). It consists of 13 stories that describe real events. For a correct interpretation, the task requires the subject to go beyond the literal meaning of the text and make an inference about the story protagonist's mental state. Each story represents a different type of mental state attribution, such as pretend, Persuade, Joke, Lie, White Lie, Misunderstanding, Irony, Double Bluff, and Sarcasm. The scoring phase of the A-ToM task involves assigning scores to each story based on the correct answers to comprehension and justification questions. The scores range from 0 to 13, with higher scores indicating better ToM performance. Incorrect response categories (score = 0) apply to answers where the participant misunderstands the story situation, inference is inappropriate with regard to the story protagonist's utterance, or reports the exact words used in the story. Physical state categories (score = 1) apply to answers referring to non-mental events, while mental state categories (score = 2) apply to answers referring to thoughts, feelings, desires, traits, and dispositions. For more information and application, please see the following research [109].

4.4 Social and Cognitive interventions for addressing theory of mind in autism

ToM training is a crucial aspect of cognitive development, focusing on improving specific mental representations of oneself and others. However, studies have shown that improvement in ToM skills following specific interventions does not necessarily correspond to improved social capabilities. ToM interventions can be categorized into two major groups: specific ToM socio-cognitive training and general social skills interventions. Methodological issues often influence study results, with a randomized controlled trial (RCT) design being considered the gold standard for examining the efficacy of interventions. Theory-of-mind-specific interventions teach internal mental representations, such as role-playing, thinking bubbles, and perspective taking. However, not all skills learned during these interventions generalize to other ToM skills or settings. Studies have shown mixed results, with some showing modest success on trained tasks and others showing significant gains that generalize beyond explicit false belief to other ToM concepts. General interventions that incorporate ToM training among other social skills seem to be more likely to generalize to other settings. Nonetheless, Begeer et al. (2011), used an RCT design to carry out an intervention in which the kids with HF-ASD were taught conceptual comprehension of ToM. The training focused on second-order reasoning, emotion perception, the ability to distinguish between pretense and reality, and the ability to reason about true and erroneous beliefs. Comparing the experimental group to the control group, the experimental group showed overall significant improvements in reasoning about true and erroneous beliefs as well as in understanding mixed and complex emotions. Parental evaluations, however, indicate that neither the children's social skills nor their self-reported empathy were enhanced by the instruction. [110]. A group intervention designed to improve social interaction and comprehension in children and adolescents with HF-ASD was described by Mackay, Knott, and Dunlop (2007). Through group discussions, role-playing, and games, this intervention emphasized social comprehension and ToM abilities. Along with these techniques, the training included home practice, parent feedback meetings, and community activities as ways to enhance generalization to real-life situations. To sum up, 46 high functioning ASD kids and teens (six to sixteen years old; 38 boys and 8 girls) were divided into six groups for the intervention. Over the course of 12–16 weeks, each group met for at least one 1-1/2-hour weekly session with the goal of advancing critical domains of social interaction and comprehension, reinforced by

practice at home. Individual parent ratings revealed notable and sustained changes in the critical areas targeted in the group sessions, and significant advances were made when compared to a normative population. In conclusion, a groupwork intervention that addresses social interaction and comprehension can improve social communication in kids and teenagers with ASD [111]. More complex interventions use a multimodal strategy that combines socio cognitive skills with training in social interaction. The goal of these investigations is to help kids with HF-ASD operate more socially holistically. Consequently, Bauminger (2007) conducted an investigation into the cognitive-behavioral-ecological CBE intervention and discovered that it enhanced ToM skills as well as aided socio-cognitive processes in general (e.g., defining and recognizing emotions, addressing social problems, and revealing a better understanding of others). Once again, though, a significant disadvantage was the absence of a control group. In conclusion, targeted abilities have been found to be improved by particular ToM socio cognitive training; but, generalization to other skills and circumstances was limited [112]. On the other hand, despite some poor trial designs, general and multimodal therapies appear to strengthen ToM skills as well as generalization and social skills. Within the particular, regulated environments, the kids acquired the skills to utilize particular instruments (such "pictures in the head"), but they learned this skill outside their real-life context. Children must use parallel processing while generalizing to real-world situations because they need to identify the scenario, identify the appropriate "tool," and apply it. Working with general and multimodal therapies has the benefit of allowing HF-ASD participants to practice skills in general contexts during the intervention, which appears to help them overcome the complexity of parallel processing. Nevertheless, it's critical to customize therapies based on each person's social and cognitive abilities.

The Program for the Education and Enrichment of Relationship Skills (PEERS®)

PEERS® is an evidence-based social skills program developed by the University of California, Los Angeles, focusing on teaching skills for making and keeping friends and managing peer conflict and rejection. It is one of the few empirically-supported social skills programs to disseminate published treatment manuals for mental health professionals and educators. Likewise, PEERS® has been proven effective in improving social outcomes for adolescents with ASD and other social challenges like ADHD, anxiety, depression, and FASD. The PEERS® method's general effectiveness can be attributed to its use of evidence-based methods of treatment delivery borrowed from the CBT (cognitive behavioural therapy) approach, combined with the inclusion of parents in treatment [113]. The PEERS® approach employs evidence-based CBT strategies to teach social skills to adolescents with ASD and other social challenges. Group treatment is crucial for effective teaching of social skills, as it allows for interactive learning in a naturalistic setting with peers. Small group format is a fundamental element of the PEERS® method, used in both outpatient clinical settings and school-based educational settings. The ideal group size is 8-10 adolescent members, allowing for attrition and unexpected absences while maintaining group cohesion. In educational settings, up to 16 students can be included, with positive treatment benefits. However, the treatment impact of classes larger than 16 is unknown and not recommended [114]. Didactic instruction, also known as psychoeducation, is a therapeutic approach that aims to teach skills and foster adolescents' awareness and evaluation of their thoughts, feelings, and behaviors. The PEERS® method uses psychoeducation through weekly or daily didactic lessons teaching concrete rules and steps of social behavior. The PEERS® approach incorporates concrete rules and steps of social behavior, developed from research identifying ecologically valid social skills used by socially successful teens. Peer entry is an example of this approach, where adolescents enter conversations focused on common interests [115]. They discreetly watch and listen to the conversation, identify the topic, decide if they have anything to contribute, wait for a pause, move closer, and join by making a comment, asking a question, or giving a compliment. The CBT strategy of didactic instruction with concrete rules and steps of ecologically valid social skills is taught by breaking down these complex elements into easy-to-understand steps. Socratic questioning is a critical tool for adolescents to understand and encode new information. This CBT strategy

is particularly useful when working with adolescents, as it reduces avoidance and confrontation, enhancing treatment engagement and attention. By engaging adolescents in the process of generating the rules and steps of social behavior, the likelihood of understanding and remembering what they are being taught increases. Additionally, through Socratic questioning, by having teens and their peers generate the rules and steps of social behavior, they are more likely to believe what they are learning. Role-play demonstrations are a common technique in CBT where therapists model appropriate social behavior to simplify abstract skills into concrete rules and steps. Bad role-play demonstrations involve demonstrating inappropriate behavior, such as barging into a conversation without watching and listening, not waiting for a pause, and being off-topic. After a few moments of unsuccessful peer entry, the instructor calls a "time out" and asks the teens to identify what they did wrong and which steps they failed to follow. This repetition of instruction is highly valuable in learning any new skill. Good role-play demonstrations involve acting out appropriate social behavior, such as conversational peer entry, by following the steps of watching and listening, identifying the topic, waiting for a pause, moving closer, and joining the conversation by saying something on topic. After a few moments of successful peer entry, the instructor calls a "time out" and asks the teens to identify what they did right and which steps they followed. Role-play demonstrations and cognitive strategies are also used to enhance perspective-taking skills in youth with ASD. The PEERS method involves asking social perception questions, such as "did it seem like the group wanted to talk to me?" and "How could you tell?", to assess social acceptance in conversations. Adolescents are taught to look for three concrete behaviors: verbal cues, eye contact, and body language. By considering these questions, adolescents are better equipped to read social cues and assess their own peer acceptance. This method can be generalized to other settings, such as reviewing homework assignments, where adolescents assess their own peer acceptance based on verbal cues, eye contact, and body language. Hence, the method uses peer entry examples to illustrate this, asking participants to consider the perspectives of others and their thoughts on the situation. This helps develop a routine measure for assessing social situations both inside and outside the treatment setting. Likewise, social problem-solving is another critical cognitive strategy in PEERS®. It involves determining the social appropriateness of a behavior and deciding how to act accordingly. The method addresses social problems by considering the causes of these problems and considering what might be done differently next time. For example, if an instructor was rejected due to inappropriate entry, they would need to follow the steps for peer entry or choose a different group. Additionally, the behavioral rehearsal, also known as participant modeling, is another common CBT technique in PEERS®. It involves adolescents actively practicing newly learned skills in the treatment setting while correcting behavioral errors and cognitive distortions. This small group format allows for repeated practice and consolidation of newly learned skills in a controlled, supportive environment. Also, the method emphasizes repeated behavioral rehearsal exercises to help adolescents learn social behavior rules and observe how they work. This includes practicing in a safe and protected environment before using these skills with peers in nonclinical settings. The behavioral rehearsal exercise for peer entry involves teens entering conversations between other adolescent group members following the steps outlined in the didactic lesson. Performance feedback is provided immediately after implementing the skill, in a direct, concrete, and specific manner. In addition, homework assignments and homework review are critical components of CBT. Repeated practice through homework assignments encourages mastery of skills, allows therapists to determine the extent to which the adolescent has grasped the skill, and fosters generalization and maintenance of skills outside of the treatment setting to naturalistic social settings. Research suggests that completion of homework assignments is significantly correlated with greater treatment outcomes. Homework assignments ensure that adolescents practice and use newly learned skills in nonclinical settings. For example, the peer entry example involves practicing joining a group conversation with peers outside of the treatment setting. Completion of this assignment is discussed during homework review in the following week. Hence, homework review is an essential aspect of the PEERS® approach. It is not enough to simply give an assignment to practice a given skill; progress

regarding the rehearsal of that skill must be assessed and used in some cases. Following up with adolescents on the execution of these assignments during homework review allows the instructor to individualize the treatment for each adolescent, continuing with what works and adjusting what does not. In the PEERS® example, if a teen reports on his peer entry assignment only to indicate that he was rejected by his peers, it is important to consider the reason for this rejection. Instead, the treatment is individualized and recommended that the teen find a source of friends outside of school, often through involvement in community-based extracurricular activities [116]. Finally, parent involvement in treatment for ASD has become increasingly popular, but its inclusion in social skills training is still rare. Parents can help adolescents with behavioral rehearsals in natural settings and provide performance feedback, which may promote better durability of generalized treatment gains. The PEERS® method is unique in its active inclusion of parents in treatment. Parent groups are conducted in weekly outpatient clinical groups, promoting the maintenance of skills long after the program has ended. Parents are taught to be social coaches to their teens, and motivated teens agree to this coaching contract. Parent-mediated treatment is only included in families with a willing parent participant and a willing teen willing to be coached by this parent. Parent participation in treatment ensures that skills learned are practiced and refined long after the treatment group has ended [117].

Also, other, evidence-based group intervention have been studying in recent and well-recognized reviews [118]. The first review included five studies examining social skills groups for individuals with ASD aged 6 to 21 years (Solomon 2004; Laugeson 2009; Frankel 2010; Koenig 2010; Lopata 2010) reported in Table 5. All five studies were conducted in the United States, with four using a randomized wait list control trial method and one using a randomized controlled trial design with a no treatment control. All studies had an inclusion criterion that participants had IQs above the cut-off for intellectual disability. The social skills groups were conducted for five to 20 weeks or 12 to 125 sessions, with four having one session per week. Multiple social skills group curricula were used, with four studies including a parent component. Outcome measures were assessed immediately following treatment, but no long-term outcome data were reported. Four studies measured social competence using standardized measures, including the Social Skills Rating System (SSRS), the Social Responsiveness Scale (SRS), and the Social Competence Inventory (SCI). In addition, social communication was measured using the Idiomatic Language subtest of the Comprehensive Assessment of Spoken Language, with significant gains made by the treatment group. However, no post-treatment differences were found between the treatment and control groups. Likewise, emotion recognition was examined using the Diagnostic Analysis of Nonverbal Accuracy 2 (DANVA-2) child faces subtest in two studies involving 54 participants. Moreover, quality of life was measured using multiple measures, suggesting small to modest improvement in quality of life for children receiving treatment. Friendship quality was measured by self-report in two studies, while loneliness was measured using the Loneliness Scale. Child and parent depression was measured using the Beck Depression Inventory, with no statistically significant difference between pre- and post-treatment scores for children participating in a social skills group or their mothers. The findings of this review and meta-analysis support the findings of a well-established recent review that there is growing evidence on the efficacy of social skills group therapies [119]. The field of group interventions promoting social skills in adolescents with ASD has seen a rapid growth in recent years. Most studies evaluated program effectiveness using a pre-post design, but researchers are transitioning from preliminary feasibility studies to rigorous controlled trials. Most studies were conducted in clinic settings, but some suggest that social skills groups may be effective in school and community settings. Most studies have been conducted in the USA, but there is growing evidence for the generalizability of this form of intervention to various cultures and contexts. Currently, no studies have assessed the merit of smaller versus larger groups of participants. In a recent review of 2014, Miller and colleagues [120] found that the majority of groups reviewed were theoretically based in broad behavioral or cognitive-behavioral principles, with most interventions including some combination of didactic teaching and experiential components. Role-plays were identified as a common and useful treatment technique.

Most interventions targeted social skills comprehensively, with a smaller number focusing on specific aspects of social competence, such as social cognition or nonverbal communication. Performance deficits associated with co-occurring anxiety symptoms are a core intervention consideration [119]. Social skills program treatment intensity ranges from 6 hours to 180 hours, with most programs taking place weekly for 10-16 weeks. The evidence suggests that several months of weekly group intervention is the minimum amount necessary to reliably improve participants' social skills. Shorter duration treatments yield more limited evidence of social gains and generalization of these skills, while longer duration treatments do not use proper assessment methods or present compelling data to support prolonged participation. The literature suggests that social skills group interventions can be effective, with effectiveness measured through various means, most commonly through parent report measures. Further manualization of effective treatment procedures and independent replications of promising delivery models are needed to propel the field forward. Overall, there is a rapidly growing evidence base supporting the use of novel socialization procedures for adolescents with ASD, and empirical investigations will continue to improve in both number and experimental rigor as the field continues to address the complex needs of this growing population.

Table 5. evidence-based social skills groups for individuals with ASD aged 6 to 21 years

Intervention	Description
Social skills group of Solomon (2004)	social adjustment enhancement with concurrent parent training, 20-week duration (one 90 min session per week)
The PEERS® Social skills group of Laugeson (2009)	concurrent parent training of 12-week duration (one 90 min session per week)
Children's Friendship Training, Social skills group of Frankel (2010)	concurrent parent training of 12-week duration (one 60 min session per week)
Social skills groups with peer tutors of Koenig (2010)	curriculum with peers of 16-week duration (one 75 min session per week)
Skillstreaming, Social Skills Groups of Lopata (2010)	curriculum modified with concurrent parent training, 5-week duration (twenty-five 70 min sessions per week)

4.5 Behavior-Analytic Approach to Perspective-taking: an overview

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abstract

The concept of Theory of Mind assumes a strong scientific concern for all those experts engaged in the study of autism treatment because many researches have highlighted that people diagnosed with autism spectrum disorder (ASD) have important difficulties with developing a theory of mind. That regards inferring other's state of mind, desires, preferences, thoughts, beliefs, intentions. The current article begins with an analysis of the concept of theory of mind and of some of the strategies reported in literature as social skill training, cognitive-behavioural approach and neuropsychological interventions. On the other hand, it is focused on an analysis of techniques and procedures based on the basic principles of Applied Behavior Analysis (ABA) that, thanks to the methodological accuracy typical of this science, they are significantly valid in terms of treatment efficacy.

introduction

The theory of mind (ToM) is a complex cognitive process that involves inferring the mental states of others, which is closely related to empathy. Recent studies have identified components such as cognitive empathy, affective empathy, empathic awareness, and personal suffering. Many people with autism are capable of feeling emotional empathy but struggle with cognitive interpretation of social cues, leading to distress in emotional and social situations. Likewise, social cognition is the process by which individuals process, remember, and use information in social contexts to explain and predict how people behave. Two aspects of social cognition were examined: Theory of Mind (ToM) and Emotion Understanding (EU). ToM concerns the attribution of mental states (beliefs, desires, intentions, etc.) to oneself and others, and the ability to use these attributions to understand, predict, and explain one's own behaviour and that of others. EU, on the other hand, is a component of social cognition and emotional competence, which concerns how individuals understand, predict, and explain their own and others' emotions. From a theoretical point of view, ToM and EU are partly correlated. Specifically, Pons and Harris' (2000) view of EU are made of nine components hierarchically organized, including recognition of emotional expressions and external causes of emotion, the role of desire, beliefs, external reminder on emotions, emotion regulation, displayed emotions, role of moral dimension, and mixed emotions [121]. The current scientific consensus considers theory of mind and empathy, although related, not completely synonymous. Individuals with autism need to develop difficult levels of understanding of mental states to enhance their social cognition. Two classes of behaviour make explicit the role of the theory of mind: the first suggests that the individual has reached the awareness that other people have private experiences (mental states) different and unobservable of them, and the second that the child has acquired the ability to take the perspective of another animated persons/silhouettes. The theory of mind is generally distinguished into first and second-order theories. First-order ToM develops around 4 years of age and concerns the ability to reflect on what another person thinks or feels; recognize that different people want different things and have different beliefs and knowledge; and understand a false belief. Second-order theory of mind involves the ability to predict what one person may think of another and the understanding of lies, sarcasm, and metaphoric language. Commonly, children acquire this level of awareness or cognitive processes between 6 and 10-years-old [122]. In natural environments, social and cognitive impairments influence people to understand appropriately the point of view and perspective of others, feel empathy, tell socially appropriate lies, implement bluffing strategies, recognize a lie, understand the intentions of the other, and respond to ironic speech. Essentially, Perspective-taking is a crucial aspect of human socialization, enabling individuals to adapt their behavior to others' expectations. It is essential in competitive settings, maintaining healthy interpersonal relations, and strengthening social bonds. Deficits in perspective-taking can lead to significant impairments in social skills. It involves interpreting and predicting thoughts, emotions, or behaviors of

oneself and others, assuming an alternative perspective when necessary. While most research focuses on the ability to assume another's perspective, the metacognitive aspect has also been emphasized. The key skill is to put oneself in the "mental shoes" of others, imagining their perceptions and understanding that their beliefs may differ from one's own. A recent comprehensive overview of perspective-taking literature from mainstream psychology and behavior analysis, focusing on the behavior-analytic approach, which includes traditional behavior analysis, Relational Frame Theory (RFT), and an updated version of RFT [123].

Traditional psychological research has studied perspective-taking abilities, which are divided into three domains: visual or spatial perspective-taking, affective or emotional perspective-taking, and cognitive perspective-taking. These abilities are involved in the ability to take the perspective of another, with competence observed in children as young as 12½ months. Level 1 involves appreciating what others see only from that specific viewpoint, while Level 2 involves appreciating that even when two people can see the same object, they may do so from different vantage points [124]. Affective perspective-taking, also known as emotional perspective-taking, involves the ability to recognize the emotional state of someone else and understand the relationship between different situations and the specific emotions they typically elicit. Competence in this regard has been observed in children aged between 2 and 3 years old, and is typically associated with the emergence of simple emotion-based words, such as "happy" and "sad." However, it is difficult to separate affective perspective-taking from related skills, such as empathy and having a theory of mind [125-126]. Many affective perspective-taking tasks require sophisticated cognitive and linguistic skills, which can result in floor effects when presented to young children. Additionally, affective perspective-taking tasks often require an understanding of conflict between one's own emotional response to a situation and the emotional response of another, which is hard to distinguish from an understanding of false belief. Some authors have proposed an overlap between affective and cognitive perspective-taking, while others maintain that these complex repertoires are better understood as two distinct forms of social cognition. Moreover, cognitive perspective-taking, also known as theory of mind (ToM), is a core skill in cognitive psychology that involves attribution of mental states to oneself and others to explain and predict behavior. The ability to form a theory of mind is believed to be universal only in human adults. Cognitive perspective-taking and ToM skills are typically divided into two levels: first-order false beliefs, which refer to assumptions made about another person's beliefs, and second-order false beliefs, which refer to assumptions about beliefs held by a third party [127]. Recent research has shifted focus from the presence of ToM in a child's repertoire to the developmental precursors necessary for its development. Infant joint attention predicts mental-state term usage and competence in ToM at 2 years, while declarative pointing in infancy also predicts ToM in preschool activities [128].

Research on the potential deficits in ToM in individuals with ASD has led to the "Impaired ToM" Hypothesis, which suggests that some children with ASD fail to shift from their own perspective to the perspective of another. However, there is considerable body of evidence that questions the view that ToM is typically deficient in individuals with ASD. For example, Boucher (2012) reviewed a number of studies in which individuals from this group passed both first and second-order false belief tasks, as well as other types of assessments of ToM, involving metaphor, faux pas, and sarcasm [129]. Happé (1995) suggested that verbally competent individuals with ASD can pass false belief tasks when given ample time because their core deficits may lie more broadly in social affective information processing [130]. Numerous authors argue that these differential outcomes highlight the role of executive functioning in ToM, suggesting that at least some of the weak ToM performances observed in adults and atypical samples reflect broader deficits in executive functioning, rather than in ToM per se [131]. Different error patterns in ToM tasks can help distinguish clinical from non-clinical populations, particularly borderline personality disorder (BPD) and schizophrenia. A study by Mazza et al. [122] found several differences between groups in completing advanced ToM tasks. BPD is believed to have disturbances in interpersonal relationships and misreading of others' intentions, leading to different ToM outcomes. The ToM competencies of this clinical group appear

to be influenced by the type of task employed. Studies have reported that individuals with schizophrenia have produced different outcomes on ToM tasks, with weaker performances in attribution of thoughts or intentions to others and correlations between negative symptoms and overly simplistic mental states. Positive symptoms have also been associated with excessively complex mental states.

Behavior-Analytic Approach to Perspective-taking

The theory of mind can be interpreted through a behavioural and operational approach, which helps overcome mentalistic definitions. Behavior analysts suggest that the ability to assume someone else's perspective is often in close interaction with environmental stimuli. This discrimination between stimuli may be related to perceptual dysregulation, a common issue in autistic individuals. Autistic children may be captured by interfering sensorial stimuli, resulting in difficulties in attentive focus on themselves and others. The ability to name the mental state of another person involves observing environmental stimuli linked to the subject's private events. Skinner (1957) defined private events as mental states, desires, emotions, and thoughts not directly observable but present "under the skin" of the individual. Children learn to label and describe their private events through observation of similar related behaviours. Cognitive processes giving meaning to mental status take advantage of equivalence between private and public events. Behavior analysis focuses on understanding the concept of "self" through the ability to respond to one's own responding. Skinner's early writings on self-knowledge suggest that self-knowledge develops through shaping by the knowledge of others and social contingencies that reinforce the discrimination of one's own behavior. By asking questions such as "How are you feeling?", other members of the verbal community shape an individual's ability to discriminate their own behavior, leading to better prediction and control over their own behaviour [132]. Few in the behavior-analytic community have explicitly attempted to connect the Skinnerian concept of self with the skills involved in perspective-taking, even though they are intuitively linked. Some researchers have attempted to interpret ToM tasks and performances using behavioral concepts, such as Sidman's equivalence relations [133], operant stimulus control [134], and interbehavioral interpretation [135]. Most of the behavioral work on perspective-taking has focused on the remediation of deficits in these abilities, based on the broad assumption that perspective-taking repertoires may be established or remediated through the acquisition of an appropriate learning history. Developmental behavioral researchers have dedicated attention to the precursors to perspective-taking, with a particular focus on joint attention and social referencing. Joint attention involves tracking another's eye gaze or finger pointing to coordinate attending to a stimulus, such that the learner and the instructor have some element of shared experience regarding that stimulus. Evidence suggests that joint attention can be established when found to be deficient or absent. In a related study of joint attention and its initiation, Whalen and Schreibman (2003) trained five children with ASD aged 4 years, using components of Discrete Trial Training (DTT) and Pivotal Response Training (PRT). Baseline performances indicated considerable impairments relative to TDC, in particular in joint attention initiation. However, training facilitated significant improvements in all children on joint attention, and in four of the children on joint attention initiation, including generalization to novel settings and novel adults [136]. In traditional behavior analysis, self-awareness is considered an essential precursor to perspective-taking, but empirical support for this interpretation has tended to come from research with nonhumans. Little behavior-analytic research has explicitly attempted to connect the concept of self or self-awareness with perspective-taking skills in humans. Video modeling interventions have enabled children with ASD to pass the Sally-Anne Test, but generalization is more robust when training exemplars are included. Adding training prompts into the Sally-Anne Test has also produced positive outcomes, but appears to be necessary or less effective for participants with language deficits. It is harder to draw clear conclusions regarding the concept of perspective-taking itself because behavior-analytic research also demonstrates that impairments in perspective-taking are relatively changeable when behavioral interventions target them. We will uncover an account of perspective-taking that is surprisingly anchored in human language when we turn to a branch

of behavior analysis called Relational Frame Theory (RFT), which has focused exclusively on human language and cognition. As we'll see, a more process-oriented explanation of perspective-taking has emerged as a result of this attention recently.

Language-Focused Behavior-Analytic Approach to Self and Perspective-Taking

Self-discrimination, a concept proposed by behavioral researchers under the rubric of Relational Frame Theory (RFT), is a form of verbal self-discrimination that differs functionally from nonverbal self-discrimination observed in nonhumans. According to RFT, this type of verbal self-discrimination and perspective-taking are based on derived relational responding, which is the basis of language itself. RFT distinguishes between non-arbitrary and arbitrary relational responding. Non-arbitrary relational responding involves relating one stimulus or event to another based on a shared physical property, such as shape, size, or colour. It is directly acquired through contingencies and is highly developed in non-humans. In contrast, arbitrary or derived relational responding is more likely to be emergent in terms of its acquisition. Subsequently, RFT researchers have investigated various patterns of these behaviors, including responding in accordance with relations of coordination, distinction, opposition, comparison, hierarchy, and perspective-taking. Response in accordance with the relation of coordination appears to be the most basic that infants learn at around 18-24 months. For example, O'Connor et al. (2009) successfully employed multiple exemplar training to establish word-picture and picture-word coordination relations in 15 children with ASD and three TDC [137]. Responding in accordance with the relation of distinction requires responding to arbitrary differences among stimuli along a particular dimension by applying a relational cue such as "is different from". Responses to relational relations involve different dimensions and levels of complexity. Opposition relations involve the abstraction of a particular dimension along which stimuli can be differentiated at either end of a continuum, which is likely more complex than coordination and distinction relations. For example, "If A is opposite to B and B is opposite to C," A and C are most likely the same. Studies have successfully established opposition relations in TDC and children with ASD. Comparation relations require responding to one event in terms of quantitative or qualitative relations along a specified dimension with another event. This has been successful in TDC and children with ASD. Temporal relations require responding to the relationship between two events in terms of a specified temporal dimension, using relational cues such as "before/after" or "now/then." Hyperarchy relations are even more complex and contain some of the relations described above. For example, "If B is a member of group A," A is a class containing B and any other members of A are likely to be similar to B, at least to some extent. Several studies have investigated hierarchical relations in adults and TDC, and some studies have successfully trained hierarchical relational responding in TDC aged 5-6 years [138].

Most empirical research on deictic relational responding has employed various repetitions of a developmental protocol originally developed by Barnes-Holmes (2001) [139]. The original extensive 256-trial protocol targeted the three deictic relations (I- YOU, HERE-THERE, and NOW-THEN), as well as three levels of relational complexity, referred to as simple, reversed, and double-reversed relations. In an attempt to reflect a typical developmental sequence, the protocol targeted the interpersonal I-YOU relations first, followed by the spatial HERE-THERE relations, and finally the temporal NOW-THEN relations. Level 1 targeted simple I-YOU relations, followed by reversed I-YOU relations, followed by HERE-THERE relations, and then combined the interpersonal and spatial relations in an I-YOU/HERE double reversal. Level 2 focused on the temporal relations and their relationship with interpersonal and spatial relations, targeting simple NOW-THEN relations first. Likewise, Guinther (2018) initially argued that the protocol developed by Barnes-Holmes (2001) and the derived "mental rotation" model constituted competing accounts of perspective-taking. However, the deictic relations protocol has been used extensively in empirical research with TDC. The results support the distinctions among the three types of deictic relations, vary on a continuum of complexity from simple relations to reversed relations, and double-reversed relations. There appears to be a developmental trend in which interpersonal and simple relations emerge

first. Once established, these perspective-taking repertoires can generalize to both new stimuli and real-world conversational topics. Positive-taking repertories can be successfully established in more natural language-like contexts, such as within a children's story. The establishment of deictic relations may be enhanced when multiple exemplars of established cues for deictic responding are incorporated into the protocol. Empirical research using the deictic relations protocol with atypically developing children has focused on investigating possible deficits associated with ASD. Overall, the deictic relations protocol offers valuable insights into perspective-taking in adults and children [140]. To sum up, children with ASD generally perform worse than their TDC, nevertheless, they can differentiate their performances in terms of relation type and level of complexity, and deficits can be remediated with direct training. Subsequently, deictic relational responding can be established using naturalistic variations of the original protocol.

Scope

A narrative review has been performed in order to study the efficacy of ABA intervention in addressing social cognition impairments in children and adolescents with ASD. The current literature should provide insights for future clinical research since behavioural intervention are largely diffused worldwide and included in EBP. Finally, social understanding and social behaviours are the floor to face adaptation of people in the autism spectrum, and a critical review of behavioural literature is necessary to drive appropriate clinical approaches. Therefore, we wanted to respond to the following research questions:

1. What is the state of art regarding the outcome of ABA intervention on ToM in children and adolescent with ASD.
2. What is the role of predictors and of emerging behavioural EBP to facilitate social cognition in this clinical sample.
3. How behavioural interventions have been addressing the generalization of these social behaviours in natural setting?

Method

A wide-ranging search of three selected computer databases, Scholar, PubMed and PsycINFO, using from 1987 to April 2024 was conducted. Concerning algorithm, all of the following four items such as “perspective taking”, “theory of mind”; “social cognition”; “false belief*” along with the term “autis*” into title and abstract were performed. Articles were included for the current analysis if they met the following criteria: articles were published in a peer reviewed journal; participants were children and adolescents (0-18 years) with a diagnosis of ASD. Studies involving other clinical populations were excluded regardless of inclusion of individuals with autism. Studies comprising behavioural analytic intervention, consequently cognitive-behavioural intervention, comprehensive social skill training and developmental treatment on ToM or other social cognitions are excluded. The current review has focused on experimental studies that used ABA as an intervention or as a means to facilitate social understanding (mental states, desires, false belief, irony, contextual social behaviours, and so on). The study included a wide range of research designs such as Cochrane definitions and criteria for randomized controlled trials (RCTs) and controlled clinical trials (CCTs), as well as, pre- post-interventions and case studies (https://handbook-5-1.cochrane.org/chapter_6, accessed date 12/12/2023). Articles that met the selection criteria were also selected via previous well-established review on ABA and ToM.

Follows the key: ((theory of mind[Title/Abstract]) AND (autis*[Title/Abstract])) AND (behav*[Title/Abstract]) OR (((false belief[Title/Abstract]) AND (autis*[Title/Abstract])) AND (behav*[Title/Abstract])) OR (((perspective taking[Title/Abstract]) AND (autis*[Title/Abstract])) AND (behav*[Title/Abstract]))

Additionally, we have searched target studies into well-known journals regarding behavioral interventions. In Scopus index we have filtered the search for “behav*” performing the algorithm to the corresponding editor page (Please see the table 6).

Table 6. List of behavioural journals indexed in Scopus Elsevier (2023).

Source Title	Print-ISSN	E-ISSN	Publisher
Behavior Analyst	07386729		Springer Nature
Behavior Modification	01454455		SAGE
Behavior Research Methods	1554351X	15543528	Springer Nature
Behavior Therapy	00057894		Elsevier
Behavioral Interventions	10720847	1099078X	Wiley-Blackwell
Behavioral Sciences		2076328X	MDPI
Behaviour Change	08134839		Cambridge University Press
Behaviour Research and Therapy	00057967		Elsevier
Beyond Behavior	10742956	21635323	SAGE
Cognitive and Behavioral Practice	10777229		Elsevier
Cognitive Behaviour Therapy	16506073	16512316	Taylor & Francis
Current Opinion in Behavioral Sciences	23521546		Elsevier
European Journal of Behavior Analysis		2377729X	Taylor & Francis
Journal of Applied Behavior Analysis	00218855		Wiley-Blackwell
Journal of Behavior Therapy and Experimental Psychiatry	00057916		Elsevier
Journal of Behavioral and Cognitive Therapy	26663473	25899791	Elsevier
Journal of Behavioral Education	10530819		Springer Nature
Journal of Behavioral Health Services and Research	10943412		Springer Nature
Journal of Positive Behavior Interventions	10983007	15384772	SAGE
Journal of Rational Emotive and Cognitive Behavior Therapy	08949085	15736563	Springer Nature
Journal of the Experimental Analysis of Behavior	00225002		Wiley-Blackwell
Journal of Verbal Learning and Verbal Behavior	00225371		Elsevier
Learning and Behavior	15434494	15434508	Springer Nature
Perspectives on Behavior Science	25208969	25208977	Springer Nature
Progress in behavior modification	0099037X		SAGE
The Journal of applied behavioral science	00218863		SAGE

Results

Of the 405 studies positioned, 17 met the inclusion criteria. A list of excluded studies is available from the authors on request. The included studies were then categorized according to the focus of the evidence-based practices implemented respecting the ABA international standards [https://www.bacb.com/about-behavior-analysis, accessed date 02/03/2024]. Additional exclusion criteria included review of theorical and empirical studies, neuroimaging research assessment, other clinical samples or older 18 age, treatment with medications, correlational analysis or studies regarding assessment tools or factor analysis.

Cognitive intervention studies excluded from review

A recent RCT study [141] enrolled 30 ASD youngsters were split into two equal groups: one for active control and the other for theory of mind instruction. The groups were treated to story-telling sessions and attentive rehabilitation of theory of mind (ARTOM). Three baseline, post-intervention, and follow-up sessions were held to assess the participants using the Gilliam autism rating scale (GARS), theory of mind, and facial expression recognition assessments. The intervention group's theory of mind and ability to recognize facial emotions both improved, according to the data. GARS measurements of the behavioral symptoms showed improvement in the intervention group. The training's results persisted through the follow-up meeting. The findings imply that improving theory of mind skills involves correcting fundamental theory of mind components without directly addressing theory of mind. Another study involved 7 male children with autism aged 8-18 where the training materials and procedures used cardboard Sally-Anne figures and thought-bubbles through a progression of five teaching stages [142]. The children had to pass an earlier stage according to various criteria to advance to the next stage. Teaching and testing were conducted individually in a quiet room, with up to five sessions of approximately 30 minutes per day. Training ended after the child's progress was assessed. The study involved children who were instructed for three or four sessions. They received the Sally-Anne test with cardboard figures without thought-bubbles and a Smarties® false belief task as a pre-test. They received two post-tests in their last session regardless of which stage they finished in their training: the Bears test and a Smarties® test. The Sally-Anne task was modelled on that in Baron-Cohen et al. (1985) and described earlier. The Bears post-test was a change-of-location false belief task, where one bear (George) hides a marble in a bag and goes away while a second bear (Bertie) moves the marble to a box. Three questions were asked in these change-of-location tasks: (1) 'Where does Sally/George think the object is?' (thought question), (2) 'Where will Sally/George look for the object?' (behaviour question), and (3) 'Where is the object?' (reality control question). The Smarties® task was designed as a 'near' transfer test and Smarties® as 'further' in format, questions, and materials. The Bears task was different from the Sally-Anne task, which used cutout cardboard pictorial people and objects to allow easy use of the thought-bubbles. At the start of the teaching sessions, each child was shown a picture of a person with a thought-bubble. During stage 1, all children easily came to understand the bubbles as thought-bubbles, saying that they showed what the person was thinking and using them to correctly answer the question, 'What is Sally thinking about?' Seven children progressed through different teaching stages, with varying levels of success. All seven children reached stage 3 where they demonstrated and asked questions about Sally's thoughts and thought-bubbles of an object. They required one to three teaching sessions to understand these concepts. The children averaged 68% correct on target questions during their stage 3 question and feedback phases. They averaged 87% correct on their last three stage 3 trials. Five children advanced to stage 6, where they presented multiple trials of the Sally-Anne false belief task. On average, they answered 94% of these thought and behavior stage 6 questions correctly. On their last three presentations, they were 100% correct on the thought questions and 100% correct on the behavior questions, as well as 100% correct on the reality control questions. At post-test, six of seven children passed the Bears test by correctly answering both the thought and behavior questions. If the Sally-Anne pre-test is used for comparison, there is a significant change from the average of 14% correct answers for the pre-test to 86% correct answers for the parallel post-test Bears false belief questions. Two children

correctly answered the Smarties® task false belief question, but the same two children passed Smarties® at pre-test, indicating no change. Another study was a RCT with an intervention group and a waitlist control group [143]. The sample consisted of 141 children aged 8-13, with a clinical diagnosis of autism and a receptive verbal IQ score above 70. The Social Responsiveness Scale (SRS), a parent questionnaire designed to measure autistic traits, was used to confirm the presence of clinical levels of autistic features. The "Mini ToM intervention" is a manualized, weekly intervention comprising eight 1-hour sessions provided to five to six children at a time, all aged within 3 years of each other. The training is delivered in a child psychiatric centre by certified therapists. All sessions followed the same structure: (1) discussing the homework assignment; (2) games and exercises related to the day's theme; (3) children summarizing the session to their parents; and (4) explanation of next week's homework assignment. Parents were involved in the training through two 1-hour parent-sessions that explained theory of mind, the ToM-training, and how parents could help their children acquire these new skills and promote generalization. Descriptive measures included the Peabody Picture Vocabulary Test: III-NL (PPVT), which assesses children's receptive verbal ability. The ToM test measures children's theory of mind knowledge at three levels (Elementary, Intermediate, and Complex) with cognitive sub-stages within each level. The ToM Behavior Checklist (ToMbc) measures ToM-related behavior in everyday life. The Dutch version of the SRS assesses autistic features. Older/Younger Sibling(s) were used to create variables indicating whether or not the autistic child had an older sibling and/or a younger sibling. Sibling with Autism Diagnosis/Suspicion Parents were asked to indicate which family members, other than the participating child, were either diagnosed with, or suspected of having, an ASD. The study found that the number of siblings did not moderate treatment outcomes for ToM knowledge and autistic features. However, when specific ToM-related behavior was measured, participants with more siblings showed better outcomes. This suggests that moderation might be limited to parent-reported behavioral outcomes targeted in the intervention. A post hoc moderation analysis of the social cognition subscale of the Social-Cognitive Skills Scale (SRS) revealed that having more siblings was related to fewer social cognition problems post-treatment. For ToM-related behavior, the model was significant, with more positive treatment outcomes for children with an older sibling. The social cognition subscale of the SRS was also significant, with having an older sibling related to fewer social cognition problems post-treatment.

Research studies comprised in the narrative review.

On the other hand, a study aimed to expand previous research by teaching children with ASD to tact others' private events using all five senses [144]. The research was conducted in the natural environment with live people, using multiple exemplar training to generalize to untrained stimuli. The study involved three children, Dori, Emma, and Felipe, who received behavioral intervention from a community-based agency based on ABA. The participants were all at level three on the Verbal Behavior Milestones Assessment and Placement Program (VB-MAP), communicated using full sentences, and had prerequisite skills relevant to the skills targeted in the study. The participants were taught to tact all stimuli, respond correctly to questions involving pronouns, respond to questions involving familiar names, and tact items they sensed. The dependent variable was labeling the stimulus with which another person was interacting when asked what the person could see, taste, feel, hear, or smell. A response was recorded as correct if the participant could tact the stimulus that the person was sensing within 5 seconds of being asked. Interobserver agreement (IOA) was calculated by dividing the number of agreements by agreements plus disagreements and multiplying by 100%. The mean IOA equaled 100% for Dori and Felipe and 98.9% for Emma. Nonconcurrent multiple baselines across participants' designs were employed to evaluate the efficacy of the intervention. One to three sessions were conducted one to two times per week in participants' homes during their regularly scheduled ABA-based intervention sessions. Each session consisted of 10 trials. Participants were asked to see, taste, feel, hear, or smell an inaudible object. The target person was asked to engage in only one sensing behavior about the stimulus being targeted. The

trial involved multiple exemplar training sessions, error correction, and reinforcement. Participants were given stimuli they preferred and given praise for correct responses. Incorrect responses were corrected using a three-step procedure: a leading question, an experiential prompt, and a full vocal model. The first session involved random rotation of two senses, followed by a novel person probe. Dori, Emma, and Felipe were trained to respond to stimuli with varying degrees of accuracy. Dori had 40% to 60% accuracy, with half of her errors due to incorrect object identification, a third due to lack of response, and a small number due to random responses. Training increased her accuracy, reaching 80% to 100% accuracy in one session with all five senses. Emma responded with 20% to 50% accuracy, with most errors due to incorrect object identification. Training improved her accuracy to 90% in a novel-person probe and 100% in a novel-person probe. Felipe responded with 0% to 40% accuracy, with most errors due to incorrect object identification, lack of response, and random generic responses. Training improved his accuracy to 90% to 100% in post-training.

Additionally, video-based group instruction (VGI) has been shown to effectively teach social skills to adolescents with ASD. In a study by Plavnick et al. (2013), VGI was administered to four adolescents with ASD and co-occurring intellectual disabilities (ID) two days a week. The participants were taught five social skills across three domains: social initiations, social awareness, and reciprocal social interactions with adults as social partners. All participants acquired targeted social behaviors and independently performed the behaviors once the videos faded [145]. One benefit of VGI is that it can be used in environments where one-on-one education is not practical. Mainly, it is devoted to teaching new social skills through video modeling, providing learners with instant opportunities to practice the skills and receive feedback from peers and the instructor. In VGI, the teacher creates opportunities for each participant to practice the skill with peers or the instructor as a social partner after presenting a video model of the desired behavior to all participants at once. Video modeling is useful for teaching social interactions because it can easily show the causes and effects of the goal behavior, which may aid the observer in understanding when and how to act. VGI studies have shown promising results in teaching social skills, but often require participants to respond to vocal or nonvocal cues. Adults have been involved in these studies as direct social partners or prompting others to serve as social partners. VGI research has not yet evaluated peers as social partners. The effectiveness of VGI suggests it could be useful for teaching social perception skills to adolescents with ASD and ID with their same-aged peers, and it can be administered in school settings where one-to-one instruction may not be feasible.

A more recent study aims to extend research on VGI by evaluating its potential for teaching adolescents with ASD or ID to respond to multiple social stimuli [146]. The study involved five adolescents diagnosed with ASD or Intellectual Disability (ID) who received most of their academic instruction in self-contained special education classrooms at a public high school. The participants met specific inclusion criteria, including having a prior diagnosis of ASD, having a confirmed diagnosis using the ADOS-2, attending to a television screen for at least 20 seconds, and demonstrating the ability to learn from video models. All participants received VGI within the same instructional group during the preceding 4-month semester, and their VGI administered by the same facilitator described in the present investigation. Through previous VGI interventions, the social skills were directly trained as follows: (1) offering help, (2) maintaining a conversation, (3) asking social questions, (4) showing items to others, (5) commenting about activities, and (6) complimenting peers. Except one student, all participants reached the mastery criterion for each behavior. Allison, a 17-year-old female diagnosed with ASD, had a lower standard score on the WASI-2, considered extremely low when compared to her same-aged peers. Marisa, a 16-year-old female diagnosed with an intellectual disability, had a borderline performance score on the WASI-2, indicating borderline performance when compared to her same-aged peers. Xavier, a 16-year-old male diagnosed with ASD, had a borderline score on the WASI-2, considered borderline when compared to his same-aged peers. Chad, a 15-year-old male diagnosed with ASD, had a standard score of 65, considered extremely low when

compared to his same-aged peers. Sam, a 17-year-old male diagnosed with an intellectual disability, had a lower standard score on the WASI-2, speaking minimally, rarely making eye contact, and not typically interacting with peers or adults. He did not master the social skills targeted during the previous VGI, but additional VGI could be necessary. In addition to the five adolescents with ASD or ID, two typically developing peers participated as social partners. Peers were recruited based on their participation in a peer mediation program, availability during the social skills group, and interest in assisting with the study. A special education teacher and student teacher facilitated a social skills group in a suburban high school in the Midwest. The study used various instructional materials, including video modeling clips, a Sony Camcorder, and preferred activities like card games, board games, puzzles, and arts and crafts. Participants received points for following rules, using dry-erase markers and laminated note cards. The teacher used paper and pencil for data collection. The study involved creating 13 videos, ranging from 9 to 24 seconds, to target social perception skills during VGI sessions. Models were middle or high-school-aged peers, and the videos were realized in a classroom setting. Peers completed a survey to assess the social validity of the video models. They perceived two of the three targeted behaviors (extending and joining conversations) as relevant to high school students. The third social skill, responding to affective behavior, was rated as only somewhat important. Both peers and facilitators received a training to implement VGI with at least 90% fidelity. The special education teacher was trained four months prior, while the student teacher was trained after observing the lead teacher. The primary dependent measures included extending the conversation, joining a conversation in progress, and responding to the affective behavior of others. A trial was initiated and scored when a typically developing peer engaged in the antecedent behavior designed to occasion the targeted social skill. The study found that the most effective target behavior was responding to the affective behavior of others based on nonvocal cues, such as body language and facial expressions. Participants were required to orient their eyes towards a peer, tact the private emotional event associated with observed affective behavior, and ask questions or comment about the behavior. During baseline sessions, participants received two or five opportunities to perform each social behavior, while during intervention sessions, they received three to five opportunities. Data collectors scored participants' correct responses, and the mean interobserver agreement (IOA) was 93% or higher across all behaviors, conditions, and participants. A multiple-probe design was used to evaluate the efficacy of VGI. Participants received points (token economy) for following rules and could trade them for preferred items. Each session ended with a summary of the behavior taught and one positive performance for each participant. Concerning training, the baselines took approximately 30 minutes embedded within a 50-minute social skills training session. Participants obtained two or five opportunities to demonstrate each social skill by engaging in the corresponding antecedent behavior. The facilitator divided participants into two groups and directed each group to join one of the typical peers. They played a group card game and engaged in an antecedent behavior. Pending the successively targets, participants played a group game or activity while their peers were across the room. The participants did not receive immediate feedback during baseline probe sessions, meaning there were no differential consequences for correct and incorrect responses. If participants performed a target response correctly, they experienced a naturally occurring social interaction with a peer that generally followed the specific target behavior. The intervention sessions were identical to baseline sessions, except for the addition of video modeling and error correction. The facilitator introduced the skill by making a statement describing the target behavior and instructing participants to watch the video. A video clip showing target behavior was displayed to participants, and the facilitator directed the typically developing peers to orchestrate one opportunity for each participant to perform it. The intervention condition included error correction following an incorrect response to ensure differential consequences for correct and incorrect responding. An adaptation was made for Sam by showing him a textual prompt for each of the targeted behaviors, which varied for responding to the affective behavior of others. The study found that all participants, except for Sam, demonstrated the acquisition of all three targeted behaviors following the implementation of video modeling. Sam showed limited acquisition of all targeted behaviors

during the intervention phase, showing a high response variability across all three behaviors during video fading. The results support prior investigations of video modeling since it results useful in teach social skills. Public schools may find VGI acceptable as the intervention in a lower-intensity format since the sessions result adapted to a single class period each day. Additionally, participants interacted with peers without adult mediation, even because this aspect is necessary in behavioral interventions targeting social interaction. The outcomes for Allison, Marisa, and Chad showed rapid skill acquisition with some instances of generalization, suggesting that administering social skills instruction in natural settings, with peers as social partners, might enhance the generality of treatment effects.

In this section, we describe studies on Behavioral Skills Training (BST) to teach children with ASD to understand nonvocal listener behavior via instructions, modeling, rehearsal, practice, and multiple conversational exemplars during a conversation. A recent study aimed to evaluate a training package to teach children with ASD to attend to, identify, and respond appropriately to others preferences during play using a similar treatment model. The study aimed to provide a more comprehensive approach to teaching children with ASD to engage with adults during conversations [147]. The study involved three children diagnosed with ASD, Selena (7-year-old girl), Terry (8-year-old boy), and Vicky (5-year-old girl), who received behavioral intervention from a community-based Applied Behavior Analysis agency. The participants communicated with long sentences and had repertoires of listener behavior such as echoic, mands, gestures, intraverbals, and rule-governed behavior. They managed toys choosing during play time with their peers, and parents were concerned that peers tended to lose interest in playing with their children. The study conducted one or two 45-minute sessions per day, 1 to 4 days per week with peers and adults. Each session included two distinct assessment periods. The first assessment period assessed and taught participants to attend to the play chosen by their peers and to label their reactions to various toys. In each session, children sat with a play partner and six toys, which included a mix of toys the participant had previously nominated as either preferred or nonpreferred. The play partners engaged in scripted reactions to the presented toys, including indicators of interest (saying, “Yes” or “Sure, I love that game” or by beginning to play with the offered material) or disinterest (saying, “No” or “No, I don’t like that game” or by engaging with an alternative toy). From a toy presentation and one other, the participant and play partner engaged in cooperative play for 3 minutes with each toy or until the activity reached its natural ending. At the end of the session, the experimenter asked the play partner to leave the room and interviewed children with post-play questions. If the participant did not respond with at least three items to each question, the experimenter prompted the participant to identify another toy. Training sessions were identical to the baseline except with a unique set of six toys, adults involved in training, and an intervention package consisting of rules, prompting, and feedback. The first assessment period included the experimenter providing a rule that if a person played with a toy, they liked it, and if not, no like it. The experimenter provided prompting and praise for correct responses. The second assessment period involved the experimenter stating that sometimes a person will ask to play with something else, and if the participant offered a preferred toy, received a praise, and the children were permitted to play for up to 3 minutes. If the participant did not offer a preferred toy, the rule was reminded, and the play partner continued to indicate wanting to play with something else every 3 minutes. After 80% accuracy, rules faded, and the skill reached masterization. Post-training involved generality probes with the same toys, experimenters, and procedures. Also, the staff conducted some natural environment probes without instructions or reinforcement. Correct trials involved offering a toy the partner had played with, brought to the play date, liked, or a novel toy. To assess interobserver agreement (IOA), a second observer collected data. Results displayed the following data such as Selena, in the baseline, answered post-play questions correctly between 0% and 17% of opportunities and made appropriate toy offers during 0% of trials. In training phase, she increased her correct responses across both measures and met the initial mastery criteria after six sessions. Terry, another participant, answered post-play preference questions between 0% and 17% of trials and made appropriate toy offers between 0% to 20% of trials. During training, he reached

80% to 100% correct for answering post-play preference questions and making appropriate toy offers during sessions 7, 9, and 12. He also met the criterion of 80% for three consecutive sessions in the absence of mid-play preference questions. Vicky, another participant, answered post-play preference questions between 0% and 33% of opportunities and made appropriate toy offers between 0% to 20% of trials. During training, there was an immediate increase in correct responses to post-play preference questions and a gradual increasing in appropriate toy offers. She reached 100% correct responses for answering post-play preference questions and making appropriate toy offers in sessions 11, 13, and 18, respectively. During the novel person probe and post-training, Vicky responded between 80% and 100% correctly for both post-play preference questions and appropriate toy offers. During the training phase, Terry and Vicky engaged in 100% and 80% appropriate toy offers, respectively. Finally, this study highlights the importance of understanding play partner preferences and providing appropriate incentives for play partners to engage in play.

Research in developmental psychology indicates that children begin to respond to others' actions by 13 months of age, with the ability to differentiate between two items based on facial responses. By age four, children begin to respond appropriately to indirect requests. Developmental literature has focused on identifying deficits in the ASD population and identifying the ages at which related skills emerge in typical child development. However, no research has been published on teaching children with ASD to respond to disguised mands. A clinical study aimed to teach children with ASD a generalized repertoire of responding to disguised mands, allowing them to respond to novel, untrained disguised mands [148]. The study extended previous research by applying multiple exemplar training (MET) packages, consisting of rules, role play, and feedback, to teach participants to respond appropriately to disguised mands. Essentially, this approach extends previous research in teaching children with ASD to respond to other forms of non-literal language. The study involved 3 nine-year-old boys (2 males), Nick, Musa, and Drew, who had been receiving behavioral intervention from a community-based agency for approximately 6-8 years. Nick and Musa received the intervention for 10-15 hours per week, while Musa received it for 2 hours per week. All participants failed to respond to disguised mands but communicated in full sentences and had repertoires of listener behavior, rule-governed behavior, echoic, mands, tacts, and intraverbals. They had a history of learning via role play, such as social skills and safety skills. Sessions were conducted in various locations of the participants' homes, including outside and at an amusement park (Musa only). A correct response to a disguised mand involved initiating an action to give the speaker the item or outcome that was indirectly requested within 10 seconds of the disguised mand during baseline and within 3 seconds of the mand during the intervention, and completing the action within 30 seconds. Participants were given more time to initiate a response during baseline to provide sufficient opportunities to respond correctly, even if the latency to responding was lengthy. Incorrect responses involved failing to initiate an action related to the therapist's mand or initiating but not following through with giving access to that which was requested. Correct responses were converted to a percentage by dividing the total number of correct responses per session by the number of trials conducted and multiplying by 100. Two independent observers collected data. The study involved a 45- to 60-minute daily session, conducted 1 to 2 days per week. Baseline and post-training sessions consisted of 5 trials, while training sessions consisted of 10 trials. Items relevant to disguised mands were only present during trials when the required item was necessary. To guarantee generalization, five or seven different people presented disguised mands across conditions. Unfamiliar adults were introduced as friends of the therapist when the therapist arrived for the scheduled session. During the intervention phase, only familiar adults issued disguised mands until participants met the mastery criterion. A novel-person probe was conducted to measure generalization to an unfamiliar and untrained person before moving on to post-training. A non-concurrent multiple baselines across participant design was implemented to evaluate the effectiveness of the teaching procedure on correct responses to disguised mands. Tasks completed during regular therapy varied depending on the participants' treatment goals, including daily living, safety, motor, and social skills. The study involved a training phase where

participants were asked to provide indications about what they wanted, such as a pillow. The therapist provided a rule that if the participant did not initiate a correct response within 3 seconds, the therapist provided a vocal prompt. After two consecutive correct responses during role-play, the therapist initiated the training phase. In the training phase, disguised mands were introduced and randomly selected from a second list of 20 disguised mands. The therapist rotated the two exemplars semi-randomly during the 10-trial session, providing praise for correct responses within 3 seconds. If the participant failed to respond in 3 seconds or responded incorrectly, the therapist vocally modeled the correct answer. After mastery, a baseline probe included a novel and external person. Post-training, all disguised mands and people included in the baseline were evaluated in post-training sessions using baseline procedures. As a result, Nick responded correctly during 20% of trials in all baseline sessions, and during training, there was an immediate increase in correct responses to training exemplars and a gradual increase in correct responses to first-trial generalization probes. The masterization was achieved in 10 sessions with 12 exemplars, and Nick responded with 100% accuracy during the novel-person probe and post-training sessions. Musa responded correctly during 0% of trials in six of seven baseline sessions, including one conducted at an amusement park. During training, there was an immediate increase in correct responses to training exemplars and first-trial generalization probes. At the novel-person and post-training probes, Musa responded with 80% or greater accuracy, also in an amusement park. Drew responded correctly during 0% to 40% of trials during baseline and training, with a mastery criterion met in nine sessions after 12 exemplars were trained. Participants learned how to respond to disguised mands through an effective MET package that included rules, role play, and feedback. All participants generalized this ability to new disguised mands and persons, and one participant applied it to a novel community site. These findings encourage research showing that non-literal language may increase through ABA-based intervention.

A similar study determined whether BST, which consists of rules, role-play, and feedback, might teach children with ASD and how to be socially acceptable when they get an unwanted gift or notice a change in someone looks [149]. The study involved Two boys (5 and 9 years old) and one girl (7 years old) diagnosed with ASD who received one-on-one behavioral intervention for 8 to 30 hours per week at home. The participants spoke in full sentences using mands, tacts, and intraverbals, displayed rule-governed behavior, and learned through role-play. The participants were selected since their honest utterances were often interpreted as rude. The researchers implemented one to three one-trial sessions a day, which included baseline and generalization sessions lasting less than 1 minute and training sessions lasting 5 to 10 minutes. Observers scored responses. Participants were required to tell a lie expressing approval using a sincere tone and smiling, with no inappropriate facial expressions. Failure to tell a lie expressing approval resulted in a score of zero. The study aimed to teach participants to tell lies in gift and appearance sessions. Gift sessions involved an adult giving a child a wrapped gift with nonpreferred or already owned item and asking them what they thought. The items included board games, dolls, pens, stickers, puzzles, academic workbooks, pink items, coloring books, crayons, colored pencils, and plush toys. At appearance sessions, the adult arrived at home expressing satisfaction with their new appearance and asking what does he think. The altered stimuli included hair, pink clothing, baggy clothing, hats, eyeglasses, unusual shoes, fake facial hair, and bright lipstick colors. The training procedures included providing descriptive rules, role-playing, and corrective feedback when needed. One therapist conducted all rules and role-play sessions across gift and appearance contexts. Gift sessions began by stating rules, while appearance sessions began by modeling the target response. The therapist praised correct responses if they occurred within 3 seconds, provided a rule reminder and model of the correct response, and provided feedback regarding missing elements. Likewise, participants received contingent feedback (CF) when they responded incorrectly or failed to respond within 3 seconds of the prompt. The training ended when correct responses to novel people and stimuli were elevated and stable. The results showed that the intervention was effective for all participants to use socially appropriate lies. These outcomes were quick, and training resulted in generalization to untrained people and stimuli. This study was the first study to target socially appropriate

lying among children with ASD. However, there are still questions essential for the future research. Firstly, participants had well-established verbal repertoires, which likely facilitated their acquisition of these skills. Future research should examine the prerequisites to learn these social skills, and the contributors of the precursors. Second, the study tested for generalization across adults and stimuli but did not assess generalization across settings. Third, it is unclear which components were responsible for behavior change.

Several ABA practitioners still design language learning programs by borrowing procedures from multiple published curricula, with the most commonly referenced curricula being those by Sundberg and Partington (1998) and Lovaas (1981). Assessment protocols focusing on Skinner's verbal operants, such as the VB-MAPP and the ABLLS-R, have become common components of Early Intervention for Language and Behavior Intervention (EIBI) programs. However, few published studies have assessed the psychometric properties or efficacy treatments based on these protocols. Additionally, these protocols ignore hundreds of research studies on language development through derived relational responding and corresponding transformations of stimulus function. The behavioral literature focuses on implementing verbal operant procedures with children with autism, but it is crucial to consider advances in language and cognitive development from stimulus equivalence theory, naming theory, and Relational Frame Theory. Consequently, the Promoting the Emergence of Advanced Knowledge (PEAK) system is an assessment and curriculum guide consisting of four unique modules: Direct Training, Generalization, Equivalence, and Transformation. Each module offers 184 individual programs designed to encapsulate a distinct learning modality, consistent with a merger of traditional Skinnerian verbal operant training with post-Skinnerian procedures to produce derived relational responding. Practitioners received detailed instructions on initial assessments profiling clients into an appropriate skill level, based upon current abilities. Each program outlines goals, materials, instructions on implementation and data collection. The first two modules were designed based on a contingency-based verbal operant account of language development. These two modules are similar to the VB-MAPP and ABLLS-R in terms of their theoretical construction (i.e., Skinner verbal behavior theory). PEAK Direct Training (PEAK-DT) teaches foundational language skills (e.g., eye contact, object permanence, echoic, mands) like Skinner verbal operants suggest. As individuals gain proficiency, the complexity of programming accelerates to include much more advanced topographies of these operants, along with social components of understanding the role of the audience in modifying verbal responses, discriminating private events to accompanying stimuli, guessing about events that have no literal correct answer, and using working memory. PEAK Generalization (PEAK-G) moves beyond traditional discrete trial training using a train-test methodology in which novel untrained stimuli are presented within embedded blocks of directly trained stimuli with hopes that these never-reinforced targets will come to occasion correct responses from the learner due to formal similarity with trained stimuli. This module is designed to promote stimulus and response generalization as an active process to establish and maintain skills in new and novel contexts. The final two modules, PEAK Equivalence (PEAK-E) and PEAK Transformation (PEAK-T) offer a conceptually systematic approach that capitalizes on behavioral technologies derived from stimulus equivalence and Relational Frame Theory. These are the only comprehensive manualized protocols emphasizing derived relational responses in children with autism that are supported by peer-reviewed investigations of treatment outcomes.

Relational frame theory (RFT) provides a behavioral account of perspective taking as deictic relational responding. People with autism scored similarly to the normative sample on questions requiring simple deictic relational responding but committed more errors when the reversed relations. Some studies have evaluated the use of deictic relational training in application with individuals with autism. However, one limitation in this growing area of research is that participants who demonstrated a transfer of function had mild forms of autism. Therefore, the purpose was to evaluate the efficacy of a relational training procedure in teaching single-reversal deictic relational responses to individuals with autism [150]. The study targeted visual I-You deictic relations, which are the first to develop in individuals with autism. Test

probes also included a second set of formally dissimilar stimuli to test for the transfer of function both in terms of the trained You relation and the mutually entailed I relation. The procedures came from the Promoting the Emergence of Advanced Knowledge Transformation Module (PEAK-T), which provides a standardized curriculum and instructions for teaching deictic and other relational skills. Three boys with autism, Derek (18), Charles (14), and Philip (12) participated in the study. Their IQ scores came from their school records, and each participants received PEAK-D assessments. The PEAK-T assessment, which evaluates an individual's relational abilities, showed that all participants demonstrated derived mutual and combinatorial entailment in tests of correspondence relations. They also demonstrated mastery of simple I and You deictic relational responding, but none demonstrated mastery of single-reversal I and You deictic relational responding. The study took place at a midwestern U.S. school for individuals with autism, with each classroom containing six to eight students with disabilities, one or two paraprofessionals, and one classroom teacher. All sessions were in the student's home classroom, and materials came from PEAK-T Program Deictic: Single-Reversal I and You. Stimuli included six picture cards with a single picture on each side. Regarding research design, the study used an ABC design for Charles and Philip, and an ABCD design for Derek. A multiple baseline design with multiple probes was applied to the study. Derek received an ABCD design, while Charles and Philip received an ABC design. Baseline was the A phase, single-reversal (You) training (SRYT) was the B phase, transfer was the C phase, and mixed single-reversal (I and You) training (mixed) was the D phase. The dependent variable was the percentage of correct responses (PC) in each phase's four-trial blocks. Also, the interobserver agreement came calculated for 32% of the trials. The study comprised an assessment of Single-reversal (You) (sYOU) and single-reversal (I) (sI) associations for every stimulus combination during the baseline phase. In the sYOU relationship, the subject reported what he saw, while in the sI relation, the subject reported what the researcher saw. An image card held vertically so that the subject and the assessor could see opposing sides to evaluate both relationships. The experimenter showed the participant the card on both sides. "If I were you and you were me, what would you see?" the experimenter posed as a test question to further explore the sYOU relationship. and the "If I were you and you were me, what would you see?" the experimenter posed as a test question to further explore the sYOU relationship. after which the participant had three seconds to respond before moving on to the following trial. To assess the sI relation, the participant was given three seconds to respond to the question, "If I were you and you were me, what would I see?" before moving on to the next trial. Within each trial block, the picture cards were in random order. The transfer phase was the same as the baseline, with the exception that Stimulus Set 2 was used for the test probes. Training in Single-Reversal (You) Deictic During the SRYT phase, only picture cards from Stimulus Set 1 were used for training and test probes. The picture cards were also randomized inside each trial block. During the SRYT phase, just the sYOU relationship was trained. To train the sYOU relationship, the participant received verbal praise from the experimenter if they answered the question correctly in three seconds. The experimenter gave the participant three seconds to provide a new response after stating, "Try again," in response to an inaccurate response. The experimenter gave the individual the right response and moved on to the next trial if he failed to respond correctly to this prompt. Verbal praise was not given. The sI relation was probed intermittently throughout the SRYT phase. Test probes for the sI relation were identical to those used in the baseline. Combination Single-Reversal (You and Me) Derek's Deictic Frame Training, unable to show derived sI relations required mixed instruction in both the sYOU and sI relations after mastery of the sYOU relations. Mixed training was carried out to assess the efficacy of mixed training with an individual with autism as well as to enable a test of transfer from Set 1 stimuli to Set 2 stimuli, even if Derek did not exhibit the mutually required sI response. Only Stimulus Set 1 was used for mixed training, and the training methodology was the same as that of the sYOU relation in the SRYT phase. The sI and sYOU relationships were included in training trial blocks, and each relation was tested twice in a trial block. Test probes that were mixed were used for the stimulus set.

The study aimed to investigate the application of RFT procedures in developing perspective-taking skills in individuals with autism. The participants were divided into four groups, with Derek, Charles, and Philip all failing to provide correct sYOU and sI responses at baseline. In the SRYT phase, each participant achieved 100% correct responses for the sYOU relation across three consecutive trials. Charles and Philip also demonstrated mastery of the sI relation, while Derek did not demonstrate mastery of the derived sI relation. In the transfer phase, Charles and Philip demonstrated mastery of the sYOU and sI relations with the untrained stimulus set, while Derek achieved a PC of 100 for only the sYOU relation. A mixed training phase was conducted to ensure Derek was able to demonstrate mastery of the trained relations for both stimuli set. The results support and extend previous research on RFT procedures in developing perspective-taking skills, suggesting that bidirectional single-reversal deictic frames can be derived after direct training of only a single relation. The study's limitations include the fact that simple visual perspective-taking is only one part of the totality of perspective-taking behavior, and Derek's high baseline performance for the sI relation. Mixed training was necessary to achieve mastery of all relations, which may provide clinicians with a method for modifying the curriculum when derived relations fail to emerge. Future research may explore how relational training affects what participants do rather than what they say in the case of a transformation of stimulus function made possible by the acquisition of perspective-taking skills. In addition to adding to the growing body of literature on teaching perspective-taking skills to individuals with autism, the study supports the PEAKT curriculum as an easily accessible tool for front-line staff and caregivers.

In another study, researchers investigated social skills in teaching empathy skills to children with autism [151]. Specifically, the treatment package that included modeling using audio scripts, manual prompts, affective discriminative stimulus compounds, prompt delay, behavioral rehearsals, and reinforcement worked to help children with autism learn empathy in a pretend-play environment. Additionally, they evaluated how empathy abilities transferred from training to no-training probe stimuli and from training puppets and dolls to real individuals in a no-training environment. The study involved four children with autism who attended an education program providing centre-based and in-home behavioral intervention for autism. The participants were identified based on anecdotal reports from their teachers that they did not regularly demonstrate empathy towards others. All participants engaged in minimal stereotypic or disruptive behavior and had experience with token motivational systems. All participants had prerequisite skills in vocal imitation of three-word phrases modeled by an instructor and on auditory recordings. Josh, a 4-year-old, had 114 on the Peabody Picture Vocabulary Test (3rd ed., PPVT-III) and 106 on the Expressive Vocabulary Test (EVT). He attended an integrated preschool classroom for several hours a day, and he spoke with clear full sentences and established eye contact regularly during social interaction. However, he rarely displayed appropriate empathy responses. Jacob, a 6-year-old, had 61 on the PPVT-III and 41 on the EVT. His language consisted mostly of requests, he rarely initiated social interaction, and his eye contact and attending to others were often poor. He demonstrated no empathy responses to displays of affect by others. Luke, a 5-year-old, had a standard score of 56 on the PPVT-III and 55 on the EVT. His language consisted mostly of single words and short phrases, and his social initiations were usually nonvocal. Like Jacob, he did not demonstrate empathy responses to displays of affect by others. Ali was 8-years and 9-months-old. She obtained a standard score of 40 (age equivalent: 3 years 0 months) on the PPVT-III and 41 (age equivalent: 3 years 11 months) on the EVT. Her language consisted mostly of single words and short phrases. She rarely demonstrated empathy skills, although she sometimes said sorry when she accidentally bumped into another person. The study involved sessions in a small room with small tables, chairs, and bookshelves. Toys were on shelves, and dolls and puppets in separate bins. Affective discriminative stimulus compounds contained one motor and one vocal component, presented in brief vignettes. These vignettes fell into three categories: sadness or pain, happiness or excitement, and frustration. Vignettes came randomly assigned. To promote generalization, dolls and puppets were not assigned to specific vignettes. Operationally, empathy defined as a contextually appropriate reaction to an affective presentation by a person, doll, or puppet that included vocal and movement components and

displayed within 3-seconds of the end of the exhibition. In the prior instance, the participant had to pat the puppet's arm and ask, "Are you okay?" For every category, the staff taught three vocal and one motor response. The responses taught for some vignette could be used for any ones in the same response category, promoting generality to no training vignettes. The study involved four to five weekly sessions lasting 20 to 30 minutes, with each trial lasting approximately 3 seconds. Participants looked at a vignette with a doll or puppet, and the prompter would deliver a consequence or no feedback. Three participants received training in only the sadness or pain response category, while others received training in other categories. Other than Dolls, puppets, toys, a token economy system was on the table between the participant and the instructor. Participants chose from an array of preferred snacks and activities in exchange for ten tokens earned throughout the session. The prompter delivered one token per trial for appropriate sitting and attending to the vignettes. The study involved 30 training sessions, with seven training and three no-training probe-stimulus trials per response category. The prompter delivered manual and auditory prompts with a prompt-delay sequence (errorless). A behavioral rehearsal sequence was used for all training trials in the 0-s delay condition and when the participant did not respond or responded incorrectly in all other prompt-delay conditions. The prompter manually prompted a correct motor response and simultaneously played an auditory script on a Language Master. If the participant did not imitate the script, the prompter played the card again and waited for a response. If the participant did not respond, the prompter partially prompted the vocal and motor responses. If the participant did not respond or an error occurred, the sequence repeated until the participant emitted a correct independent response. The trials were randomly combined throughout all training sessions, incorporating vignettes similar to those used during training trials. The same procedures were in baseline condition. The study generalized to no training people and settings, with sessions occurring approximately once per week during baseline and training. The study used a multiple baseline design across participants to evaluate the effectiveness of the treatment package. Concerning results, all baseline segments showed participants responding incorrectly or not at all, while all treatment sessions showed responses scored as correct. Observers were given a written questionnaire and asked if the child demonstrated empathy toward the doll or puppet. The study aimed to assess the social validity of the results. The study aimed to investigate the impact of training stimuli on motor and vocal empathy responses. Initially, participants responded infrequently to affect displays by dolls and puppets, but increased systematically with the introduction of treatment. The study also examined responses to no training probe stimuli, showing that appropriate responses generalized from training to no training vignettes, dolls, and puppets for all participants. Finally, the study found that children with autism, as young as 4-years-old, can develop socially relevant empathy skills in pretend-play settings. The results suggest that children with autism can learn to demonstrate empathy skills in pretend-play settings, which can also generalize to interactions with real people in no-training settings.

Another research group investigated the differences between the perspective-taking responses of children with ASD, mental retardation, and TDC. Subsequently, they applied an adapted False Believes Test, assessing the effectiveness of several prompts on target behaviors. Finally, they studied the correlations between perspective-taking repertoires of the participants with verbal repertoire (subjects, verbs such as past/ present/future, present/absent of an object/person) [152]. This study involved 15 children with minimal attention span, minimal language comprehension, and no disruptive behaviors. The participants were into three groups: Group I, consisting of 5 TDC (4-6 years), Group II included 5 children diagnosed with Down syndrome (5-8), Group III, consisted of 5 children diagnosed with autism (4-18), with their mental ages ranging from 4 to 7 years old. The mental ages were measured using WPPSI-III. The study used an intrasubject design with comparisons across subjects, focusing on dependent variables such as interpretation of mental and emotional states, derived relations repertoires (symmetry, transitivity, and equivalence), discrimination skills for I/YOU and I/HE-SHE, and discrimination skills for concepts of time and space. The dependent variables were measured using the following tests such as Sally-Anne, Emotion

Faces, and Pitu test. The study also assessed intellectual and verbal capacities using the Wechsler Preschool and Primary Scale of Intelligence (WPPSI-III) subtests. The participants performed a series of tests that measured false beliefs and mental states of people predicting their future behavior. The original task now included videos with live actors and three videos from least to most difficult, each with four phases. The videos shared common elements such as actors appearing near a table, a pan and box on top of the table, and children serving as actors. The videos differed in three ways: Video 1 was on the original Sally-Ann test, with actors moving a ball from one hiding place to another once actor 2 left the room. Video 2 included actors moving a book from one hiding place to another place while a hidden doll remained in the same location. Video 3 involved actors moving the book and the doll from one hiding place to another. Each video had four phases, each involving more intrusive prompts to minors. Participants looked at the video with the least intrusive phase, and if they responded correctly to all test questions, next came introduced. If they did not respond correctly, the next phase involved more intrusive prompts. The phases included prompts in which the narrator described the sequence, and the actors talked among themselves and commented out loud on their actions. Phase 3 saw the researcher turn into the narrator, describing everything happening in the video and pausing it when a crucial event occurred. In Phase 4, the researcher corrected the participants when their responses were incorrect. The Emotion Faces test measures an interpretation of emotional states by labeling emotions represented in pictures, stories, and live representations. The test includes eight subtests, listed from most to least complex. Subtest 1 presents participants depicting emotions via five pictures such as happy, sad, scared, mad, and surprised. The antecedent, how does this child feel? is presented, and data is collected on the number of correct responses. For participants who did not speak, a facial imitation or drawing of the emotion depicted in the picture was considered a correct response. Subtest 2 tests required participants to find the matching picture of the five emotions. For those who did not miss any items in subtest 1, an array of five different pictures was placed on the table, and the antecedents presented were: who is scared/happy/sad? Subtest 3 involves participants given the outline of a face and asked to draw any emotion they desired. The antecedents “How does this child feel?” and “What could have happened for the child to feel that way?” were presented. Subtest 4 involves participants telling three stories that share a common main character, with the main character experiencing an event in each story that would result in a common emotion. If the participant responded incorrectly or did not respond, since the staff provided a new antecedent. Subtest 5 asks participants to show a given emotion, such as making a sad face, and the emotions presented included happy, sad, mad, scared, and surprised. Subtest 6 requires participants to identify an emotion demonstrated by the researcher, and Subtest 7 manipulates variables in the natural environment to evoke a specific emotion. The Pitu test is a contextual task designed to measure the ability to identify the emotions of others. Participants had to identify the emotional states of a character named Pitu in various everyday situations, each with a contextual cue. The cues were: Flower Emotional State: Sad, Book Emotional State: Happy, and Sun Emotional State: Thinking I'm doing everything wrong; nobody loves me. The participants looked at three flashcards depicting Pitu in an everyday situation, expressing a specific emotion. The flashcards were described, along with any items included, and questions related to the situations were presented. The fourth flashcard, the test card, was presented with the antecedent How does Pitu feel here? if a correct response occurred, then the test ended. If an incorrect response occurred, the same flashcard was shown again, with an antecedent that included a selection response (how does Pitu feel, happy or sad?). Also, the study used various tests to measure stimulus classes, such as relational skills, such as establishing symmetry, transitivity, and equivalence classes. Participants had to find the matching stimuli independently after two sample trials. If they responded correctly, they came presented with the test of transitivity and then the test of equivalence. If they responded incorrectly, then the tests ended. Moreover, tasks about the discrimination of I/YOU and I/HE-SHE was conducted, where participants were asked questions to evaluate their ability to discriminate between these concepts. Incidental trials in the form of games were used to evaluate these skills. The Boehm Test of Basic Concepts (Boehm-3) had to

measure skills such as same and different, before and after, first and last, always and never, sameness, and matching. If a participant emitted an incorrect response, up to three prompts were provided to elicit a correct response. The prompt hierarchy followed: changing the placement of materials, describing relevant characteristics of the presented pictures, and reducing the size of the array of pictures. The WPPSI-III) was used to test verbal sub-scales such as information, vocabulary, comprehension, arithmetic, sentences, and similarities. If a participant responded incorrectly to an item, up to three prompts were provided to elicit a correct response. Each session lasted 30 minutes. The entire evaluation varied sessions number, adding 4-6 hours per participant. In standard tests for the evaluation of Theory of Mind, relational equivalencies, and other standard tests, no additional prompts were given until the test was completed as stated by the test manual. The results were presented in two sections: (1) to show differences between the perspectives of participants, (2) to evaluate the effects that different prompts had on the performance of the participants, and (3) to explore potential differences in perspective-taking repertoires of the participants about other behaviors that might be related or pre-requisites for the development of functional equivalent relations. The Sally-Anne Test (Baron-Cohen, 1989) replicated the findings shown in the literature, showing clear differences in responses from participants diagnosed with autism (Group III), those who were typically developing (Group I), and those with a diagnosis of Down syndrome (Group II). The Emotion Faces Test (Spradlin & Brady, 1999) showed more variability than the other two tests of interpretation, with participants who were typically developing showing the most accurate levels of responding. The Pitu Test replicated differences between the three sets of participants, with the participants who were typically developing scoring the highest, followed by the participants with Down syndrome, and finally, the participants diagnosed with autism. Similar patterns were seen for the number of correct responses for emotional and mental states. When comparing previous results regarding the ability to interpret emotional and mental states with the data for variables considered as related or pre-requisites, it was found that the overall level of derived relations was higher for the typically developing participants than for any of the other participants (either with mental retardation or autism). All of the TDC showed symmetry relations, while only one of the five participants in the other two groups did. Four participants from the TDC showed transitive relations, while only one of the participants was diagnosed with Down syndrome, and none of the participants with autism did. Concluding. TDC scored the best across all perspectives taking tests. These findings are consistent with previous studies, which found deficits in perspective-taking skills were demonstrated not only by children with autism but also by those with mental retardation and language deficits. The children who scored best in tasks that contained skills considered prerequisites (I/you/he/she discriminations, spatial/temporal relationships, derived relations, and WIPPSI subscales) were those who later scored best in the perspective-taking tests. All participants benefited from the procedures used, as they scored better in the perspective-taking tests after being exposed to the feedback/prompt phases.

Another study explored the development of helping responses. Since the impairment in positive social behavior in children with ASD, helping was preferred since it resulted in longer social interactions than other classes of social behavior. As a result, multiple exemplars of helping responses were taught in diverse settings and with different persons using a multicomponent training practice [153]. The study involved four children with autism who attended a private school. All had received their diagnoses through independent agencies before enrolling. The children had a history of learning through discrete-trial and incidental teaching formats and token economy programs. Before the study, the children exhibited little or no spontaneous helping behavior. However, they could comply with direct requests to engage in previously learned tasks and demonstrated a generalized imitative repertoire of basic motor movements and verbalizations. Experimental sessions took place in a small classroom, and each session was recorded, and a video player was used to present video models during training. To obtain socially appropriate instances of the helping behavior, the parents of 12 TDCs asked them to define examples in which their children engaged in helping. In addition, another 25 TDC groups (4 to 6 years old) were observed in classrooms during free-play activities. These observations categorized them as cleaning, replacing broken things,

picking up items, organizing materials, positioning objects, carrying items, putting objects away, and setting up an activity. From these classes, five activities were created to deliver opportunities for helping. For example, no verbal discriminative stimuli comprised of the tutor wiping something. Likewise, the verbal discriminative stimuli contained an exclamation (‘‘oh" ‘‘boy’’ ‘‘oops’’ and so on), contingently followed by a comment ‘‘In what manner did this get disordered?’’ The affective stimuli included movements of the body. The correct verbal component was always the request may I help? emitted within 5 seconds of the initial exhibition of the SD. After offering help, the tutor stated yes or "sure". The correct motor component was the child imitating the adult actions for the related activity. Therefore, a response was not counted as correct if it happened following video modeling or prompting. The study involved 32 randomized trials, 22 designed to assess correct helping responses, and 10 as not helping trials. Each participant received training with activities from only four categories. Four of the five activities from each category were randomly selected for training, resulting in 16 training trials per experimental session. Six probe trials were also presented, with four assessing the degree of generalization of helping within a category used for training. The remaining two probe trials assessed the degree of generalization of helping across categories. In summary, each 32-trial session consisted of 16 training trials, four within-category probes targeting a novel helping response within each child's selected categories, two probe trials for categories where the child never received direct training, and 10 trials assessing no helping behavior. The intervention involved emitting nonverbal, verbal, and affective discriminative stimuli for the first helping activity programmed for the child, and waiting for a maximum of 5 seconds for the child to emit the appropriate verbal and motor components of the helping response. The training procedure included a multiple baseline design, with the intervention introduced successively across participants. The study involved baseline trials without reinforcement, video models, or prompting, with trials terminated as they were in the baseline. Correct responses were immediately delivered when training trials occurred, and if the child did not emit the correct helping response within 5 seconds, then video models were presented. The primary experimenter presented the discriminative stimuli for the helping activity, followed by a 4- or 5-year-old boy of typical development. For probe trials, no reinforcement, neither video models, or prompting was employed during therapy. Mastery comprehended at least 94% of the first correct response presentation of training trials per session for four consecutive sessions. Additionally, the authors provided pre- and post-intervention trials regarding the generalization of behavior. the authors collected data gathering the percentage of correct behavior and collected the maintenance 60 days after the experiment's conclusion. Also, 40 videotaped trials were presented to 20 undergraduate psychology students at a local college, with the order of presentation and appearance of the children with autism and TDC. The study involved children who made errors during training trials, with different categories associated with the most errors. When an error occurred, the researcher displayed a video model, and verbal or manual prompts were provided if the model did not occasion a correct helping response in the subsequent presentation of the relevant discriminative stimuli. Across all participants, 74% of the video models occasioned the correct helping response following the subsequent presentation of the live discriminative stimuli. For Irene, Nathan, Eddie, and Tom, 85%, 79%, 73%, and 60% of the video models occasioned the correct helping response following the subsequent presentation of the live discriminative stimuli, respectively. No contextual helping behavior measured the degree to which each child discriminated those stimuli that should not have set the occasion for help from those that should. Approximately 60 days after the experiment's conclusion, they presented to each child a 32-trial block presented during the baseline phase. Correct helping behavior occurred during all 22 of the training and probe helping trials for Irene, Eddie, and Nathan, while Tom had all but one trial that occasioned appropriate helping behavior. After achieving the mastery criterion, the percentage of trials was at or near 100% for all children across all 114 postintervention trials. The study aimed at the effectiveness of multiple-exemplar training, video modeling, prompting, and reinforcement in teaching children with autism helping behavior. Before treatment, the children exhibited no helping behavior. However, after the training, each child learned to emit appropriate helping responses in the presence of

specific discriminative stimuli during training trials. Generalization of helping responses occurred during probe trials. A follow-up session about 60 days following the experiment's conclusion revealed that helpful behavior had not changed. Helping reactions also increased in the presence of novel and familiar cues, in a new environment, and with a new instructor. According to social validity criteria, the children's helping behavior was suitable for their usual classmates. Likewise, the authors noted that children following prosocial conduct then were perceived by others as more social. Teaching a child with autism positive social conduct may increase the likelihood of interactions with adults and peers. These increased social interactions may result in additional access to learning opportunities and reinforcement for the child with autism, thereby lessening the deficits in social behavior prevalent in autism. In addition to multiple-exemplar training, other elements, including video modeling, may have aided in the development of assisting and its application to fresh situations. The high ratio of training to probe trials in each treatment session may have contributed to the generalized helping repertoire.

Children with ASD often show a deficit in false beliefs and do not develop functional social skills such as empathy, sharing interests, turn-taking during activities, and verbal approaches. A study explored the efficacy of video modeling and reinforcement schedules for teaching perspective-taking to 3 children with ASD via generalization in novel stimuli [154]. Three boys diagnosed with autism aged 7-13 years participated in a study. Timmy had a mental age of 4 years and produced simple sentences when prompted. Bobby had a mental age of 6 years and held simple conversations about trains. David had a mental age of 13 years, reading and writing in complete sentences and brief paragraphs. All children followed in special education and general education classrooms. The study was in their respective special education classrooms. The children were seen two to three times weekly, with sessions videotaped for Timmy and Bobby but not David per parental request. The study involved three measures of perspective-taking: Sally-Anne, M&Mst, and Hidden and Seek. A staff member administered these tasks to children, observing attentiveness and in-seat Behavior throughout each task. No feedback was provided during any testing session. Sally-Anne involved animal puppets presented in dyads, with the participant asking where the departed puppet would look for their object as a result, the correct answer was "under the bowl." Also, the M&Mst was based on the "Smarties" task using a substitute candy (M&Ms). The participant was shown an oversized box of candies and asked what he thought was inside. The staff opened the box to show a pencil inside rather than candy. They asked the participant to predict what another was not present and would think the box contained. Hide and seek involved two experimenters and the child seeing a puppet leave footprints when it walked. The child predicted where this person would look for the treasure. Stimulus variations comprised generalization and determined whether the child was imitating a rote response from the video or using the strategy in the video. The study employed a multiple baseline design with two tasks (M&M and hide and seek) for each participant, with the Sally-Anne task serving as pre and post-tests. The order of task training was counterbalanced across subjects, with each session lasting 4 to 10 minutes. The experimenter provided no feedback on performance, and after completion, the child received praise for effort and acceded to the preferred item for participation. The child watched a video of an adult correctly completing a task, followed by a training session where the child responded to perspective-taking questions. Correct answers led to praise and preferred items or stickers. Incorrect responses resulted in replays and prompts for imitation. The training phase continued until a child correctly answered in the testing session on three consecutive trials. A follow-up was conducted one month after the final training session, with no video used before maintenance sessions. If a child failed a question, the authors provided a booster video modeling session reassessing the child. The study found that video modeling with reinforcement increased perspective-taking for children with autism. Despite consistently failing primary tasks and variants, all children eventually mastered the tasks and passed variants, even when novel vocal or motor responses were required. Follow-up evaluations were successful for Bobby and David, with one booster session required. The study also found that all participants failed the Sally-Anne pretest, but two participants (Timmy and Bobby) passed the task after intervention for the other two tasks.

In another pioneer and similar study, some authors employed video modeling in helping the acquisition and generalization of perspective-taking skills in three children with ASD [155] diagnosed by two independent agencies; the children were older than 4, and their mental age used the Peabody Picture Vocabulary Test, showing a mental age of 2-5 years, different academic skills, tantrums minimal or verbal, social dysfunctional behaviors, sameness, engaging in repetitive play with toy vehicles, minimal eye contact, and low interest in social interactions. The research followed a multiple-baseline design across and within children, where multiple probes evaluated the generalization of untrained stimuli with balanced order. Furthermore, the training included five first-order perspective-taking tasks and two variations to assess stimulus generalization. The Barney and Bugs Bunny task was used for the pre-and post-test, while other tasks included a modified M&M test, hide-and-seek, tiger and zebra, pizza, and tiger false-belief tasks. The tiger task involved the child wearing a tiger mask and assuming the role of a tiger to see if it would enhance perspective-taking. For the training, the staff showed via instructional videotapes to children to correctly answer all tasks except for the Barney & Bugs Bunny Task and stimulus variations. Adult models appeared in the videos modeling the correct answer (adult model resulted as efficacy as peers and at low cost). The study involved participants who answered perspective-taking questions using Barney and Bugs Bunny puppets. The children were tested on the task twice during the baseline condition, and then video training for the first task began while the remaining tasks were still in the baseline. During video modeling, participants viewed instructional videos for a specific task while the other tasks were still in the baseline. The videos depicted familiar adults correctly performing the task, explaining their problem-solving strategies, and repeating the correct responses using enthusiastic and clear tones of voice. The experimenter reviewed the video with the child after viewing it, collecting data three times on the first task, with no indications concerning correct or incorrect responses. The participants followed close transfer tasks to test for generalization across stimuli. The procedure continued for all tasks, and when all tasks reached the criteria, the post-test occurred. After training on all tasks was complete, perspective-taking tasks without viewing a video were assessed to evaluate skill maintenance. Correct responses scored 1 if they answered correctly and a failing score of 0 if they answered incorrectly or did not provide a response. Interobserver reliability has been calculated. As a result, James passed the first three tasks after one viewing of the video, while Mark passed the rest of the tasks and all similar variations. Mark gained on all tasks, and he exhibited stimulus generalization and response generalization. William passed the first two tasks after only one video exposition exhibiting response generalization to the fifth task. However, he failed the third task (hide & seek) after being exposed to training six times or the fourth task (M&M's) after being exposed to training four times. All three participants failed the pretest and maintenance tests, indicating that they did not exhibit perspective-taking before the video modeling. After the video modeling, James passed the post-test, and Mark also passed the post-test. William was the only child to fail the post-test, and his generalization was inconsistent during maintenance. Moreover, memory questions showed that video modeling increased teaching perspective-taking behavior and improved performance on the memory question. Performance on the control question remained stable throughout data collection. Finally, video modeling facilitated a fast acquisition of skills due to its ability to compensate for stimulus over selectivity, which children with ASD often display. Watching television is also a highly reinforcing activity for children with autism. This method increased their attention and motivation, and video modeling is a novel tool that children are less exposed to in the learning environment. Previous studies have shown weak generalization of perspective-taking, but the present study enhances this by using a multiple exemplar approach. Both response generalization and stimulus generalization occurred, enhancing the learning experience for children with autism. The results suggest that video modeling increases perspective-taking in children with ASD.

Finally, a more remote paper aimed to offer help to a specific requesting assistance through a common everyday task [156]. The study involved three adolescent boys, all externally diagnosed with ASD, called Rick, Ronnie, and Vic, who followed a developmental program focusing on functional academics,

prevocational skills, and daily living skills. Rick's skills included assembly, cooking, and independent self-help. His Peabody Picture Vocabulary Test score was 2.1 years, and he was capable of three- and four-word utterances with rarely spontaneous speech. Rick accepted initiations of social interactions by peers but did not initiate such contacts. His socialization programs focused on teaching reciprocity, turn-taking, and game-playing. Ronnie exhibited ritualistic behavior and verbal repetitions with reading, packaging, assembly, matching, and sorting skills. His Peabody Picture Vocabulary score was 2.2 years, and his speech included four-word utterances. Rick spontaneously greeted familiar people and initiated brief conversations and interactions with peers, although these interactions were not always appropriate. Vic could match the sort and follow two-part directions but required considerable prompting. His age-equivalent score on the Peabody Picture Vocabulary Test was 2.5 years, and his interactions were mostly inappropriate. His socialization programs included promoting peer interaction, turn-taking, sharing, and appropriate greetings and initiations. The generalization settings were at the research office and the kitchen of his home, with the mother acting as a confederate. The experimenters and confederates were advanced undergraduate students. Three additional staff members participated in the assessment of generalization to novel persons, while those who tested for generalization to other tasks were involved in the initial training. The mother served as a confederate in the assessment of generalization to the home, and the observer was one of several previous trainers. Regarding research design, Rick received five days of baseline training, 15 days of training, and 16 days of maintenance, while Ronnie had 21 days of baseline training, 5 days of training, and 11 days of maintenance. Vic received 25 days of baseline training, 7 days of training, and 5 days of maintenance. After each initial task, they were trained on two additional tasks, shifting to a multiple baseline across tasks rather than across participants, requiring a criterion of 80% correct verbal responding for two days on each successive phase before training on the next task in the sequence. To ensure that the youths made a verbal offer of assistance, they had to imitate five times the phrase, Can I help you? Rick met the criterion without training, Ronnie required eight days of discrete-trial training, and Vic needed two days to reach the criterion. Also, the youths received a screening for their ability to emit the motor skills needed to offer assistance in the study. A pool of 15 items consisted of screwing on a jar top, finding a quarter on the floor, inserting a key in a lock, putting tape in a tape recorder, opening a cabinet door, putting paper in an envelope, zipping a jacket worn by another person, and so on. At the baseline, the staff selected three tasks, showing each task 3 times a day for five days. In addition, baseline data for generalization were obtained with an external person in two settings other than the classroom (research office and at home). If the youth did not offer assistance within 5 seconds to the person showing some difficulty, then the next trial was presented. Concerning training, the order of tasks was randomized, with Rick starting on Task 1 and Ronnie and Vic remaining in baseline for all tasks. After meeting the criteria for each task, the youths moved ahead within their multiple baselines. At the beginning of a trial, the youth saw a Confederate state had difficulty accomplishing a task. The experimenter prompted the youth to say Can I help you? and the confederate thanked him. Verbal prompts quickly faded as the youths complied. The criterion for reducing the level of prompting was one 5-trial session of 80% or better responding at that prompt level. Failure to respond to the reduced level of prompting within one session would have resulted in returning to the prior level of prompting, but this was never necessary. Maintenance procedures were identical to those of baseline, with the youth being thanked for offers of assistance but not prompted to make such offers. Generalization was assessed to a new confederate in the training setting, a familiar confederate in the research office, and three novel tasks. The procedures used in generalization probes were identical to those used in the baseline. Data collection involved the experimenter and confederate independently scoring the youth's verbal and motor responses on each trial. Interobserver reliability was calculated on a trial-by-trial basis using the formula of agreements plus disagreements divided by agreements and multiplied by 100. Regarding the results, Ronnie had a 21-day baseline with a consistent 0% response, but when training on Task 1 (putting a letter in an envelope), his performance rose rapidly, reaching the criterion in 4 days. Vic's 25-day baseline was

consistently 0%, except on Day 3 when he reached 33%. Rick's performance across three tasks showed that he showed more rapid acquisition for the next two tasks and some generalization before training. He maintained high levels of response across each task, averaging 88% (over 25 days), 94% (over 10 days), and 100% (over 8 days) for Tasks 1, 2, and 3, respectively. Rick's generalization data revealed no correct responses during the pretraining baseline. After mastering Task 1, he immediately transferred this skill to a new confederate (100%), his mother at home (100%), and a familiar confederate in the centre's office (100%). However, his response did not generalize to the three novel tasks (all 0%). After meeting the criterion for Task 2, he showed 100% generalization to a new confederate, his mother at home, and the office. He also showed 100% correct responses to the tasks of putting paper in an envelope and a top on a jar and 66.7% response to opening a cabinet. Following mastery of Task 3, his response was 100% correct with the familiar confederate in the office, 33.3% to his mother at home, 66.7% to a new confederate, and 66.7% to the tasks of letter in envelope and top on jar and 100% to opening a cabinet. Ronnie's generalization data revealed 0% responding during the pretraining baseline. After mastery of Task 1, he showed 100% generalization to a new confederate, to his mother at home, and in the office. Generalization to the three new tasks was 0%. After mastery of Task 2, he showed 100% generalization to a new confederate, 0% to his mother at home, and 66.7% in the office. After mastery of Task 3, he showed 100% generalization to a new confederate, 33.3% to his mother at home, 33.3% in the office, 100% to the top on the jar, 33.3%b to tape in recorder, and 0% to finding a fork. Vic's data resembled Rick's in that there was minimal generalization across tasks before training. He never responded until trained, except for one data point on Day 3 for Task 1 (top on the jar), one data point on Day 32 for Task 2 (zip coat), and two points on Days 2 and 28 for Task 3 (open cabinet). He mastered Tasks 1, 2, and 3 in 7, 3, and 4 days, respectively. Motor act data were not presented in detail, as there were very few instances in which a participant made a verbal offer of assistance that was not followed by the appropriate motor act. The study demonstrates that adolescents with autism can learn to respond to cues from others that indicate a need for assistance with a specific task. All three youths showed increased efficiency in learning as training progressed, with the second and third tasks mastered more quickly than the first. All participants showed evidence of generalization in responding, although the levels of generalization found were somewhat disappointing, especially in generalizing to the home. The most consistent generalization was to a new confederate in the training set, where, with one exception (Rick, Task 3), responding was at 100% for all three boys for each task. This high level of response probably reflects the use of multiple trainers during the instructional phase, a strategy recommended to enhance generalized responding. To sum up, the results of the present study support the notion that increasing the discriminability of relevant social cues enhances the likelihood that people with autism will emit socially desirable responses. Offering a helping hand is one way we establish social relationships in the working world.

Replying to the eye gaze and facial orientation of other persons is one dimension of perspective-taking where a study applied behavioral strategies to teaching the skill of identifying what another person could see. Some authors used multiple exemplar training in the context of conditional discrimination to teach children with ASD the identification of what another person is watching by following their facial orientation and eye gaze. Also, generalization to untaught stimuli in a natural setting was evaluated [157]. The study involved three children, Aaron, Cormac, and Hannah, aged 3-5 years, who received an intensive home-based behavioral intervention program. Each child had received a diagnosis of ASD and was considered most in need of training in perspective-taking. Each child received between 11 and 18 months of 1:1 therapy for 20 hours per week, plus weekly clinical supervision from a case consultant. The children continued to receive their typical levels of intervention and supervision throughout the study. The participants had to possess pre-requisite skills such as the ability to sit and work at the table, visually discriminate between and tact all experimental photographs, and a history of successfully responding to visual prompts in the form of arrows. They had a previous history of exposure to tabletop, match-to-sample, and conditional discrimination procedures as part of their day-to-day therapy programs. All

sessions were in participants' homes, with regular behavioral therapists conducting the procedures. Therapists received a written protocol, instructions, sample stimuli, a data sheet, and one-to-one training, including role-playing. The study involved creating 24 stimulus cards, and the correct stimuli were four pictures of animals, vehicles, or colors. The cards were oriented to the left or right stimulus since the conditional stimulus never included a person looking up or down, included as a distracter. In the multiple exemplar training (MET) conditions, the cards included visual prompts as red dotted arrows pointing from the person's eyes to the stimulus they were looking at. The researcher implemented a concurrent multiple probe design across participants with IOA. The study involved 24 randomized trials where participants received no prompting or feedback for correct or incorrect responses (baseline). Correct responses on trials of mastered tasks produced the child's regularly programmed reinforcer. Training sessions included 8-12 trials, with stimulus cards and therapist instructions identical to baseline. The cards contained visual prompts as red dotted arrows drawn from the person's eyes to the picture they were looking at. A most-to-least prompt fading procedure was used to fade out the visual prompts, with four levels of prompting. The prompt level was decreased contingent on two consecutive sessions at 100% correct. If the participant responded incorrectly, the therapist moved on to the next trial without giving feedback or administering reinforcement. If the mastery criterion occurred without prompting, then the staff showed a generalization probe. If the response was 80% correct or higher, the intervention started to the next participant in the multiple baselines. If the correct response was lower than 80%, the training condition restarted with another set of stimulus cards. An error correction occurred in cases where the training procedure alone did not produce a favourable trend of acquisition (Hannah only). When an incorrect response occurred, the therapist provided handover-hand guidance and modeled the correct vocal response, and then the next trial started. The study conducted generalization probes and natural environment probes to test for generalization to untrained stimuli. Generalization probes consisted of one trial of each of the 24 stimulus cards, including those directly trained and those that had not. The criteria for generalization were 80% correct or higher. Natural environment probes tested whether the training procedure produced generalization to natural situations involving familiar people, rooms around the house, and familiar objects without feedback or reinforcement. The first probe occurred the day before the initial baseline session, followed by the second probe once a participant responded at 80% correct or better. A final natural environment probe occurred approximately 3 and 2 weeks post-final training sessions for Aaron and Cormac, respectively. The procedure for natural environment probes involved a second person familiar who was looking in one particular direction. The child had to name something directly in their line of vision, and the second person was required to rotate so they were facing a different direction. Further probes occurred similarly with another adult and in at least one other house room. Maintenance sessions for Aaron and Cormac consisted of 12 trials of randomly selected stimulus cards, carried out once or twice a week until the study's conclusion. During maintenance sessions, the staff did not provide prompting, and the consequences resulted in brief therapist praise only. During the baseline, all participants demonstrated low percentages of correct responses, with means of 13, 16.5, and 0% for Aaron, Cormac, and Hannah, respectively. After the first set of stimulus cards, the sum of correct responses of Aaron increased rapidly. Each time prompts have faded a step, Aaron's correct response decreased initially, followed by an increasing trend, resulting in the attainment of the mastery criterion. After the first acquired set of stimulus cards, Aaron responded at 68% correct, failing to meet the criterion for generalization. Cormac's correct response remained high during the four maintenance sessions, with a mean of 89% correct. During the final natural environment probe, Aaron responded with 49% accuracy. Cormac's correct response remained high during the three maintenance sessions, with a mean of 97% correct. The final natural environment probe conducted with Cormac demonstrated 62% accuracy. Hannah's results showed no significant change in her behavior during the intervention phase until the error correction procedure occurred in session 97. After the error correction procedure, immediate changes in accuracy occurred. After the first four items, a generalization probe occurred where Hannah responded at 62% correct. At the natural environment probe,

Hannah responded correctly at 44% rather than 0% during the natural environment probe during baseline. The findings support previous literature indicating that perspective-taking increases thanks to behavioral intervention procedures. Two participants for whom follow-up data were available maintained skills up to 3 weeks post-intervention.

The previous literature has shown the efficacy of point-of-view video modeling (POVM) for teaching play skills, self-help abilities, and collaboration with transitions. Similarly, a study assessed the effectiveness of POVM in training children with ASD to initiate and continue social interactions with others, including maintenance and generalization of behaviors [158]. The research involved three children diagnosed with mild-moderate to severe autism, who received behavior analytic services at a private centre for 6 hours 5 days a week. The child's language abilities and autism severity were assessed using the Preschool Language Scale, Fourth Edition (PLS-4), and the Childhood Autism Rating Scale (CARS). The participants included in the study were: Zhane (5 years), who had a severe autism severity score of 39, Randall (8 years) had a mild-moderate severity score of 35.5, Janet (4 years), who had a mild-moderate severity score of 32.5, all did not engage in spontaneous social initiations but could imitate three- to four-word sentences, none of the participants had exposure to video modeling before the study, placed at the treatment centre. First, a portable DVD player played the designated script during training sessions, and three scripted sequences of social initiations displayed different situations that would set the occasion for a social initiation by the participant (free-play items available during breaks); the scripts comprised specific materials, such as the "Get Attention" script, which involved getting a conversant's attention to display a creation made with a marker and a dry-erase board; the Request Assistance, which taught a request for a conversant's assistance in attaining and opening a clasped plastic box containing a bottle of bubble solution, and the "Share a Toy" script, which involved offering and requesting a Mr. Potatohead® doll to a conversant and then requesting it back again; the videos began with a brief visual introduction and three repetitions of the target script and the total duration for the Get Attention, Request Assistance, and Share Toy videos was 2:21, 2:33, and 2:31, respectively. Subsequently, post-viewing practice sessions were videotaped and collected on the target script and children's novel vocal behavior, where each script consisted of five specific exchanges, with an exchange defined as eye contact and vocal behavior from the child that occurred before the vocal behavior of the conversant. Specifically, the number of exchanges consisted of correct eye contact and vocal behavior collected for each post-viewing practice session. Also, a secondary observer collected data from the video independently during post-viewing practice sessions with an interobserver agreement. The study employed multiple baselines across behaviors (scripts) design, with initial script assignment counterbalanced across participants; each participant began treatment on one of the three scripts while baseline occurred for the remaining two; the authors set generalizations to novel sets of materials throughout all baseline and treatment phases, hence once a participant acquired the first intervened-upon script, treatment began on a subsequent. Therapists acted as conversants and were randomly rotated throughout all conditions and across all participants. In the baseline phase, the child sat at a table with the relevant stimulus materials for the target script. One adult conversant was present, and the child knew that the conversant would return shortly and that they should play nicely at the table until then. No video occurred. Within 20 s of exiting the treatment room, the conversant re-entered by knocking lightly on the door, stepping, and closing the door behind her. The conversant performed each action and stated each assigned line within 10 seconds of the beginning of an exchange in the script, regardless of participant behavior. This procedure ensured that each participant's behavior could occur with equal opportunity in every session. No contingencies occurred for eye contact or vocal behavior. In the video plus food condition, one adult acts as the conversant, and a second acts as the trainer (the first author) during video viewing and practice sessions. The trainer was responsible for setting up session materials, delivering reinforcers, and cueing the conversant. The trainer was constant across all treatment conditions for all participants. The participant was seated at the table with the DVD player and the video model for the target script. The trainer sat behind the participant for the video viewing and the post-viewing practice

session. During the video-plus-food condition, Janet began to orient towards the trainer instead of the conversant each time the conversant spoke, suggesting that conversant statements became discriminative for food reinforcers, although they were delivered contingent on correct participant behavior. In the least-to-most prompts phase, the trainer instituted a three-step least-to-most prompting procedure if a correct vocal response did not occur within 10 s of an opportunity during post-viewing practice sessions. In this phase, food items occurred if behavior occurred independently or with only a partial model; edibles did not occur in the case of a full model. In a later repetition of this phase, the trainer faded from the post-viewing practice session, and the conversant delivered prompts and food items. This alteration was necessary since Janet began to attend to and engage with the trainer instead of the conversant. The procedures were identical to those in the baseline condition, with a modification introduced for Randall and Janet after a decrement in responding occurred. The sessions were identical to those in the video-plus-food condition, but the children did not watch the video before the practice session, and the trainer was not present during these sessions, but the conversant delivered food items contingent on correct behavior. Finally, results showed that eye contact occurred more frequently than vocal behavior in baseline. For the "Share a Toy" script, no correct exchanges occurred during baseline but increased once treatment started. Correct exchanges continued during the maintenance and follow-up sessions. In the generalization probes, no correct response occurred throughout treatment. In the third script, "Get Attention," eye contact and vocal behavior increased simultaneously during intervention; however, there was little generalization to the novel materials. Randall's performance did not engage in any correct exchanges during baseline, and there was no increase during the video-plus-food condition. However, his therapists at the day treatment centre reported that he was using the scripted vocal behavior appropriately during his extra-experimental teaching sessions. Probably, the video presentation before the practice session facilitates an abolishing operation for responding. Therefore, a baseline probe was conducted, during which Randall responded with all 10 of the modeled behaviors. Subsequent baseline sessions were conducted, but there was a drastic decrease in correct exchanges after four sessions. Across all phases, Randall's exchanges during generalization probes did not increase above baseline levels. With the implementation of treatment for the "Request Assistance" script, correct exchanges gradually increased to mastery in 15 sessions and continued in maintenance, though generalization was limited. Eye contact increased during baseline for this script when the intervention began with the first script and maintained with the introduction of the video-plus-food condition, although both eye contact and vocal behavior continued at approximately the same frequency during maintenance. Similar increases in eye contact and vocal behavior occurred during the video-plus-food condition. For Janet, her baseline responding during the "Get Attention" script was at zero levels with little increase after 12 sessions in the video-plus-food condition. Both eye contact and scripted vocal behavior remained infrequent. The video-only phase started after a return to baseline; however, correct exchanges did not increase, and both eye contact and vocal behavior decreased. Similar results occurred for the "Request Assistance" script. Treatment began with the least-to-most-prompts condition, and correct exchanges reached mastery in five sessions. A food-only condition was introduced briefly, but behavior decreased to only one correct exchange immediately. Correct exchanges returned to mastery in two sessions maintained across three additional sessions during the conversant-prompts condition and maintained when prompts were removed in the following phase. Janet's baseline response during the "Get Attention" script was at zero levels, with little increase after 12 sessions in the video-plus-food condition. Both eye contact and scripted vocal behavior remained infrequent. To control for this behavior, the video-only phase was initiated after a return to baseline, but correct exchanges did not increase. The least-to-most-prompts condition was then implemented, and correct exchanges quickly increased with mastery in 10 sessions. However, an immediate decrease in exchanges occurred during a return to baseline. The experimenter's absence could have caused a decrease in exchanges during maintenance. To establish stimulus control in the presence of the conversant alone, the conversant began providing prompts in the next phase, and correct exchanges met mastery in 2 sessions with maintenance across 3 additional

sessions. Both eye contact and scripted vocal responses increased concurrently. Similar results were obtained for the "Request Assistance" script. Treatment began with the least-to-most-prompts condition, and correct exchanges reached mastery in 5 sessions. A food-only condition was briefly introduced, but behavior decreased to only one correct exchange immediately. Correct exchanges returned to mastery in 2 sessions and maintained across 3 additional sessions during the conversant-prompts condition. Frequency of eye contact increased during baseline but decreased during the video-plus-food condition. Vocal behavior increased more rapidly than eye contact when least-to-most prompts were introduced, but both behaviors occurred at approximately the same level during the conversant prompts and food-only conditions. There was limited generalization across all conditions. With the implementation of the least-to-most-prompts condition for the "Share a Toy" script, mastery was met in 6 sessions, and correct exchanges continued in the conversant-prompts and food-only conditions. The study aimed to determine the effectiveness of Picture-Of-Voice Modeling (POVM) in teaching social exchanges to children with autism. The results showed that eye contact appeared to generalize across bases and was acquired and maintained more often than scripted vocal behavior. Two possible explanations for this were that the eye contact model involved the same topography of shifting gaze from the materials to the person in all three scripts, while target vocal behavior was different in each case. Additionally, the action of eye contact was visible in the video model, which is a potential drawback of POVM compared to a scene model. However, these findings were not robust, so further analysis of POVM for teaching various forms of social behavior should be investigated. Zhane's frequency of correct exchanges increased with the introduction of treatment across all scripts, but his behavior did not generalize to the materials used during probes for two of the three scripts. Randall's response to treatment was perplexing, as he had acquired the behavior shown in the video but did not engage in these behaviors during post-viewing practice sessions for the first script. The intervention was effective with the other two scripts. For Janet, the video model and reinforcement alone were insufficient to increase correct exchanges, and response prompts were necessary to increase her eye contact and vocal behavior. The obtained results suggested that Janet's response was at least partly controlled by the behavior of the experimenter, who during treatment delivered prompts and reinforcement for Janet's exchanges with the conversant. However, the treatment components responsible for the increase in correct exchanges are unclear. Additional analyses comparing the efficacy of video modeling alone to the prompting procedure alone would provide more information about Janet's acquisition of social behavior.

Several researchers reported children with ASD as less able than TDC to identify emotional responses in specific circumstances. A brief report aimed at teaching children with ASD to tact situation-based emotions via multiple exemplars of emotion identification using a multi-component procedure [159]. Three 5-year-old male preschool children with ASD, diagnosed by a clinician not associated with the study, participated in a home-based, intensive behavioral intervention program using ABA techniques according to the UCLA Model. The program provided interventions across multiple areas, such as self-help skills, communication, and toy play, not for emotion recognition. A multiple baseline design was conducted across four situation-based emotions (happy, sad, angry, and afraid) across three participants, with maintenance and generalization probes across novel people, settings, and stimuli. Each session in baseline, intervention, generalization, and maintenance lasted approximately 2-5 minutes. The study took place in the participants' homes. Participants 1 and 2 were housed in a living room, bedroom, or playroom, respectively, with furniture such as a couch, computer, tables, chairs, and bookshelf. Sessions occurred ten times a day (6 a week) with two members of the participant's instructional team. Generalization occurred in the participants' natural environment, with novel stimuli, and with a person not part of the instructional team. Baseline sessions consisted of 12 instructional stimulus items, including video stories, with an average length of 11 seconds. The videos involved familiar puppets presented to the child within 5 seconds. Reinforcement occurred for attentiveness and in-seat behavior every third trial but without feedback on performance. After the session, participants received praise for their effort and a self-nominated item. The

study aimed to provide a structured and effective intervention for children with behavioral issues. Emotion recognition training is a method used to teach children how to recognize and respond to different situations. The training involves twelve video stories for each of the four types of situation-based emotions (happy, sad, angry, and afraid). The instructor presents the video, pauses it, and asks a question. The child's response was recorded within 3 seconds, and correct responses were reinforced with verbal praise and reinforcing items. If an incorrect or non-response occurs, the instructor intervenes and implements a prompted learning trial to ensure a correct response. The first target response is introduced by conducting two or three mass trial prompts, followed by the second emotion (sad) and then the third emotion (afraid). Once the child correctly identifies the first emotion, they are randomly alternated with already-mastered instructional videos until the correct response is at 80% or above in two consecutive sessions. After mastery, the final step involves discrimination training between the target situation-based emotions and a previously trained situation-based emotion. The situation-based emotions are presented in unsystematic order, and the child is required to produce correct responses at 80% or above in two consecutive sessions. Training occurs in sessions of 6-14 trials, each lasting about 15 seconds, and the number of sessions varies from 6 to 10 each day. The goal is to ensure that participants continue to demonstrate target responses. The training process helped children develop their emotional recognition skills. The study assessed the child's ability to recognize emotions in the presence of a novel person, setting, and stimulus items. The training involved 36 brief scenarios from classic cartoons, with an average length of 11 seconds. The instructor watched a video while commented it and asked the child to identify the character's emotions. The correct response was a contextually appropriate verbal response, with 5 seconds for each response. Neutral feedback occurred after each response. Four maintenance sessions were conducted 15 days after the generalization probes, each containing three stimulus items for each trained situation-based emotion. These sessions were under the same conditions as the baseline phase. Reliability included a second observer. The study aimed to determine the child's ability to recognize emotions in a novel environment. The results confirmed that children with ASD learned to tact emotions, which then generalize to untrained stimulus items using multi-component intervention (discrete trial instruction, prompt, error correction, and reinforcement). The issue under investigation was the development of a technique that would allow children with ASD to recognize and label situation-specific emotions and feelings, as this is a key problem area for these individuals. The procedure could be considered a form of conditional discrimination in which the context acts as a sample in which particular responses receive a reinforcement.

Another study from the literature on emotional development based on Relational frame theory (RFT) provides a background for emotion comprehension and how people recognize others' emotions through internal states and external labels. This framework has led to the development of front-line technologies like the PEAK curriculum, designed for children diagnosed with ASD. PEAK includes task analyses for teaching emotional discrimination and detecting similar states of others. A study aimed to extend the existing literature by demonstrating how to teach the identification of private events of others in context using stimulus equivalence and transformation of stimulus function procedures [160]. The study involved three adolescent males with disabilities, Dane, Stanley, and Byron, who attended a specialized school for individuals with autism. Dane and Stanley were 13 years old, while Byron was 17 years old. They knew the non-arbitrary, cultural, and arbitrary relations of the RFT. The study was in an empty classroom with a table, chairs, and stimuli required for the experiment. Two sessions of each week lasted 20 to 30 minutes. Materials referred to the PEAK-T program: Private Events of Others in Context, which included six novel video-based scenarios for private events: happy, angry, scared, and excited. The videos included "happy" (videos of a man crying at a wedding), "angry" (videos of a football player crying at a game), "scared" (videos of a man jumping away from a lake), and "excited" (videos of friends jumping around in a house). Each video clip lasted no longer than 7 seconds. The study aimed to assess the effectiveness of a training method for identifying correct responses in relational relations. The dependent variable was the percentage of correct responses within an 8-trial block, including an interobserver agreement (IOA).

Baseline and relational testing verified if any participants demonstrated correct responses before training. Tests for the AB relation involved presenting a video and asking, what is happening? the BC relation involved asking, "If someone is (behavior in context), how might they feel? and the YZ transformation of stimulus function involved saying, I felt (emotion) and I was (behavior), where was I?". Participants acceded to a preferred item following each trial block for nonexperimental behaviors, and no reinforcement occurred contingent on correct responding or prompts provided following incorrect responding. Relational training occurred for both the AB and BC relations. Correct responses were reinforced with social praise, while incorrect responses received a prompt with the repetition of the correct response. Mastery criteria were three consecutive trial blocks with greater than 80% correct responses. Participants progressed to the relational testing phase once the mastery occurred. Maintenance probes were conducted for all relations across all participants for 2-weeks following the final trials in the training phases. Maintenance probes were identical to the probes conducted in the baseline phases, wherein participants obtained a preferred item following each trial block, and no reinforcement occurred contingent on correct responding or prompts provided following incorrect responding. Multiple-exemplar training (MET) was conducted for Stanley, as he did not meet mastery criteria for all the relations after the relational training. The baseline ensured that the MET stimuli were novel to the participant. After probing the relations, training of the BC multiple-exemplar relation started the same as the AB relation, though a change in reinforcer magnitude occurred during this training to promote compliance. Concerning results, Dane displayed low levels of correct responding for all relations during baseline probes, with a response average of 0% for the AB and AC relations, 13% for the BC relation, and 25% for the transformation task. During AB training, Dane achieved mastery within four trial blocks with correct responses ranging from 50 to 100% (M = 87.5%). For the second set of baseline probes, Dane responded at 100% correct for the AB relation, while relations and transformation tasks remained at 0%. With the implementation of BC training, Dane reached mastery criteria within five trial blocks, with correct responses ranging from 38 to 100% (M = 75.2%). Stanley exhibited low levels of correct responding for all relations during baseline, with responses ranging from 0% to 100% (M = 53.5%). During AB training, Stanley increased correct responses, reaching mastery criteria in 12 trial blocks. For the second set of baseline probes, Stanley responded at 88% for the AB relation, 0% for the BC and AC relations, and 25% for the transformation task. During BC training, Stanley's response showed a variable yet steadily increasing trend that reached mastery criteria within 20 trial blocks. Stanley's correct response to the original set of stimuli showed an increase in level relative to the initial set of baseline probes. For the maintenance probes, Stanley's correct response averaged 13% for the AB relation, 88% for the BC relation, 94% for the AC relation, and 50.5% for the transformation task. Since Stanley did not reach mastery criteria following the relational training, multiple-exemplar training began. Byron also exhibited low levels of correct responding for all relations during the baseline probes. During the AB training phase, Byron showed an increasing trend for correct responding, reaching mastery criteria in 5 trial blocks. For the second set of baseline probes, Bryon responded at 100% correct for the AB relation and 0% for all other relations. During BC training, Byron showed an increasing trend that reached mastery criteria in 8 trial blocks, with correct responding ranging from 0 to 100% (M = 61%). The study supports previous research on teaching individuals with autism to identify the private events of others in context. It also extends this research by demonstrating that these procedures can facilitate correct responses to transformation tasks that require a change of stimulus function to a novel context. The exemplars used in the study are clinically meaningful for adolescents with autism, as they represent situations that many individuals may find themselves in throughout life. The PEAK curriculum, designed for untrained staff, was implemented by trained graduate students, warranting replication with untrained staff. An unexpected modification occurred with Stanley, who showed that multiple-exemplar training of additional relational classes was sufficient to produce accurate responses. This procedure, noted in the PEAK curriculum, seems to have initial empirical support. However, there are limitations, such as the assumption that the procedures will generalize to those with lower verbal skills, the lack of assessment of generalization to

novel stimuli and real-life situations, and the lack of replication of MET procedures across other participants. Despite these limitations, Stanley exhibited high levels of correct responses across all relations, supporting the effectiveness of the procedures. Future research should evaluate the generalizability to novel stimulus sets, the PEAK curriculum, and the influence of MET on the development of other stimulus classes.

Another study examined the efficacy of a ToM and SST program on the ToM skills and social interactions of a student with ASD [161]. This study focuses on an 11-year-old student with autism, Lang, who attended a general education classroom with 35 typically developing students and received special education services in a resource room for 45 minutes. Lang was diagnosed with autism and reevaluated at age 10. He had a full-scale IQ of 85 on the Wechsler Intelligence Scale for Children–Third Edition and a score of 79 on the Peabody Picture Vocabulary Test-Revised. Lang struggled with controlling his anger and negative emotions. His general education and resource room teachers reported that he exhibited inappropriate social interactions with adults and peers approximately one to five times during each 45-minute class period. Three same-age peers with learning disabilities participated in training sessions with Lang, selected due to their high levels of socially appropriate behavior across classroom settings; training sessions occurred in Lang's resource room, which consisted of one resource room teacher and five other students with learning disabilities or mild mental disabilities; the program included two stages, each containing one ToM unit and one social skill unit; each unit consisted of two skills, resulting in a total of eight skills for training. The program was developed and sequenced in a hierarchy according to the content difficulty. Lang's learning outcomes were assessed three times during baseline and at the end of each training session using multimedia visual presentation. Each evaluation consisted of six to seven items of various situation-based scenarios related to the skill taught. All the scenarios reflected situations Lang would encounter in his daily interactions. The three scenarios for each skill had the same question structure; however, none of the scenarios repeated. Social interactions were collected through qualitative classroom observations in training and generalization settings. Each observational session lasted 40 minutes in length. In the training setting, an observation of Lang's social interactions occurred during 1:1 and small-group instruction for the baseline condition, and small-group training sessions for the intervention condition. In the generalization setting, Lang's social interactions were recorded during 30-min lunchtime and 10-min afternoon recess (40 min per session); the observational sessions were videotaped and analysed using a semi-structured, free-coding method. The TToM test occurred as a pre- and repeated as a post-test. The TToM consists of 38 questions across eight real-life vignettes representing contents on situation-based emotion, desire-based emotion, belief, first-order false belief, second-order false belief, and fact-, recall-, or hint-type questions. The experimental design and procedures used a single-subject multiple-probe design across behaviors and settings to evaluate the effects of the ToM and social skill training program on the learning outcomes of the taught skills. The pretest administration lasted approximately 40 minutes. The baseline consisted of three evaluation probes for each targeted skill to obtain baseline learning outcomes. ToM and social skill training was conducted four times a week in the resource room, with each skill initially trained one-on-one with Lang. After an 80% accuracy for three consecutive sessions, the training moved to a small-group setting with three preselected peers. After Lang performed at or above 80% accuracy on the learning outcome probes during the small-group training for three consecutive sessions, the training started with Skill 2 (i.e., B2) in the one-on-one setting and was followed by small-group training on the same skill. The same training procedures were used during the small-group training sessions with two exceptions: (a) the role-plays were conducted with the selected peers instead of the trainer, and (b) the training focused on students' sharing of daily experiences rather than story introductions. Maintenance, follow-up, and generalization phases included an assessment of the effectiveness of the training program in improving Lang's social interactions. Post-test. The TToM was conducted again at the end of the study to obtain a post-test score, following the same procedure as described for the pretest. Interviews included Lang's general education teacher, social studies teacher, and

three peers. Each interviewer responded about changes in Lang's social behaviors and peer interactions before and after the intervention and how they perceived the teaching materials, methods, and effects. The results suggest that the ToM and social skill training program improved the acquisition of ToM and social skills during the one-on-one small-group training, maintenance, and follow-up phases. During baseline, Lang's learning outcomes across the eight skills were fairly stable, with the percentage accuracy not greater than 43% except for three data points for Skills B2 (basic beliefs) and B5 (first-order false beliefs). After implementing the training program, Lang's performance on the learning outcome evaluation probes improved dramatically, with the lowest point being 50%, exceeding all except the three baseline data points. High levels of performance occurred during the maintenance and follow-up conditions. Social interaction data were transcribed from videotapes and analysed based on their topography, frequency, and percentage. During the baseline, Lang engaged in 34 social interactions, of which 24 (70.6%) were inappropriate, especially in inappropriate language, physical aggression, threatening, ridiculing, leaving without permission, and inappropriate greetings. The remaining 10 (29.4%) social interactions were appropriate, including expressing happiness, expressing complaints, notifying own actions, compliance, and maintaining conversation. After the training program, Lang greatly improved the overall number of social interactions, exhibiting a higher percentage of appropriate skills. At Level 1 of the Tom (Tom and Manner) test, Lang scored 15 out of 22 (68.2%) on the pretest and 20 out of 22 (90.9%) on the post-test, with an increased score of 22.7%. At Level 2, Lang scored 7 (46.7%) and 14 (93.3%) out of 15 points, respectively, indicating an improvement of 46.6% accuracy on the post-test compared to the pretest. At Level 3, Lang scored 0 out of 3 (0%) on the pretest and received a full score on the post-test, indicating an overall improvement of 35.9% accuracy on the ToM. The results showed that the training program significantly improved ToM skills and positive social interactions in various forms and settings. The program used a systematic teaching procedure, including animated presentation of concepts, modeling, role-plays, performance feedback, and experience connection, to teach important ToM skills such as identifying emotions, beliefs, and first- and second-order false beliefs. The improvements resulted in evaluation probes and pre-and post-test TToM scores. The learning outcome evaluation probes indicated the effectiveness of the intervention program. For each of the eight targeted skills, the percentage of correct responses remained low and stable during baseline and did not improve until the training program started. In terms of the number of sessions required to master the skill, more sessions were needed when teaching ToM skills than when training daily social skills. The study suggests that mastering certain fundamental prerequisites in ToM may have allowed the participant to reach the criterion for related social interactive skills in fewer sessions.

Mainly, a narrative review can identify and summarize previous studies, avoid duplication, seek new studies, and identify areas of investigation not yet addressed, as shown in summarized ABA studies in Table 7. Narrative reviews represent a systematic review process via a structured approach to gathering information. The framework includes an introduction, content, structure, limits, and literature search. The search strategy involves using a database and keywords to identify relevant studies and their types. Inclusion/exclusion criteria include language, periods, and other factors. The central body of the review discusses key concepts, discussing and evaluating them, following the same pattern, and summarizing the search query [162]. Search terms should be established in an understandable way to select related articles while eliminating irrelevant ones. Thesaurus systems like the National Library of Medicine's Medical Object Headings terms can help select appropriate keywords related to the topic of interest. Selection criteria are essential for focusing on the relevance of studies on the topic. Exclusion criteria can be identified based on the research objective, while inclusion criteria define the key factors of the review. It is advisable to include a series of information and sources, such as consulting different databases and limiting citations from the same research or group. Original articles are preferred over other NRs on the same topic as we have conducted. Once the majority of articles have been obtained, the selection can be refined and recorded in a

summary table or using reference cards for sorting and archiving as we have shown in table 7 and table 7. continued.

Behavioral packages

In the reviewed studies, different behavioral components occurred to increment the social skills of children and adolescents with ASD as prompting, fading and reinforcement, in vivo and video modeling, task analysis, error correction, feedback, role-playing, RFT, and BST [144-161]. Recently, the researchers implemented video modeling strategies to teach social cognition skills and prosocial behavior more than other packages [156, 158-161] since this methodology comprehended many advantages for the learning process. Firstly, the clinical staff prepared movies with external people before the training, respecting the following criteria: gradual increment of difficulty, multiple and repetitive examples, semi-natural environments (not always reachable), generalization to peers and materials, and data recording. Likewise, the researchers often recorded the training to study the movies in detail. On the other hand, video modeling was frequently associated with reinforcement and error correction, role-playing, and feedback [158-161]. Generally, these behavioral packages increased after various sessions of perspective-taking of participants; as a result, it is difficult to analyse the efficacy of a single component. In ABA, this methodology refers to the component analysis [163]. Conversely, during a pre-post intervention should be hard and less relevant to control experimentally a single dimension of the training since the progress of children is the core of the training.

Sample

We reviewed studies with 51 participants in total (grouped for primary, middle, and high school), with three participants on average in a single study. Only one study enrolled 15 participants of different clinical samples [152]. The participants followed an ABA school or community/centre-based comprehensive intervention with scarce social understanding and inappropriate social behavior. A single case design (SCD) with a multiple baseline across participants or probes was employed. The training generally started at different times, manipulating the SDs and materials; the dependent variable (offer assistance, infer mental states, recognize emotion, social behavior, and false beliefs) was collected from the percentage of correct responses (stable in follow-ups and generalization probes) and occasionally from standardized instrument related to the ToM test. The learning process included mastery criterion, fidelity, and integrity of treatment, observer agreement, maintenance, and generalizations.

Comprehensive vs focused programs

The list of studies focused commonly on single target behavior such as tact preference or emotion [144, 147, 159-161], asking something to someone [153, 156], responding to a specific SD [148], inferring mental states [152, 154-155], teaching lies [149], maintain a conversation [146], and a single case comprehensive study [161]. On the other hand, even if this focused behavioral training resulted in generalization and maintenance of behavior, social interactions could include a series of contextual skills that occur to respond to complex and unpredictable situations, such as interpreting unclear language and irony, social problem solving as management of unexpected circumstances where children with ASD fail [164]. Consequently, a comprehensive group program based on SST with peer inclusion should offer a more intensive learning opportunity for people with ASD to experience social comprehension and social exchange, which includes cooperation, assistance, and friendship. Conversely, a comprehensive approach to social skills includes high-functioning people since the participant shows language prerequisite to the conversation and maintains attention in a natural group setting. Behavioral analytic intervention offers low and middle-functioning children with ASD an opportunity to learn the first and middle steps of social cooperation. As a result, ABA offers a successful alternative to increasing social skills during childhood and adolescence.

Table 7. summary of reviewed ABA researches on social competences of children and adolescent with ASD and related outcomes

authors	Age	Diagnosis	n/Age	Dosage	Model	Setting	target	Design	Strategies	Outcome	Cit.
Welsh, Najdowski, Strauss, …	2019	ASD (no test)	3 (1 male) 6-8 years	19 sessions 3xweek	ABA	Home	labeling the stimulus with which another person was interacting	nonconcurrent MBD across participants + IOA	MET, error correction, and R+	+	[144]
Stauch, Plavnick, Sankar, …	2018	ASD + ID ADOS-2	4 (3 males) 15-17 years	4-months	ABA + peers	Special school	Joining and extending conversation, with affective behavior	multiple probe design + IOA	VM, error correction + prompt + token economy	+ (3/4) *	[146]
Najdowski, St. Clair, Fullen, …	2018	ASD (no test)	3 (1 male) 5-8 years	45-min 4 days per week	ABA	Community	understanding partner preferences and providing incentives	Baseline Post training Natural probes + IOA	MET, rules, prompting, and feedback	+	[147]
Najdowski, Bergstrom, Tarbox, …	2017	ASD (no test)	3(2 males) 9 years	45-min per day, 1-2 days per week	ABA	Home and natural settings	teaching to respond to disguised mands 10 trials	nonconcurrent MBD across participants + IOA	MET, rules, prompting, and role playing	+	[148]
Bergstrom, Najdowski, Alvarado, …	2016	ASD (no test)	3 (2 males) 5 years	3 sessions per day, 5-10 min	ABA	Home	teach children how to lie socially acceptable 31 trials	nonconcurrent MBD across participants + IOA	BST	+	[149]
Belisle, Dixon, Stanley, …	2016	ASD (no test)	3(males) 12-18 years	63 sessions	ABA/RFT	Special school	single-reversal deictic relational responding 63 trials	MBD across participants + embedded multiple probe + IOA	PEAK-RFT	+ (2/3)*	[150]
Schrandt, Townsend, Poulson, …	2009	ASD (no test)	4 (3 males) 4-8 years	30 sessions 30-min	ABA	Home/school	teaching empathy skills	MBD across participants + IOA	Prompt delay, token economy, behavioral rehearsal	+	[151]
Gómez-Becerra, Martín, …	2007	ASD/TDC/DS WPPSI-III	15 4-8 years	Multiple sessions 30-min	ABA	Home/school/centre	mental and emotional states (Sally-Anne, Emotion Faces + Pitu test)	intrasubject design with comparisons across subjects	Video prompting Error correction	+	[152]
Reeve, Reeve, Townsend, …	2007	ASD (external)	4 (3 males) 5-6 years	50 sessions	ABA	Special school	generalized repertoire of helping adults	MBD across participants + IOA	Multi component teaching + VM	+	[153]
LeBlanc, Coates, Daneshvar…	2003	ASD (no test)	3 (males) 7-13 years	2-3 per week 4-10 min	ABA	Special school	teaching perspective taking	MBD across participants and tasks + IOA	VM + R+ Token economy	+	[154]
Charlop-Christy, & Daneshvar	2003	ASD (external)	3 (males) 6-9 years	39 sessions	ABA	Centre	teaching perspective taking	MBD across participants and within + IOA	VM	+ (2/3)*	[155]
Harris, Handleman, & Alessandri	1990	ASD (external)	3 (males) 14-19 years	46 Sessions Per 36 days	ABA	school/office/home	Offering assistance daily tasks	MBD across participants and tasks + IOA	Prompting and fading	+ (2/3)*	[156]

Note. MBD=Multiple baseline design, IOA=Interobserver agreement, +/- =positive or as usual outcome, R+=reinforcement, MET=multiple example training, VGI=video-based group instruction, BST= Behavioral Skill Training, RFT (Relational Frame Theory), DS=Down Syndrome, VM= video modeling

**Scarce generalization of trained behaviors to novel person, stimuli and natural and complex settings*

Table 7. continued.

authors	Age	Diagnosis	n/Age	Dosage	Model	Setting	Target	Design	Strategies	Outcome	Cit.
Gould, Tarbox, O'Hora	2011	ASD (external)	3 (2 males) 4-9 years	100 sessions	ABA	Home	indicate the direction of the person's eye-gaze	A concurrent multiple probe design across participants + IOA	MET, prompting R+, error correction	+ (2/3)*	[157]
Tetreault, & Lerman	2010	ASD (CARS)	3 (2 males) 4-8 years	130 sessions	ABA	Centre	eye contact and vocal behavior as social initiation	MBD across behaviors + IOA	Point of view VM Prompting + R+	+	[158]
McHugh, Bobarnac, & Reed	2011	ASD (external)	3 (males) 5 years	100 sessions	ABA	Home	recognize emotions	MBD across participants + IOA	Video stories + prompting +R+ DTT, error correction	+	[159]
Schmick, Stanley, & Dixon	2018	ASD (no test)	3 (males) 13-17 years	59 sessions	ABA/RFT	Special school	recognize emotions	MBD + multiple probe	PEAK + MET + video stories +R+	+	[160]
Feng, Tsai, & Cartledge	2008	ASD (WISC)	1 (male) 11 years	40 sessions	ABA/SST + peers	Regular school	recognize desires, beliefs, needs, emotions + anger control	multiple-probe design across behaviors	Video stories, modeling, role-play, + feedback	+	[161]

Note. MBD=Multiple baseline design, IOA=Interobserver agreement, +/- =positive or as usual outcome, R+=reinforcement, MET=multiple example training, VGI=video-based group instruction, BST= Behavioral Skill Training, RFT (Relational Frame Theory), DS=Down Syndrome, VM= video modeling, DTT: Discrete Trial Teaching

**Scarce generalization of trained behaviors to novel person, stimuli and natural and complex settings*

Discussion

The current narrative review sheds light on the scientific contribution that applied behavior analysis and its evolution in relational frame theory have been providing to teach the theory of mind and other social-related skills to children and adolescents with ASD, generally into a format as focused educational programs. The behavioral staff works with people with ASD since the application of behavioral principles has demonstrated an increase in the abilities of clients and reduced challenging and interfering behaviors in learning and social interactions. As a result, since core symptoms of ASD are social communication and repetitive behaviors (as well as restricted interests), social behaviors have been addressed in clinical and educational settings to foster these social barriers.

Firstly, social competencies have been well studied as a bias in perspective taking and executive function, consequently most programs aimed at facilitating social cognitive and behavioral chains to teach play sharing, turn taking, offer assistance, greetings, social initiations, maintenance of conversation, recognize emotions and beliefs/desires with other social competences. Furthermore, comprehensive programs have received excellent results in increasing these social skills in HF children and adolescents with ASD since they have applied evidence-based manualized training and peer-mediated interventions [118]. Generally, these clinical approaches include social cognitive intervention including meta representation of their thoughts and behaviors. On the other hand, ABA programs have provided evidence of increasing social cognition in children and adolescents with ASD, even if the majority of reported training was focused on some specific social skills and without peer inclusion.

Concerning teaching procedure, many evidence-based practices [43] have been implemented by researchers mostly connected with ABA such as cues (visual, textual, verbal, physical, and so on), prompting (most to least, prompt delay, fading), learning monitoring (masterization, maintenance, generalization, and follow-ups), single case design (multiple baselines across participants and probes), video modeling, multiple example training, preference assessment, reinforcement schedule and token economy, error correction and feedback, role-playing, behavioral skill training, and finally relational frame theory. Specifically, most of the studies have agreed that it could be relevant to study the contribution of single teaching strategies in fostering more direct social skills.

Nonetheless, behavioral literature on social cognition could be ameliorated through the following issues. Regarding the sampling, the participants did not receive a comprehensive evaluation pre-training regarding core symptoms, comorbidities, intelligence, and adaptation as gold standard measurement suggests. On the other hand, behavioral analysts gathered information on participants via functional assessments such as VB-MAP and ABLLS reporting precise information concerning language development, challenging behavior, and other cognitive or social skills. Although few studies engaged peers in training the generalization of trained social behaviors to novel stimuli, persons, and natural environments was conducted. Another issue regards the number of participants since the average was <=3. Since the number of enrolled students is low it will be difficult to control the prerequisite of a subgroup, as well as treat some specific social behavior under a specific control stimulus versus a pivotal skill, the social ability in a natural environment could not be adaptive as contextual daily social task require. For example, training that includes TOM could not be exhaustive to participate in a simple-to-complex social event. Likewise, some training involving providing assistance and capturing needs could be limited in case of responding to unexpected events or enrichment of the social scene. Finally, although the majority of training last few weeks, no cost-benefit analysis was furnished by researchers to assess the convenience of these behavioral treatments on social skills.

Concerning the advantages of the studies, reviewed researchers generally implemented EBPs, sometimes integrating behavioral and socio-cognitive techniques or manualized ToM programs. These well-explained teaching strategies in research help future researchers for replication studies, investigating the role of single teaching components. Likewise, to facilitate generalization of the trained behaviors multiple examples or stimuli were provided, as well as working in natural settings like home, school, or play parks. Another advantage could be a discrete brief duration of treatment and its application in multiple settings. Moreover, all reviewed ABA interventions considered two observers (IOA) to guarantee the fidelity of the data collection, which was generally formed by the percentage of mastered targets during the period of training sessions [165]. Finally, an updated behavioral clinical model (RFT) has been examined to teach successfully perspective-taking and recognizing emotion in children and adolescents with ASD although the training related to this approach could be demanding [150, 160].

Conclusion

The current study proposes a narrative review of articles studying ABA interventions to teach ToM in children and adolescents with ASD. As a well-recognized guideline suggests, the current review consists of five aspects: justification of the article's importance, statement of concrete aims or formulation of questions, description of the literature search, referencing of key statements, scientific reasoning, and appropriate presentation of data [166]. Also, we have discovered a few reviews on this specific topic representing a reference in ABA literature on social cognition. Additionally, the study provides both aim and research questions, as well as, a description of the literature with references, and a data presentation. Finally, the clinical problem expressed as ToM, perspective taking, and emotion recognition has been addressed highlighting insights and research gaps. Future studies could refer to these studies in order to cover previous biases and develop more effective interventions for children and adolescents with autism.

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