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ToM & ASD: The interconnection of Theory of Mind with the social-emotional, cognitive development of children with Autism Spectrum Disorder. The use of ICTs as an alternative form of intervention in ASD

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Abstract. Autism Spectrum Disorder is a complex, heterogeneous disorder that affects perception, information processing, social interaction, verbal, and nonverbal communication, and social, and cognitive behavior. Theory of Mind concerns the observation, understanding of mental states, as well as the interpretation of the behaviors that result from them. The present paper focuses on the interconnection of Mind Theory with the social-emotional, and cognitive development of children with Autism Spectrum Disorder. The research findings give prominence to the existence of an interaction between the Theory of Mind and the function of the individual's social, emotional, and cognitive skills. Therefore, the limited development of Mind Theory observed in children with autism is associated with deficits in their social, cognitive, and metacognitive mechanisms. As a result, the focused holistic approach to their weaknesses in combination with the use of ICTs is a promising, alternative form of therapeutic approach.

Keywords. theory of mind, autism spectrum disorder, social-emotional development, social interaction, self-regulation, empathy, cognitive development, executive functions, language development, working memory, attention, cognitive flexibility, planning, inhibition control, metacognition, alternative therapies for autism spectrum disorder

1. Introduction

Autism is a set of heterogeneous developmental conditions, that present difficulty in social communication, as well as unusually repetitive behaviors and interests. The incidence is higher in boys than in girls [1].

Autism Spectrum Disorder is a complex neurobiological disorder characterized by neuropsychological and behavioral deficits [2]. In particular, individuals on the autism spectrum display informal cognitive profiles, such as reduced social knowledge and perception, dysfunction in executive skills, informal perceptual ability, and information processing. Its etiology includes a combination of genetic and early developmental environmental factors. Therefore, the successful evaluation of the disorder presupposes the interdisciplinary, developmental, and timely detection of all possible parameters that shape the overall picture of autism, so that the intervention is effective [1].

The ability of Theory of Mind (ToM) is particularly crucial in any individual's life, as it helps to draw conclusions about all the mental states that cause action and reflect the mental content of ourselves and others [3].

The social and communicative weakness of autism is attributed cognitively, mainly to ToM deficits. People on the autism spectrum describe how difficult it is to "read the mind" of other people during social interactions [4].

However, the first symptoms of autism associated with perception, social stimulus processing, and attention deficit disorder are associated with weaknesses in aspects of ToM and with deficiencies in the development of social and cognitive skills [5].

Research indicates that the function of ToM is particularly associated with other cognitive, mainly executive processes such as memory, observation, cognitive flexibility, and the ability to inhibit since the creation of complex mental states requires the cooperation and involvement of higher energies [6,7,8].

In particular, the ability to inhibit control, i.e. the need to inhibit one's vision to examine the point of view of others, but also the working memory, where it is necessary for parallel maintenance of the perspectives of the individual and others, play a key role at the cognitive and social level in the development of Theory of Mind [9].

In recent years, the treatment of children with autism, to avoid the side effects of medication, has turned to alternative forms of intervention such as special diets, vitamin supplements, yoga, acupuncture, music therapy, the use of digital technology, etc. [10]. Specifically, the use of ICT in the educational process of children with ASD, as a form of an alternative approach, modernizes the learning, and school environment, enhancing the creative, critical, and research thinking of children [11]. A particular preference is observed for mobile technology, as a means of the learning process, due to its easy-to-use applications, enhancing the communication and organization of children with autism [12].

2. Method

The present study is a literature review, which is carried out in selected bibliographic databases, such as Google Scholar, Research Gate, Scopus, PubMed, and ERIC. It is also a literature review, as it is the appropriate way of collecting and composing previous research to promote knowledge [13]. The current study mainly contains articles related to preschool age, and adolescence from beginning to end.

3. Theoretical background

3.1. Theory of Mind

The Theory of Mind (ToM) is a complex cognitive function that helps us understand other people's cognitive and emotional states, interpret and predict their behavior. Closely related to self-awareness, it is essential for the regulation of social interactions [14]. In particular, the ToM is the ability to attribute to ourselves and others' mental states perceiving the causal relationship that connects them with the behavior they cause [15].

Developmental psychology mentions three main theoretical directions that approach its function: Theory for Theory, Theory of Mental Simulation, and Modularity Theory, where according to [16] the most efficient interpretation of ToM is achieved by combining three theories.

ToM is a fundamental social-cognitive ability, the development of which affects various aspects of children's lives and develops gradually between 2 and 5 years. By the age of two, there is a basic understanding of emotion, perception, desire, and intention. At the age of

4-5 years, the reasoning of false beliefs appears, where children try new theories through their experiences, revising the existing ones [17].

However, the mental process of processing behaviors and evaluating the content of beliefs develops gradually with the acquisition of language ability and executive skills [18]. Understanding false beliefs are linked to some real behaviors in 4-year-olds and suggest the evolution in their cognitive development [19].

At the same time, the performance of children in tasks of false belief is a process, the completion of which is influenced by their perception, the function of executive control, conceptual understanding, and their cognitive, social, and individual differences associated with ToM [20].

Research indicates the existence of two ToM systems, one is silent unconscious, occurs at a young age and is associated with the monitoring of mental states, and the other develops gradually, functioning in a deliberate, controlled manner allowing explicit, conscious conclusions [21].

In addition, we distinguish the cognitive TOM of the individual which leads to conclusions about the motives and beliefs of others, and the emotional TOM, which requires the cooperation of empathy and is necessary for the understanding of emotional states [22,23].

3.2. Autism

Autism is a neurodevelopmental disorder whose exact causes remain unknown [24]. The term "autism" comes from the Greek word "autós" which means "self". The Swiss psychiatrist Eugen Bleuler coined the term in 1908, referring to patients who developed withdrawing from reality [25].

Main features ASD

The deficits of "Autism Spectrum Disorder" are described through two great groups of symptoms: social communication and stereotypical repetitive behaviors, activities, and interests [26,25]. Show difficulties in environmental influence, self-service skills - independent living, motor coordination and body perception in space, and sensory sensitivity to various environmental stimuli [27,28]. Deficiencies are also found, in the development of visual symbolism, language, problem-solving working memory, response inhibition, visual-spatial skills, attention, Mind Theory, general information processing, and social-emotional skills [29]

Diagnosis

The diagnosis of the disorder is made at any age, mainly from about two years, accompanying the person throughout his life and affecting his functionality, interaction, behavior, and communication with other people [24]. Accurate diagnosis is achieved by differential diagnosis, interdisciplinary, developmental, and timely detection of individual indicators, such as medical, genetic, and environmental factors, necessary for the confirmation and individualization of the assessment, but also the better clinical description of individuals [26,1].

Intervention

The intervention and education of children with ASD should be multidimensional and individualized while covering many areas of development and aiming at their functional independence and quality of life, combined with the provision of appropriate family support [1]. While there is no standard treatment for autism, early detection and treatment can improve

the structure, function, and brain's behavior, reducing or preventing the onset of severe symptoms throughout a person's life [24].

Causes

Autism is a multifactorial condition, as far as the causes that bring on it. However, the interaction of genetic and developmental early environmental factors plays the most significant role in its occurrence [1]. Several studies have substantiated the view that inflammation is caused by environmental toxic infections and comorbidities in the brains of children with a genetic predisposition to ASD is one of the substantial causes of the disorder [30,31].

Comorbidity

It is observed that about three-quarters of children with ASD have concomitant disorders such as ADHD, anxiety, bipolar disorder, inflammatory bowel disease, epilepsy, mental disability, Tourette syndrome, Fragile X syndrome, tic disorders, provocative or aggressive behavior [25,32].

Prevalence

A study [31] on the global prevalence of ASD confirms the existence of high variability in the occurrence of the disorder worldwide, possibly due to methodological differences in case detection and the ever-increasing prevalence estimates in each geographical area. According to a World Health Organization survey in 2012 [32], the prevalence was about 1% of the population, while a more recent study estimates the prevalence at 1.5% in developed countries.

3.3. Social development

Man through various social mechanisms that operate automatically and implicitly, gradually acquires knowledge through observation, imitation, and participation in social interactions [33]. The socio-emotional development of the individual is composed of a whole complex skills, which are progressively developing through the exploration of the environment and the experiences gained [34].

In addition, socio-emotional ability presupposes the presence of certain basic cognitive functions such as observation, perception, attention, memory, proper processing of social messages (decoding), inhibitory control, self-regulation, flexible adaptation, but also a social experience [35].

Study [34] states that we distinguish four basic skills in the social-emotional development of the individual: social ability, emotional ability, the ability to manage behavioral problems, and self-regulation.

3.4. Cognitive development

The term cognition refers to a set of mental procedures necessary for the organization and interpretation of perception. A skill that provides basic information about the environment, including the process of mental representation, is a significant developmental milestone in the first two years of a child's life [36]. Cognitive development is a gradual process, which requires the coordination and mutual influence of cognitive and emotional skills, contributing to the adaption of the individual [37].

Metacognition as a higher mental process refers to the knowledge of the individual about the function of his cognitive skills, as well as to the awareness, evaluation, and regulation of his thinking [38,39]. Research shows that the development of metacognitive skills is essential

for the development of executive functions, and social competence, but also the Theory of Mind of children with ASD [40,41].

Basic cognitive skills are perception, memory, attention, learning, language development, motor skills, and visual-spatial skills. In addition, executive function, involved in planning, coordinating, and monitoring behavior toward a goal, evolve in the context of interpersonal relationships and is associated with the development of a cognitive mechanism that promotes social interaction [42-45]

4. Correlation of Theory of Mind with Autism

Henry Wellman, one of the most influential researchers in ToM, pointed out that a hypothetical being, who knew nothing about the process of the mind, would see and hear other persons, without understanding their mental states and behaviors arising from them. Therefore, his social world would be empty of himself and others. However, the researcher's hypothesis is not unfounded, as children on the autism spectrum find it difficult to perceive and distinguish the mental states that they and others have [15]. In particular, in the first relevant study of the authors, [46] trying to examine whether children with autism lack ToM, they found deficits. In particular, it turned out that their cognitive weakness in TOM, which is largely independent of their mental age, is associated with the limited development of the symbolic game and the social weakness they display.

The main symptoms of autism are due to an insufficient neuro-cognitive mechanism that does not support the development of ToM, which is necessary not only for the perception of the mental states of ourselves and others but also for the individual's self-awareness [47]. ToM as the ability to represent mental states based on a mechanism of "initiation and expression" which transforms the primary representations (impressions from the physical world) into secondary representations, which are disconnected from reality and expressed as new representations [4].

Studies indicate a causal relationship between ToM and higher cognitive functions (executive) in children with typical development and children with ASD. In particular, responding to ToM's false beliefs requires a transition from one's perspective to another. Therefore, the cooperation of memory, attention, abstract thinking, cognitive flexibility, central cohesion, and inhibitory control is required, whose limited development that children show in the autism spectrum affects the adequate functioning of ToM [48,49].

The researchers [50] tried to study evidence of ToM processing by applying a social learning model to highly functional adults on the autism spectrum. While people with ASD were able to track the beliefs of the person they were observing, they did not use them to predict their behavior, being unable to assess their intentions, possibly because they expected them to be unchanged due to a lack of flexibility.

However, many cases of children and adults respond successfully to some TOM tasks, not least because of an advanced TOM, but mainly because of developed verbal skills, appropriate problem-solving strategies, or their conceptual knowledge of the mental states of others [48,51,5].

A person is considered to have developed ToM when he realizes that other people's behavior and his own, arise from mental states, which are shaped by his experiences, without necessarily keeping pace with objective reality. Gradually the child from 4 to 5 years old understands his mental states and others, facilitating social interaction, adaptation, and integration into the social environment. Children with autism find it difficult to discern the

motives in the behavior of others, which is why they try to interpret it, according to what they express, in a literal way [52].

ToM in children of typical development

ToM is a prerequisite for social interaction, communication, and, most likely, for the acquisition, understanding of language, the meaning of words, what the speaker intends to convey, and not so much to say literally. The development of ToM does not simply require reasoning processes but involves higher cognitive processes and specific brain connections [47].

The newborn does not have a fully developed ToM, though the brain is equipped with the proper mechanism, the social environment will coordinate and activate the action. The development of the social brain includes various processes, the perception of faces, voices, and movements of other people, which are necessary for the evolution of ToM [4].

The sharing of attention that occurs in the first year of a child's life, when he follows the gaze of another person, or when he simultaneously controls his mother's expressive attitude while observing an object, his participation later, in the symbolic game, understanding that others pretend, and the ability to mimic other people's actions are early signs of ToM development [53].

Gradually at the age of 5 years and usually before the age of 8, they perceive concepts such as false belief, deception, and lies [4]. Also, at the age of 9, children perform well in faux pas tasks, as they realize if something needs to be said or if it will affect others emotionally [53].

ToM in children with Autism Spectrum Disorders.

Imaging of the brain showed that the area associated with the ability of ToM in the prefrontal cortex is not activated in people with autism when they perform ToM tasks. The perspective of mental states is based on a cognitive system, which operates selectively. However, many people with autism, while having good cognitive abilities, still show deficits in ToM [47].

The mind blindness theory [53] refers to the delayed development of ToM in children with autism, strongly influencing the comprehension, and interpretation of the behavior of others, which often seems unpredictable, and strange.

Children with ASD in the first year of life find it difficult to follow another person's gaze, do not show objects that interest them, and do not show the ability to joint attention. In addition, they have no preference for other people's facial expressions, perhaps due to a lack of social interest [4]

Gradually, as they grow older, they have a weakness in recognizing and understanding mainly complex emotions, especially those created by a mental state, affecting behavior regulation, social interaction, and consequently, their social ability [3.8].

Deficiencies are identified in the perception of first- and second-class false beliefs, in deception, in lying, which, although they use it, they find difficult to maintain, in the use of symbolic play, which helps to understand other people's perspectives [48].

In addition, they present difficulties in perceiving thoughts and feelings of others through the eyes, as well as in understanding the faux pas tests [53]. In addition, they have difficulties in understanding, and interpreting narrative texts, as they have a reduced ability to interpret the thoughts, feelings, and actions of the characters of the story [48].

The level of difficulty experienced by children with autism influencing by various factors but differentiates significantly from their developmental stage and mental ability [11]

In conclusion, the development of ToM could function as a criterion for distinguishing the levels of severity of Autism Spectrum Disorder, as well as the level of its support, aiming at the planning of social-communication development through the intervention of appropriate practices [54].

5. ToM in the social-emotional development of children with ASD

5.1. Recognition, understanding, expression of emotions

Emotion as a dominant component of emotional intelligence could be defined as a function of the body, which through the interaction with other mental functions contributes to the overall development and flexible adaptation of the individual [55].

Emotions that are visible on the face of children in the first months of their lives are their first language of communication. Children on the autism spectrum, while able to express emotions, however, their emotional expressions differ qualitatively from those of children of normal development, having an unusual or temperamental form that makes them difficult to interpret. In addition, they cannot share their emotional experiences but also coordinate them with their verbal communication [56].

Overall, children with ASD show deficits in emotional recognition, regardless of their age and mental level, in the expression, and processing of emotional and social information, resulting from emotional facial expressions. This results in limited social interaction, and reduced understanding of other people's feelings, mainly complex, but also the actions that result from them, due to deficits in ToM and empathy [57,55].

Research shows that children with autism often have difficulty perceiving emotions due to a lack of visual attention to main facial features, which transmit similar emotional information, or the weakness of briefly processing stimuli when they alternate rapidly. Researchers administering an intervention program to improve the recognition and expression of facial emotions in children and adolescents with autism observed an improvement in primary emotion recognition, and self-expression, with elements of generalization of similar skills, contributing to the development of aspects of ToM [58].

Other studies suggest that adolescents' deficits in social behavior are related to ToM, emotion recognition, and social timing [59].

5.2. Emotional regulation and empathy in relation to ToM & ASD

Empathy is associated with self-knowledge and is considered the ability of the individual to understand the feelings and thoughts of others, through their perspective, achieving the distinction of emotions, and controlling behavior by applying cognitive and emotional skills. We distinguish between cognitive empathy, which includes the cognitive understanding of another person's perspective, but also the cognitive-emotional side of ToM and emotional empathy, which involves the utilization of emotional states [60,61].

Research has been conducted [62] on the effect of individual differences on the self-regulation of children with high-functioning autism, and the social interaction with peers in the school environment. Its results indicated limited social interaction due mainly to deficits in inhibitory control skills, joint attention, emotional regulation, and children's reduced flexibility to choose appropriate strategies for coping with social-emotional situations.

Another study [63] found that children with ASD who had high levels of mental efficiency and verbal communication performed better in communicating, regulating emotions,

understanding the mental states of others, empathizing, and adapting to social norms of different frames.

Findings from a similar study [64] in 108 children with autism, aged 4-7 years, show that reduced control of their emotions intercepts the development of social skills and interactions with others and the ability of ToM.

Peterson's study [65] highlights more deficits in ToM and less in the empathy of children with autism, with no association with ToM ability, since children with ASD, while performing false beliefs tasks had lower empathy.

In addition, findings of another research [66] show an interaction between vocabulary, executive skills, and empathy in children with ASD, emphasizing that the limited empathy they display is because they do not have the appropriate cognitive skills to develop it.

A recent study [67] focused on improving the empathic capacity of 135 children with ASD (8-13 years old) through ToM education. There was an improvement in the empathy ability, and social understanding, with little generalization to certain aspects of social behavior, highlighting the connection of ToM with empathy.

5.3. Social capacity in ToM & ASD

Social knowledge includes a set of mental and psychological functions, which form the basis for an individual's social ability, which concerns social behavior and cooperation with other people. The development of social skills, communication, and social interaction, is the means to achieve personal or group goals in social situations, areas in which children with autism lag behind and require skills related to ToM [7,68]

An especially prominent ability in which children with ASD also show weakness is joint attention, which is associated with the development of the nervous systems of the individual's social cognition, incorporating information processing of coordinated attention or action of those involved in the interactions [69].

In addition, it is crucial for people with autism to cultivate interpersonal communication and recognition of their strengths and weaknesses, in order to gradually develop healthy communication relationships with others, through self-knowledge and acceptance [70].

Researchers report in their study [71] that children with ASD and low mental status were limited in social interactions, most likely because they had difficulty perceiving other people's thoughts and feelings. While children with developed oral speech had better performance in their social transactions.

Study results [72] indicate that the ability of children to interact with peers is associated with an understanding of ToM and not so much with age and language development. ToM significantly influences the shaping of children's social life, as through mutual social contact, they apply ToM skills. In addition, children with autism show a delay in ToM and limited social skills.

Researchers focused on ToM education and its relationship to the social interaction and disruptive behavior of 97 children with autism during the period 2010-2013. The intervention improved basic skills of ToM, such as social understanding, with limited generalization to broader social behavior [73].

Researchers have found that social information processing skills link to ToM skills in children with autism. Emphasizing that they have difficulty codifying social information, understanding, reproducing stories, and correctly assessing social behaviors, perhaps because higher Tom skills are required, such as knowledge of ethical and conventional rules [74].

A study [75] examining ToM skills profile, executive functions, and realistic ability in children with high-functioning autism found reduced performance in ToM tasks, behavioral-emotional regulation, speech coherence, and communication assessment, affecting overall their socialization.

While another study reports that the reduced performance of children with ASD in Tom tasks is associated with limited attention to social stimuli [76].

According to research findings [77], the development of ToM interacts with the pretense game. The child, realizing that his thoughts and feelings are different from those of other people, is pushed away from the original representation, creating a new, meta-representation for which the cognitive process of the pretense game is necessary. The study points out that the symbolic play of children with ASD with deficits in ToM characterized by simplicity, monotony, lack of spontaneity, and variety in the use of objects. While children with developed use of narrative language create common meanings with their teammates, extending their ideas to social play.

The results of another study [68] concern the effectiveness of the realistic Play Time / Social Time (PT / ST) and I Can Problem Solve (ICPS) intervention programs in the development of ToM 52 children with autism and social skills in preschool children. The intervention programs strengthened the children's social skills, and in particular, the ICPS contributed to the management of difficult social situations and the development of ToM, providing the possibility of generalization in different contexts.

Research shows that the involvement of children with ASD with robots is accessible and attractive, because it creates a predictable environment that allows the user to repeat, reducing the stress and emotional insecurity created by communication with humans. In addition, social behaviors, cognitive skills, and several times their generalization are enhanced [78,79].

Researchers [80] utilized theatrical drama and the participation of two NAO robots to improve the joint attention skills and functional behaviors in children with autism of high functionality. As a result, was an improvement in joint attention, social interaction, and an increase in children's use of functional play, which gradually promotes the development of symbolic play and evolves aspects of ToM with appropriate social and cognitive skills.

Recent research [11] has focused on the development of social skills of 4 children with autism (7-14 years old) under the influence of intervention, lasting one month, with an educational robot. The results show the development in their social skills, cooperation, better communication, eye contact, the time of concentration during the script, understanding of social rules, and enhanced interaction with the teacher and other children.

6. The role of ToM in the cognitive development of children with ASD

Several studies attempt to explain the cognitive impairments of children on the autism spectrum, in combination with certain "islets of ability" such as enhanced memory, good visual-spatial ability, their markedly different mental level, utilizing the mental functions of ToM, the ability of central cohesion, and the higher known skills, the executive processes. There is a strong interaction between ToM and executive skills, as well as a necessary condition for the development of some functions and the evolution of others [81,82].

We report indicatively the Empathizing - Systemizing Theory, contains two factors that try to interpret the social and non-social characteristics of autism. The limited empathy that explains the communication and social deficits, and the developed systematizing contribute to the interpretation of repetitive behavior, narrow interests, extreme attention to detail, resistance

to change, and the need for sameness [83]. Systemizing promotes the prediction, and understanding of the inanimate universe governed by rules, as opposed to the empathy that enhances the perception and interpretation of the social world [84].

In addition, the extreme male brain theory of autism points to the evident differences between women and men in empathy and systemizing. In particular, research shows that women perform more on empathy tests, while men perform on systemizing tests, so people with autism exhibit a systemizing strategic information processing and function as one end of the male brain profile [84,83,53,85].

Researchers investigated in 100 adolescents, ages 14-16, the link between ToM, executive functions, and ASD symptoms. At the end of the study, found a direct correlation between ToM capacity and social competence and stereotypical repetitive behaviors, in contrast to the executive function associated with TOM development and not at all social communication difficulties and limited repetitive behaviors [86].

Studies show that in false belief tasks, the reasoning it performs requires the suspension of true belief, a mental function involves the cooperation of higher cognitive abilities such as working memory, attention, flexibility, and inhibitory control, which are usually limited in children with ASD [87].

Another study looked at cognitive deficits in ToM function, programming, cognitive flexibility, inhibition, memory, and poor central cohesion in 27 children with ASD and 18 children with typical development, aged 12 years. The study findings show that children with ASD performed better in understanding false beliefs, and had difficulty completing false belief tasks, suggesting that there are several nuances in the development of TOM. It is noteworthy that the verbal mental ability and the development of language capacity are associated with the delay in the development of ToM [88].

6.1. Language capacity in ASD & ToM

According to research [89], language and communication deficits are among the main characteristics of children with autism, especially in the pragmatics of language and its use in social contexts. In particular, they find it difficult to initiate and maintain a conversation, weaknesses that are social-communication deficiencies associated with underlying known disorders in the development of ToM, since effective communication presupposes language development as a means of exchanging information of feelings, thoughts, and beliefs.

Factual understanding of speech is essential for proper communication in a conversational context, which helps children understand words, and sentences beyond the literal interpretation. Research shows that children with high-functioning autism show weakness at this language level. Due to the inability to integrate information from the respective environment (central cohesion deficits), ToM deficiencies, inhibition control, cognitive flexibility, and limited social motivation [90].

Researchers assessed the ability to understand idioms, syntactic performance, and how they relate to ToM, in children with autism with high functionality. The findings showed a limited understanding of idioms in children with autism, while they could perceive idiomatic expressions when there was a language support framework and developed Tom skills [91].

A recent study in Spain [92] found that children with autism had difficulty with aspects of factual skills such as non-verbal communication, initiation of conversation, use of the environment, and use of stereotypical language. In narration, they had difficulties in understanding context and reduced coherent competence in oral narration. The main difficulties

of comprehension at the factual level were due to deficits in the ability of attention and working memory.

Another study states that the deficiencies of children with ASD in narrative speech are associated with impaired ToM and working memory [93].

While research [94] describes that bilingualism has efficacy on the development of executive functions and ToM. In particular, bilingual children with autism performed better in working memory tasks, inhibitory control, visual attention, and greater flexibility in shaping decisions in false belief tasks.

6.2. The ability to pay attention to ToM & ASD

Studies indicate a special relationship between attention to cognitive, metacognitive, and emotional functions. Attention as a higher cognitive, metacognitive process affects and affects the functionality of all, especially executive skills [95]. More specifically, attention plays a prominent role in coordinating information processing, thus creating socially and cognitively flexible individuals [96].

Executive functions are closely linked to the awareness of the mental state of a person and others, namely ToM. Specifically, the ability has a person to observe his actions and to act voluntarily is crucial for the perception and understanding of the mental states of himself and others. It found that the development of mind control not only in children with ASD but in all children enhances executive functions and is a predictor of their overall development [97].

May, Rinehart, Wilding, & Cornish compared the ability to switch and maintain attention between 64 people with high-functioning autism and 64 children of normal development, ages 7-12. The findings showed that children with autism had a reduced ability to switch attention, with similar learning performance and limited attention retention [98].

Similar findings were found in research by Sinzig, Vinzelberg, Evers, & Lehmkuhl, that found deficiencies in children with autism in maintaining attention and reduced inhibition capacity. While a small number of cognitive flexibility errors were observed in children with ASD, perhaps because they were highly functional [99].

Mutreja, Craig & O'Boyle report, in their study, that children with ASD showed impaired executive and oriented attention, compared to the attention-sparing ability that was effective at work [100].

Macoun, Schneider, Bedir, Sheehan, & Sung evaluated the effectiveness of an intervention program for enhanced attention and executive function in 20 children with ASD through the game Caribbean Quest-CQ, which belongs to the group of << serious games >>. The intervention led to improvements in visual working memory, selective attention, self-regulation, executive function, children's social ability, and the use of metacognitive strategies in school [101].

6.3. Memory capacity in ToM & ASD

The function of working memory is usable and necessary for the evolution of cognitive skills, language ability, learning, and reasoning, through the brief storage and processing of information that it performs. Interacts closely with attention as superior cognitive functions work together to maintain and manipulate representations, and information arising from stimuli, both cognitively and metacognitively [102].

Wang, Zhang, Liu, Cui, Wang, Shum, van Amelsvoort, & Chan, studied the visual-spatial and phonological areas of working memory of people with autism. Findings pointed out more deficits in the visual-spatial working memory than phonological. These deficiencies

appear to be associated with difficulties in behavioral regulation, cognitive flexibility, attention, abstract thinking, communication, problem-solving, and performance in the learning process [103].

According to Souchay, Ohlsson, & Zalla, the reduced ability of Tom is directly related to deficient autobiographical memory in autism since the reduced access to episodic autobiographical memories implies insufficient knowledge of oneself and consequently social behavior [104].

Nejati, Moradkhani, Suggate, & Jansen investigated the relationship between Tom and visual-spatial skills related to visual acuity and visual cognitive memory in 45 boys with ASD. Children with autism performed worse on ToM tasks, possibly because first- and second-class understanding of beliefs was associated with limited development of visual-spatial skills combined with reduced visual memory performance [105].

6.4. The ability of inhibition in ToM & ASD

According to Kouklari et al. weakening of executive functions may have consequences on the development of ToM. In particular, their study showed that children with ASD who performed better in inhibition work performed better in ToM tasks [106].

In particular, children with autism are less able to suppress unnecessary information in working memory, which is affected by focusing and maintaining attention, increasing limited repetitive behaviors [107-109].

6.5. The ability of programming in ToM & ASD

Kimhi, Shoam-Kugelmas, Ben-Artzi, Ben-Moshe, & Bauminger-Zviely, studied the ability of programming, cognitive shift, ToM, and their interaction in children with ASD. The findings showed that deficits in ToM, specifically in predicting a character's energy, were associated with programming skills and their ability to mentally visualize the steps required to observe, evaluate, and predict actions [110].

Similar results were found in other studies where children with ASD showed deficits in the overall programming process were associated with weaknesses in cognitive flexibility, ToM, and possibly their obsession with a structured set of solutions [111-113].

7. The use of ICTs as an alternative form of intervention in ASD

7.1. Alternative forms of intervention in ASD

ASD is a heterogeneous group of neurodevelopmental conditions, its etiology is not unambiguous. However, the prevailing view in the scientific community refers to the interaction of genetic and environmental factors [10].

The therapeutic approach includes pharmaceutical and alternative forms of intervention. The use of drugs in the treatment of ASD provides partial improvement of the main symptoms or management of symptoms arising from comorbid conditions. However, the side effects they cause and the limited holistic treatment of the disease have drawn the attention and interest of parents, researchers, and scientists to alternative practices in the treatment of autism [25].

Some of the most common therapeutic approaches for children with ASD are Applied Behavioral Analysis, TEACCH program, PECS communication system, MAKATON language development communication program, SPELL support framework, and sensory integration therapy aimed at, language, social skills, and their generalization, as well as in the organization of sensory information, promoting their independence and social adaptation [114,115,78].

The "Naturalistic Developmental Behavioral Interventions" (NDBI) that train young children with ASD in prerequisite social skills, depending on their developmental level [116,117], are considered quite effective.

In addition, Complementary and Alternative Medicine (CAM) in biological and non-biological therapeutic methods, is safe with little or no side effects [10].

It is also necessary to maintain normal levels of hormones produced in the body, mainly stress and happiness, the dysfunction of which causes children with ASD anxiety, hyperactivity, limited communication, flexibility, attention, and reduced emotional regulation [118,119].

In addition, the proper functioning of neurotransmitters, in combination with good nutrition (rich in vitamins, minerals, minerals), reducing environmental toxicity (pesticides, heavy metals, genetically modified foods), strengthens the biological defense mechanisms, and cognitive abilities promote the metacognitive process and self-knowledge [120].

7.2. The use of ICTs in the service of ASD

The use of ICTs in special education is a means of overcoming obstacles and learning difficulties [121].

The education of people with disabilities through ICTs is a scientific field, linking special education with digital learning, psychology, and neurosciences. The use of a variety of digital technologies designed for people with ASD involves computers, software, virtual reality environments, mobile digital devices, robotics, and online tools, which aim to acquire knowledge, and social and professional skills [122].

The Use of a Computer in ASD

Using a computer, through various applications, in children with autism improves behavioral problems and facilitates social interaction as the computer conveys clear social messages. In addition, it improves focus and retention, recognition of emotions, and enhances generalization in new situations [123].

Due to their predictability, computers can be used to improve the daily lives of children with autism. They have a positive effect on reducing stress and self-stimulatory behaviors, improving their concentration, attention, and communication [124].

Also, the use of technology supported by computers (COMPUTER-ASSISTED TECHNOLOGY, CAT) is very efficient in emotional understanding, in the evolution of social, communication, language development, and ToM. Typically, we mention some applications such as "Mind Reading" and "Emotion Trainer" which help to recognize emotion and describe the understanding of a situation that causes it [125].

Upgraded interfaces between people with ASD, computers, and virtual environments are particularly effective forms of digital intervention to enhance social and cognitive skills [126].

Virtual Environments

The use of virtual environments gives the opportunity to practice in social situations that approach real life [127] It is a simulation of the real world based on computer graphics, reduces redundant stimuli in each context, and allows learning through play [128]. They are considered an interactive and exciting learning space that facilitates innovative teaching activities and provides an educational benefit for children with ASD [129,130].

Virtual environments through various software promote predictable interaction, reduce stress, and enhance imagination, symbolic thinking, and social cognition, as they use specific educational scenarios [124]. The use of appropriate educational scenarios or role play in the virtual environment enhances the emotional consciousness of the individual, but also the perception of the perspective of others [131].

Virtual reality can include desktop applications providing interaction with a virtual world, to a multi-sensory environment in immersive labs [132].

We distinguish between two types of digital tools, virtual reality and augmented reality. The first concerns the simulation of reality through digital tools while the second is related to the view of the natural, real environment enriched by digital media. The use of virtual reality enhances the recognition, expression, and regulation of emotions and develops social interaction. It also reduces attention deficits. Augmented reality contributes to the cultivation of sociability, perception, recognition, and expression of emotions [133].

In autism, the use of virtual reality works constructively, as it provides opportunities for generalization of skills and knowledge, personalization of the environment with controlled stimuli, and degree of difficulty that vary according to the needs of children [134]. Essentially, children with autism interact more effectively in an environment that simulates reality, in which sensory and social inputs are limited and manageable [135].

Mobile digital devices

The applications of mobile digital technologies and tablets contribute to the development and adaptability of people with ASD, as they observe, control, regulate their behavior, and reduce their stress by better performing the requirements of everyday life [134]. Mobile applications can be one of the most satisfying forms of intervention, as they improve communication, language, emotional, and social skills and enrich vocabulary [136]. Mobile phones are an attractive learning tool compared to traditional classroom tools, as they have applications with animation, video, and graphics that entice the attention and interest of children [137].

Indicatively, we refer to the recent research of Stathopoulou et al., whereby utilizing digital social stories in children with high functioning ASD, they managed to improve the social skills of students, which were maintained for a long time, achieving a gradual generalization of their behavior. In particular, digital social stories link the functionality of social stories with the supportive practice of information and communication technology, offering a new method of developing social skills in children with autism [11].

Serious games

Serious games are digital games with educational design, where in addition to entertainment they provide the opportunity to improve the social interactions of children with ASD [127]. Promote targeted learning through play [138]. Serious games are adapted to the needs and capabilities of users aiming at specific learning outcomes [139].

Research shows that their application in the training of social skills, the recognition, and the expression of emotions in people with ASD is efficient. However, their use focuses on teaching highly functional children, and many times achieving the generalization of learned skills in real life is not possible [127].

Nevertheless, it seems that they can be used successfully in personalized learning, creating an incentive to improve the skills they teach through increased concentration, interest, and entertainment. In addition, children through digital play do not experience failure intensely,

and the impulse is created to repeat the effort, promoting self-correction and the ability to solve problems [138].

Robotics

Robotics is proven particularly effective in the cognitive, social, and emotional education of children with autism, as they reduce stress by creating a visually appealing, stable, and predictable learning environment. The use of robots in the learning process seems to alleviate the cognitive and sensory deficits of children with ASD [78,79]. At the same time, children, through their involvement with robots, develop social-emotional skills such as self-regulation, attention control, and, consequently, consciousness, which are particularly important for self-knowledge [133].

Noteworthy is the report on Socially Assistive Robots (SAR), which as an intervention tool with high interactive capabilities, can enhance the development of social communication, shared attention, and motor skills in children with autism, in the presence of an educator, through imitation and social interaction with them [78,79,140].

It is noteworthy the dominant role of ICTs is to support the daily lives of people with autism. Therefore, their use should be framed, targeted, and controlled, by a similar educational program, where the activities complement each other [135].

8. Conclusions

This study aimed to provide a brief description of the interconnection of TOM with socio-emotional and cognitive mechanisms. The main findings of the literature review are summarized below.

ToM as a higher cognitive process constitutes a complex mental "tool" necessary for the smooth integration and adaptation of the individual in the social world [141]. Its evolution affects the typical development of the individual, affecting the case of deficits in the development of interpersonal relationships, social ability, functionality, and quality of life [142,143].

The ability to understand beliefs is essential for the creation of optimal social behavior and the acquisition of necessary social skills, which are a prerequisite for its smooth integration into society. On the contrary, the weakening of ToM, the mental processes of understanding, interpretation, prediction, and manipulation of behavior, through observation, in ASD alters the correct perception of the current social environment. Therefore, it is figurative to create social interaction, communication, and socio-emotional development for children on the autism spectrum [74,144,59].

The early weaknesses of children with autism in the processing of social information, affect the development of social knowledge, and the improvement of their social-cognitive skills [145].

In particular, the attenuation of ToM in children with ASD complicates communication, and social interaction, which is necessary for the strengthening and quality of executive functions, but also the entire cognitive mechanism, since the individual improves well-interacting with the environment [45, 36].

However, the study findings indicate that the development of early cognitive skills can support the function of ToM, such as the increased ability to integrate information (posture, gestures, eye contact) from various sensory pathways. Which enhances joint attention which is an emerging behavior of ToM. In addition, the limited function of cognitive skills and especially

the higher cognitive processes affect the formation of ToM, preventing its evolution [82,146, 97,66].

Impairment of emotional capacity in children with ASD is associated with dysfunction of the amygdala, which plays an essential role in the creation of positive and negative emotions, as well as in the function of superior cognitive skills of memory, attention, and decision making, which are a crucial source of emotions [147,60].

Children understand the stimuli and then collect data through perception, attention, and observation, resulting from sensory stimuli. They then store some of the information in their memory, so that, later, they can use it to predict, interpret, actions, and behaviors, attributing to themselves and others' mental states. Therefore, there is an interaction mainly between the higher cognitive processes, the development of social-emotional skills, and the functioning of ToM [38,108,59].

The exploitation of ICTs in education domain is very productive, successful, facilitates and improves the educational procedures via Mobiles [153-158, 217], various ICTs applications [159-188, 218-222], AI & STEM [189-199], and games [200-205]. Additionally the combination of ICTs with theories and models of metacognition, mindfulness, meditation and emotional intelligence cultivation [206-216] as well as with environmental factors and nutrition [150-152], accelerates and improves more over the educational practices and results.

Moreover it is established that the utilization of ICTs is a necessary field of knowledge and a useful tool in the evaluation and intervention of ASD in recent years [148]. Many practices that utilize ICTs tools if they do not treat autism, significantly improve social, communication, and behavioral disabilities, namely the regulation of attention and behavior, the recognition and expression of emotions, and social interaction [125].

Specifically, robotics combines elements from various scientific disciplines such as computer technology, electronics, engineering, and the ICTs tools. As a result, it enhances eye contact, mutual attention, socialization, communication, and language comprehension and expression. Therefore, the application of new technology is a helpful educational tool in the development of cognitive and social skills of children with ASD and consequently of ToM [125,78,12,122]

Valid diagnosis and especially early intervention in children with ASD is fundamental, given the brain's neuroplasticity, especially in the first years of life and preschool age, because they improve weaknesses in various areas [149].

In summary, the heterogeneity observed, through various studies, in the performance of children with ASD in executive, social skills, and ToM is related to the type of work, their complexity, the level of severity of autism symptoms, language ability, mental ability, as well as their cognitive development. Given the involvement of cognitive and social functions in the development of ToM and the interaction between them, it is necessary to approach the holistic intervention in children with autism while covering the weaknesses in different areas of development. However, it is required to emphasize the training of some basic skills that penetrate the functioning of their socio-emotional, cognitive, and metacognitive development, including TOM, such as observation, attention, working memory, social interaction, and self-regulation. In conclusion, it is preferable to use alternative forms of treatment of deficits in ASD, as far as feasible, since the administration of a drug causes side effects and focuses on symptoms' treatment. In addition, by prioritizing the use of ICT as a tool for intervention in autism, it is quite possible to improve children cognitive and social-emotional through attractive structured audiovisual experiences.

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