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The Evolutionary Course of Theory of Mind – Factors that facilitate or inhibit its operation & the role of ICTs

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Abstract. The Theory of Mind is a bridge of mental understanding between us and others. Its proper functioning provides opportunities for communication, effective social interaction, development on a cognitive and metacognitive level. The present study aims to examine its developmental stages from infancy to adolescence, as well as the main factors that stimulate or defeat its course. The crucial development of executive skills, language function, and the importance of the role of ICTs is pointed out, as they compensate for the difficulties in the formation of Theory of Mind and promote its continuous improvement throughout an individual's life.

Keywords. theory of mind, explicit and implicit theory of mind, executive function, social cognition, metacognition, intention understanding, false belief first and second order, individual differences, neural processing, ICTs

1. Introduction

A man participates in a selection of social interactions to fulfill social goals, related to obtaining information, influencing people's behaviors, developing emotional intimacy. The success of his social interactions depends significantly on the ability of Theory of Mind (ToM), his ability to think, to process the thoughts, intentions, beliefs, feelings of others, thus can understand and predict their behavioral reactions. (Byom, & Mutlu, 2013).

This complex mental skill presupposes the perception of the causal relationship between mental states and the behavior that results from them. Consequently, it is necessary to know that people experience different types of mental states in different ways, which may not be identical to their own. (Samson, 2009).

According to research, we first understand similarities - differences of our perspectives about others, and then we realize their intentions, desires, knowledge, beliefs, emotional responses. This critical point of exchange of mental view in social knowledge, appears gradually with the development of joint attention in infants, serving a function of communication before language development (Mundy, 2018).

ToM is associated with primary social, emotional, and cognitive skills, especially verbal ability (receptive and expressive vocabulary), knowledge of emotions (Brock, Kim, Gutshall, & Grissmer, 2018). Its development does not require only reasoning processes but includes specific brain connections and involves higher cognitive processes such as the

executive process, emphasizing working memory, inhibitory control, attention (Frith, & Happé, 1999; Samson, 2009).

The ability of people to reflect on their mental states is a prime example of cognition, which is related to the individual's consciousness. Cognition is the basis for human consciousness and thus plays an essential role in human social interactions. (Frith, & Frith, 2012). The development of ToM helps the child to develop self-perception and cognitive ability, later enhancing the self-awareness and endoscopic awareness of the individual. (Frith, & Happé, 1999; Hughes, & Devine, 2015a).

The widespread and rapid development of ICTs is strongly involved in our daily lives, improving its quality. Specifically, ICTs through several devices, software, applications have enriched the educational process of all students and especially those with special educational needs (Kontostavlou, & Drigas, 2019). In particular, ICTs in combination with the appropriate educational framework can contribute to the development of higher cognitive skills including ToM (Drigas, & Karyotaki, 2014, 2019) (Drigas, & Pappas, 2017, 2015, 2019).

2. Method

The present study is a literature review, which was conducted in selected bibliographic databases, such as Google Scholar, Research Gate, Scopus, PubMed, ERIC. It was methodologically based on the literature review, as it is practical to describe a topic and its underlying concepts and theories (Aromataris & Pearson, 2014). It aims at a brief description of the evolutionary course of TOM and the main factors that influence its operation.

3. Definition-Brief historical review and Theoretical approaches

3.1. Definition-Brief historical background

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 development of social interactions. In addition, it is an integral part of social knowledge, a set of mental abilities, such as knowledge of interpersonal rules, which is necessary for the decoding of the social world and contributes to the regulation of behavior. (Duval, Piolino, Beaming, Eustache, & Desgranges, 2011)

The development of children's knowledge about the mind has been of particular concern to the research community. We can distinguish three main research periods in the progress of children's cognitive development. The first concerns Piaget's research, in which the child is initially exhibiting an egocentric behavior, interprets everything according to himself, and ignores the existence of other different views. But as the child grows, he gradually understands the thoughts, perceptions of other people (Misailidi, P. 2003).

The second period is related to the study of metacognitive development in the early 1970s. Metacognition concerns the functioning of cognitive processes and the strategies that achieve optimal functioning. In particular, it involves the use of superior cognitive skills (executive) for monitoring, adapting the cognitive mechanism. Metacognitive research is mainly related to the investigation of memory, perception, attention, and problem-solving in children at the metacognitive level. (Flavell, 1999). Metacognition and ToM, while considered by many theorists as two independent cognitive subjects, however, both fields of study seem to share a common goal, children's knowledge for knowledge (Misailidi, P. 2003).

The third research period gradually begins, when the term ToM is introduced in the developmental literature, after the study of Premack & Woodruff (1978) wherein their experiment "if the chimpanzee has ToM" demonstrate that chimpanzee provided a solution to

problems of reflection. mental states (intentions, purpose) in the human factor, utilizing observational learning, proving that it has aspects of ToM (Astington, & Dack, 2008).

Later, on the occasion of the previous experiment, the Austrian psychologists Wimmer & Perner (1983) using the experimental work of "unexpected movement", found that at the age of 4-6 years a new cognitive ability emerges, which is gradually established. It concerns the ability of children to represent the relationship between cognitive states between two or more individuals. Children understand a character's false belief and can justify his intentions and actions according to that false belief.

Implicit – Explicit TOM

Researchers, trying to better comprehend how children perceive and understand the functioning of the mind, suggest two different approaches to the early implicit ToM identified by the child's first year and the consequent explicit ToM that occurs at the age of 4-6 years (Teglasi, Caputo, & Scott, 2022). These two systems have been described as "lower-level" and "upper level" or "automatic" and "controlled", "low level" and "high level", "automatic" and "controlled" (Molenberghs, Johnson, Henry, & Mattingley, 2016).

The implicit understanding of false beliefs is a conceptual basis for the development of later explicit reasoning of false beliefs, but also the development and understanding of ToM skills. It relies mainly on attention and is influenced by the working memory function (Kloo, Kristen-Antonow, & Sodian, 2020; Schneider, Nott, & Dux, 2014). Implicit occurs as infants observe nonverbal behaviors responding to the goals, intentions, desires, feelings of others. Already children aged 2 and 3 years refer to their mental state but also others based on observations of patterns (Teglasi, Caputo, & Scott, 2022).

Gradually children develop explicit ToM, which includes deliberate examination, evaluation of the mental states of others, and works consciously and flexibly, compared to implicit TOM that acts quickly and unconsciously, without prior thought about the mental state. (Schuwerk, Vuori, & Sodian, 2015). The explicit process is considered a higher mental ability that involves in its function the development of executive and language skills, as the child acquires information based on the truth for the reading of the mind. However, when information is incomplete or ambiguous, children can use implicit mind processes to come to conclusions. (Teglasi, Caputo, & Scott, 2022; Molenberghs, Johnson, Henry, & Mattingley, 2016).

Affective and Cognitive TOM

In addition, a set of studies on ToM suggests a significant differentiation involving the affective and cognitive mechanism of ToM. Its cognitive component is referred to as "cool" and concerns the ability of the individual to perceive both his thoughts, intentions, desires and those of others. While, the affective cognitive component of TOM, the so-called "hot" is associated with emotional states, preferences of the individual, and others (Meinhardt-Injac, Daum, & Meinhardt, 2020).

Many people equate empathy with affective ToM, but they are two different functions. "Empathy" refers to the feeling and experience of another person's feeling, without necessarily understanding the reason that causes that feeling. While affective ToM is related to the actual understanding of emotional states, the ability of the individual to put himself in the place of the other, but without necessarily experiencing the emotion (Duval, Piolino, Beaming, Eustache, & Desgranges, 2011).

However, the successful operation of emotional ToM requires the effective processing of the processes of empathy, perception, and recognition of emotions (Sebastian, Fontaine, Bird, Blakemore, De Brito, McCrory, & Viding, 2012).

It is pointed out that the two mechanisms of ToM "cool and hot" seem to act complementary to each other, taking into account that the neural structures that are activated, are influenced by the content of mental states, the material of stimuli, and the source of information in each case (Meinhardt-Injac, Daum, & Meinhardt, 2020).

3.2. Theoretical approaches of ToM

According to the "**Theory of Theory**", the conceptual development of children, in the form of the conceptual revolution, appears at the age of 3-4 years. Children's social experiences play a key role in shaping their perceptions of others. Children acquire new information which they are unable to process with the TOM they have, as a result of which they review and develop it. In addition, the enriched social environment of children has a positive effect on the speed of development of ToM, in contrast to the cultural differences that affect the understanding of mental states (Hughes, & Leekam, 2004).

The **modularity theory** for ToM states that the ability to reason to understand the mental states of others is a set of innate specialized skills, that can process and perceive different types of mental states (Hughes, & Devine, 2015a). Specifically, TOM develops through a neurological maturation of successive mental mechanisms that are interconnected and evolve from the first year of a child's age. (Flavell, 1999)

Simulation theory, according to its proponents, states that self-knowledge and imaginative ability to pretend are fundamental skills for gaining an understanding of the mind. (Hughes, & Leekam, 2004). Therefore, the ability to understand others arises from the experience of the individual to imagine or simulate the thoughts, feelings of others, based on the mental states he has experienced himself (Hughes, & Devine, 2015a).

Necessary for the processes of simulation of mental states is considered the system of mirror neurons, which is a neural network that contributes to the understanding of the goals, intentions, and actions of the individual. It is activated as the person observes, perceives, performs similar actions with others (Mahy, Moses, & Pfeifer, 2014).

The **theory of executive function** on the development of ToM points out that, both developmental change and individual differences in ToM are inextricably linked to functions such as self-monitoring, working memory, attention, programming, cognitive flexibility, which promotes flexible behavior towards the completion of a goal. It is emphasized that weaknesses in the executive process limit social interactions, thereby affecting children's understanding of the mind (Hughes, & Leekam, 2004).

The executive function is especially significant when the child is adjusting to kindergarten, as children need to suspend their perspective on working memory and limit their impulse to process the other perspective. The development of executive skills is a key determinant predictor of ToM (Brock, Kim, Gutshall, & Grissmer, 2018).

ToM is part of the general function and basic architecture of the brain, which specializes in the recognition of mental states (Leslie, Friedman, German, 2004). Neuroimaging studies report that the medial prefrontal cortex, temporoparietal junction, amygdala, superior temporal sulcus, and temporal poles are the main functional areas of the brain involved in ToM. (Wellman, 2011; Molenberghs, Johnson, Henry, & Mattingley, 2016; Frith & Frith, 1999; Gallagher & Frith, 2003).

4. Stages of the evolution of Theory of Mind

ToM is a fundamental social-cognitive ability, the development of which affects various aspects of children's lives, such as social ability, acceptance by others, and proper adaptation and success at school. (Carlson, Koenig, & Harms, 2013). The ability to understand the mental states of others in childhood consists of a coherent and interdependent set of mental concepts (Astington & Jenkins, 1995).

Research shows that the experiences that children gain in the first years of their lives affect the development of the brain, much more than those they will acquire later. This is because the human brain is biologically prepared to incorporate specific experiences. Regarding the ability of ToM, the particularly important period for its development is the preschool period (Peterson, & Wellman, 2019).

A great number of studies indicate that the evolutionary course of ToM presents a regular developmental sequence, with a significant first step in this process when children around 18 months of age realize that not all people have the same desires. (de Villiers & de Villiers, 2014)

ToM's first research, for about two decades, states that "mind-reading" skills are developed in childhood in two stages, first with the recognition of desire around 2 years and then with the recognition of belief in age. of 4 years. However, recent studies have shown that intentions and false beliefs can appear as reasoning in children in the first year and at 18 months respectively (Sodian, 2011).

However, the mental process of processing behaviors and evaluating the content of beliefs develops gradually with the acquisition of language skills and executive function (Sodian, 2011).

4.1. Infancy

The processing of mental states while governed by different cognitive, conceptual mechanisms, is necessary for our harmonious social adaptation. In this sense, the evolution of ToM is linked to early social perception (Sabbagh & Bowman, 2018). Infants are considered to be active social partners, as they seem to tend to interact with other people, but also to encourage others to interact with them. (Hughes, & Leekam, 2004).

In infancy, there are obvious elements as precursors of ToM in children's behaviors (Warrier, & Baron-Cohen, 2018). In particular, infants at the age of 6 months can recognize that living organisms are self-propelled and can distinguish biological from mechanical movement. As a result, they are able to selectively monitor human behavior. From the age of 10 months, infants try to interpret behaviors according to the intentions of others, which is the basis for the social and communicative action of children. (Hughes, & Leekam, 2004).

In addition, at the age of about 10 months, infants' ability, known as "social reference", to use the emotional reactions of others to direct their actions to new situations is observed. (Hughes, & Leekam, 2004).

In their first year of age, infants watch and imitate other people's gestures, following their gaze, as early signs of interaction with them. (Carlson, Koenig, & Harms, 2013). They gradually develop the ability to join attention, improve the skill of attention, their perceptual ability, connecting the information of the world they observe with the inner mental states (Sabbagh & Bowman, 2018).

According to the findings of studies, joint attention is associated with the development of the nervous systems of social knowledge of the individual. It includes a system of the brain that integrates the processing of information for the coordinated attention or action of the

individual and others during social interactions, making it particularly important in the exchange of information (Mundy, 2018). At about the same age, infants show protodeclarative pointing, where the child points to an object or something happening at that moment to get the parent's attention. At the age of 18 to 24 months, children begin to understand the mental state of desire and pretense (Stone, Baron-Cohen, & Knight, 1998).

4.2. Preschool age

ToM develops gradually between 2 and 5 years. By the age of 2, ToM in children includes a basic understanding of emotion, perception, desire, intention. However, there is a difficulty for children to understand that others may have different beliefs, which may be false. (Carlson, Koenig, & Harms, 2013).

Two main mechanisms of ToM are the belief-desire performance, as well as the selection process with suspension, which is strongly associated with selective attention and develops gradually starting from preschool age. (Leslie, Friedman, & German, 2004).

At the age of 3, children realize what people are doing to fulfill their desires, without realizing that they are acting in a certain way because they are motivated by their beliefs. However, children of this age try to explain, predict emotions and actions according to the information they derive from the wishes of others. (Astington, & Dack, 2008).

Gradually, children aged 4-5 come to terms with false beliefs as they try new theories and revise existing ones. (Carlson, Koenig, & Harms, 2013).

It has been found that the understanding of false beliefs by children is of particular interest because it proves that they perceive beliefs as mental representations which do not directly reflect reality. This perception is a milestone in the ability of children to distinguish the mental from the physical world. It is also a matter of the utmost importance in their cognitive development, but also their participation in social interactions. (Miller, 2009).

The most common ToM assessment tasks involve false belief tasks, which have been used to evaluate both normal developmental children and children with developmental abnormalities. One of the most common tasks is the "unexpected location" task, in which the main character has a false belief in the position of an object, which must be understood by the examinee. (Frank, & Temple, 2009).

The performance of the false belief process requires that not only the beliefs of others taking into account but also that the beliefs of the person making the assessment be kept separate so as not to affect the output of the result. Given the high cognitive and verbal skills that are a prerequisite for the perception of false belief, this skill cannot be sufficiently manifested at the age of less than 3-4 years. This does not mean that younger children are not aware, even indirectly, of the mental states of others, which is confirmed when the infant can watch the other person's intentions. (Happé, 2003).

Research shows that children who were able to explain actions based on false beliefs at the age of 3- 4 years had better communication with their family and developed verbal interaction with their mother, which was based on causal relationships. (Astington & Jenkins, 1995).

4.3. School-age – Adolescence

It is noteworthy that the development of ToM is not limited to the preschool age, but also extends during primary school, as children develop information-processing skills and gain an increasingly complex understanding of the mental process of social data. (Osterhaus, & Koerber, 2021).

During the first school period and especially in adolescence, children begin to understand the close relationship of mental states with the context (Sabbagh & Bowman, 2018). At the age of about 7 years, children realize the possibility of integrating one mental state into another, for instance, the mother thinks that the child thinks the chocolate is in the cupboard (Astington, & Dack, 2008).

Perner & Wimmer (1985) in their experiments observed, that almost all children aged 7 to 9 years have the ability to represent mentally, and understand second-order beliefs that entail a complex perception of conflicting perspectives. Many researchers use advanced tasks such as the "Strange stories" test to examine the superior abilities of the ToM, which capture complex social communication processes such as sarcasm, irony, which even normal developmental children find difficult to respond to (Zalla, & Korman, 2018).

The second-order mental false belief process can be related to processes of metacognitive understanding, mainly of the meta-memory, as multiple representations are simultaneously justified in a complex metacognitive way. (Miller, 2009).

Thus, children progressively understand that people have beliefs not only about the world but also about the mental content of the minds of others, and then, they acquire the concepts of irony, metaphor, sarcasm in school life. (Astington, & Dack, 2008).

At an older age between 9 and 11 years, children gradually attribute to faux pas tasks, perceive two different mental states wherein the first concerns the person who says something without knowing if it will bother what already said. The second mental state contains cognitive ToM and emotional empathy and relates to the recipient of the message and its effect on his behavior (Stone, Baron-Cohen, & Knight, 1998). These tests are particularly demanding, as participants need to understand the speaker's communication intent and understand second-order beliefs. (Zalla, & Korman, 2018)

In middle childhood and adolescence, the development of ToM is influenced both by the improvement of children's cognitive abilities and by the social experiences they gradually acquire, enriching their social skills in different social environments through their interaction and adaptation (Hughes & Devine, 2015b)

While most ToM studies are related to early childhood, adolescence remains a significant period for the social-emotional development of the individual. On account of the social world of adolescents becomes wider, as they develop relationships beyond the family, which represent the basic framework for creating and promoting their self-understanding and social perception. Therefore, in adolescence, there is an improvement in social-perceptual aspects of ToM, while social, cognitive skills seem to be influenced by the development of higher cognitive processes (language, reasoning process) (Meinhardt-Injac, Daum, & Meinhardt, 2020).

Regarding the development of ToM in adulthood, it seems that it is affected by the function of the executive process, after its full maturation, in combination with neuroanatomical changes that occur in the neural network of the brain due to the external signs of aging, which generally affect the performance of the cognitive mechanism. (Klindt, Devaine, & Daunizeau, 2017).

However, the developmental, mental, and age maturity of the individual can develop his consciousness as an integral part of knowledge, which reflects his cognitive and metacognitive state. Then, his developed ability of self-knowledge contributes to the transmission of the representations that he perceives in the conceptual mechanism of the brain, in order to draw conclusions and to form high-order beliefs (Drigas, & Karyotaki, 2017, 2019).

It is worth noting the critical role of mindfulness in the acquisition of the self-knowledge of the individual and the evolution of ToM. Mindfulness, an educable process consisting of processes of reflection awareness and emotional reassessment, contributes to the complex examination of situations and factors in each context concerning the individual. A prerequisite for the completion of the process is the participation of higher cognitive skills, observation attention, inhibitory control, cognitive flexibility, and the psychological search for the real self (Drigas, & Karyotaki, 2018) (Drigas et All 2005, 2006, 2016)

4.4. Atypical development in ToM

According to several studies, children with autism and sensory impairments, such as vision and hearing problems, have deficiencies in ToM. In children with autism, studies indicate that they have deficits in ToM, where cognitive deficits limit the ability to disconnect the primary representation of an object, event, mental state from a meta representation of it (Hughes, & Leekam, 2004).

Therefore, they have limited attribution in ToM work on deception, understanding complex emotions, and belief-based emotions. However, higher levels of language skills facilitate the performance of children with autism in second-order false beliefs, although they often experience reduced comprehension in non-literal language use, sarcasm, irony, metaphorical expression. (Astington, & Dack, 2008).

However, they could improve their performance by developing their social learning and enhancing cognitive and metacognitive skills such as observation, memory, and attention. (Mitsea, Lytra, Akrivopoulou, & Drigas, 2020).

Study findings indicate that deaf children who are slow to master sign language have low performance in false belief tasks, while blind children have difficulty understanding false beliefs because they cannot see the facial expressions, gestures that accompany communication messages, thus limiting their language development (Astington, & Dack, 2008).

Essentially, humans manage the cognitive processes associated with detecting, filtering, recording, processing, and sensory signals. However, people with autism and sensory problems show reduced self-regulation of the above processes, which are necessary for the decoding of information, thus affecting the function of ToM (Drigas, & Mitsea, 2019, 2021) (Xanthopoulou et all 2019), (Stathopoulou et All 2020) (Alexopoulou et all 2019).

5. Factors affecting the function of ToM

From a very young age, people utilize observation and knowledge and suppose that others plan, organize and execute actions to achieve their goals. Human action, therefore, seems to follow a course of rational planning. However, several times people act according to habit, instinct, or with an automatic reaction to certain stimuli, without the involvement of conscious thought. As a result, the effective assessment of the mental states of others contains elements that are related not only to the planned behavior but also to the spontaneous one, which differs from the respective context, influencing the correct drawing of conclusions (Gershman, Gerstenberg, Baker, & Cushman, 2016).

However, some factors play a determining role in the evolution of ToM. We briefly present the most basic of them.

5.1. The ability to pretend - Symbolic play

Pretending ability is an early manifestation of ToM ability (Premack & Woodruff, 1978). The appearance of pretense in childhood is the beginning of an ability to comprehend

knowledge itself, an early example of the human mind's ability to perceive and manipulate information. In addition, when one pretends it refers to one's ability to understand the pretending of others, their attitude towards what they know. Consequently, it cultivates the development of meta-representations, which are the link between the ability to pretend and the ability to understand the pretense of others. The content of the pretending seems to be influenced by the level of conceptual development and the extent of extensive knowledge that the child gradually acquires. (Leslie, 1987).

Especially crucial factors in the development of ToM are the development of the imagination and the involvement of the child in pretend play, as the child is allowed to simulate desires, emotions and to imagine situations that are not currently valid. (Astington & Dack, 2008). Imagination can be expressed through symbolic play and is closely related to ToM, as it contains a virtual world in the child's mind. A virtual world constitutes the mental content of the imagination (Baron-Cohen, 2000).

Essentially the symbolic game is a social manifestation of ToM in preschool, where children disconnect the principal representation of the object from the one pretending (Kimhi, 2014). Children's participation in pretense games helps them become more aware of mental states. Specifically, the understanding of false beliefs is related to the child's abilities in the pretense game, namely the ability to simulate mental states that do not exist in reality (Astington & Jenkins, 1995).

5.2. Participation in processes that promote social interaction

Research indicates that children's involvement in school activities and interaction with peers facilitates the development of endoscopic and metacognitive skills and, consequently, the functioning of the ToM (Astington, & Dack, 2008). In particular, children who interact socially, using expressive language, develop ToM further, as they increase opportunities to practice and improve their ability to understand the perspectives of others, expressing their mental states and responding to those of other people. (Brock, Kim, Gutshall, & Grissmer, 2018).

Studies show that education in an inclusive learning environment is associated with increased development of ToM in children without disabilities. This is obviously because a heterogeneous environment and the interplay of children with or without disabilities can promote social knowledge and understanding of other people. Hence, co-education seems to have a positive efficacy on the development of ToM and consequently on its social-cognitive mechanism and school performance. (Smogorzewska, Szumski, & Grygiel, 2020).

ToM is not a simple transfer of information remotely, but it is a complex, inferential and predictive process, where it evaluates the indications of behaviors by concluding. It has been found that cultivating behavioral synchronization provides opportunities to promote the precise reasoning of others' mental states. In a typical way, we mention that music, dance, exercise in various forms of collective procedure, highlight the power of behavioral synchronization. Because, through cooperation, the psychological and mental distance between individuals is limited, and the focus on others and their mental states is achieved, facilitating their interpretation (Baimel, Severson, Baron, & Birch, 2015).

5.3. Emotional understanding

The ability to recognize and interpret emotions is considered an essential dimension of communication and social interaction (Fitzpatrick, Frazier, Cochran, Mitchell, Coleman, and Schmidt, 2018) Emotion recognition skills involve the awareness of the emotional message,

through facial expressions and contextual elements, to perceive the emotion. (Camras, & Halberstadt, 2017).

Receiving emotional messages includes a set of critical skills that provide information about the consequences of our behavior, the intentions of others, and the desire to interact with them. Specific skills include recognizing the emotional message, defining it, and understanding emotional concepts according to the social context (Halberstadt, Denham, & Dunsmore, 2001). Consequently, by observing the emotional expressions of the human face, we receive information about a person's feelings, but also about the possible behavior that he will manifest or even about his thoughts, beliefs. (Frith, & Frith, 2012)

Research suggests the ability to understand emotionally is closely linked to ToM, as it strongly interacts with its function. In addition, the interaction of emotional comprehension with superior cognitive skills, inhibitory control, working memory, cognitive flexibility strongly influences the functioning of ToM. (Martins, Osorio, Verissimo, & Martins, 2016)

5.4. Executive skills

The executive function is the conscious, targeted control of thought and action, involving procedures of working memory, inhibitory control, cognitive flexibility. It develops mainly in the preschool period and is associated with ToM developmental changes. It is even reported that the interaction between the executive function and the ToM continues until adolescence (Carlson, Koenig, & Harms, 2013).

Several researchers point to that, there are two definite functional relationships between executive function and ToM. A few of them point out the need to acquire ToM to develop executive skills. In particular, the perception of a causal relationship between mental states and behavior, as a process of representation, enables children to control their thoughts and actions. While other theorists argue that the developed executive function enhances in children the observation and processing of the mental states of others, promoting the development of ToM (Devine, White, Ensor, & Hughes, 2016).

Researchers have found that in the preschool period, developed executive skills significantly enhance children's performance in tasks of false belief, contributing importantly to the development of the representational capacity of mental states (Sabbagh & Bowman, 2018).

5.5. Language ability

ToM seems to depend on the development of language skills mainly verbal, but also many metacognitive skills (Drigas, Kokkalia, & Oikonomou, 2021). Language ability is closely linked to its development, as long as one thinks that by removing ToM from the use of language, we would have a person who can create vocabulary, syntax, and semantic system, while the use and comprehension of language lacks factual interpretation, with additional shortcomings in deciphering the communicative intentions of the speaker (Baron-Cohen, 1999)

Longitudinal studies report the correlation of the language system in terms of pragmatics, semantics, syntax with the development of ToM. From infancy, the first attempts at communication are identified with the ability of joint attention, social reference, which contribute to the later production, understanding of the language, and consequently to the development of the language and the ToM. (Astington, & Dack, 2008).

Linguistic experience strengthens the ToM mechanism in the first years of a child's life, as it activates the initial development of this mental process and contributes to its improvement (Siegal & Varley, 2002).

The research findings indicate that just as children who are not exposed to an early language environment have language development difficulties, preschool children need to engage in oral communication about mental states to highlight the reasoning of ToM (Peterson, & Wellman, 2019).

The experience of conversing through social interactions gradually introduces the child to the beliefs of others, who have and provide information about the world, offering the ability to process, imagine the present and predict the future (Siegal & Varley, 2002). In addition, the information that children derive from their oral communication is often more comprehensible and comprehensive compared to the knowledge which they acquire only from the behavior, the look, and the gestures of others. (de Villiers & de Villiers, 2014)

5.6. Genetic –Biological -Cultural influences

According to research, the performance of ToM is influenced by genetic and environmental factors. Indicatively, we mention the early conversation environments that facilitate the development explicit of representational understanding of the mind, but also cases of children with sensory impairments, neurodevelopmental disorders where they present deficits in the function of ToM (Hughes, & Devine, 2015a).

Warrier & Baron-Cohen (2018) found out in their research that genetic variants that affect the cognitive mechanism and cognitive empathy significantly affect the performance of adolescents with typical development, and those with psychiatric disorders in the performance of ToM tasks.

Research shows that dopamine and serotonin, which are referred to as the dopaminergic-serotonergic system, affect the function of ToM. ToM dysfunctions have been observed to result from the DS system, deficit-related disorders such as autism and schizophrenia. After that, any damage to this system may affect the correct prediction of the mental states of others, the development of social knowledge, and the quality of social interactions. (Abu-Akel, & Shamay-Tsoory, 2011).

In general, the function of neurotransmitters, in combination with the proper nutrition of the body, the reduction of environmental toxicity strengthens the immune system, intelligence, cognitive abilities, improving the behavior of the individual in his social interactions, strengthening aspects of ToM and process and consequently their consciousness (Drigas, & Mitsea, 2020).

In addition, cultural differences appear to influence the development of ToM, as several studies have identified discrepancies regarding the rate at which children from different cultures acquire the ability to ToM. The influences exerted by the respective cultural environment variables such as the observance and perception of social rules, the mother-child relationship in early childhood, the family relationships of family members. (Hughes, & Devine, 2015a).

The differences that have been identified between cultures affect the understanding of other people's behaviors, as cultural influence often affects certain aspects of the brain, suggesting the possible dependence of some neural networks on each culture. (Frank, & Temple, 2009).

5.7. The role of ICTs

It is noteworthy that in recent decades, the application of Information Communication Technologies (ICTs) in both the assessment and intervention of people with special educational needs works effectively in their daily lives, bridging potential gaps caused by their cognitive and social disabilities. Specifically, it provides opportunities for improvement in

communication, interaction, development of social and cognitive skills (Drigas, & Ioannidou, 2013). An indicative reference is many online applications that support the assessment & improvement of problem-solving skills (Karyotaki, & Drigas, 2016). Also, video games affect positively the memory and attention of students and people of all ages and improve as a result the mental abilities (Kefalis, Kontostavrou, & Drigas, 2020) (Papanastasiou et All 2017). The whiteboards applications can support procedures for Attention assessment (Drigas, Papanastasiou 2014, 2014). Quite promising is the use of STEM online education that can support and enhance students' mental abilities and flexibility (Kefalis, & Drigas, 2019). Artificial Intelligence is also a powerful tool (Drigas, & Ioannidou, 2011) (Drigas & Vrettaras) (80,82,90).

The access to technological means and their safe use allows to some extent, the reduction of social and cultural inequalities, creating an independent learning environment that enhances the social inclusion of all individuals (Drigas, & Karyotaki, 2014; Drigas, & Ioannidou, 2013, Drigas, A., Vrettaras, J. and Kouremenos, D. 2004).

As mentioned above, people with autism lack emotional intelligence skills, resulting in difficulties in understanding themselves and other people in terms of their emotions, empathy, and thoughts. This undoubtedly affects the evolution of ToM, their social interactions, and their interpersonal relationships (Papoutsis, Drigas, & Skianis, 2018). Nonetheless, therapeutic approaches through ICTs are effective in regulating attention, behavior, recognizing and expressing emotions, but also in developing social skills (Bakola, Rizos, & Drigas, 2019).

In particular, the use of mobile learning technologies attracts the interest of children and teachers due to their flexible capabilities in play. It is also significant that mobile learning devices through digital simulations, facilitate interactivity by promoting cognitive and affective processes (Karabatzaki, Stathopoulou, Kokkalia, Dimitriou, Loukeri, Economou, & Drigas, 2018). (Kokkalia & Drigas, 2016)

Mobile learning is perhaps the next generation of e-learning, as it enables the learner, like all wireless portable technologies, to choose the learning space (Kontostavrou, & Drigas, 2019). The usage of mobile apps appropriately designed can improve the mental operations of children with autism as well as general school students (Drigas, & Angelidakis, 2017). In particular, mobile devices can help children, especially those with autism, recognize and express basic emotions and then understand more complex emotions and at the same time the way of thinking of others by promoting their social interaction and ToM (Papoutsis, Drigas, & Skianis, 2018).

In addition, we highlight the use of robotics as a highly effective and engaging method for improving communication, social skills, and certain aspects of ToM, both in children with autism and in children without standard deviations. Indicatively we mention socially assistive robotics, a field of robotic technology that developed in recent years. (Syriopoulou-Delli, & Gkiolnta, 2020). Social robots as a form of artificial intelligence reduce the complex and unpredictable nature of verbal and non-verbal communication, enhance social interaction through play, encourage the expression of emotions and behaviors that are not easily manifested, contributing to the general development of children (Bakola, & Drigas, 2020; Syriopoulou-Delli, & Gkiolnta, 2020) (Mitsea et All 2020). Furthermore, educational robotics can improve the mental and metacognitive abilities of children with autism (Ntaountaki, Lorentzou, Lykothanasi, Anagnostopoulou, Alexandropoulou, & Drigas, 2019).

6. Conclusions

The present study aimed to provide a brief description of the evolutionary course of TOM and the key factors that affect its function. The main findings of the literature review are listed below.

Man's success in his daily life on a personal, social, professional, level but also his survival, in general, is related in large part to his ability to predict, to interpret the desires, thoughts, feelings of other people (Gershman, Gerstenberg, Baker, & Cushman, 2016).

The understanding of the operation of the ToM system results from the contribution of all the basic theoretical approaches because one complements the other, and all of them promote the efficient interpretation of the ToM mental system. (Flavell, 1999)

The research findings reinforce the view that the benefits of speech and language development are vital for understanding children's mental state and for recognizing the representational nature of beliefs (Hughes, & Devine, 2015a).

According to Drigas, Kokkalia, and Oikonomou, 2021 children gradually realize their emotions, develop thoughts, observing their mental states. First, they understand stimuli and collect data through their senses. They then store some of the data in their memory for future use. So that they can predict, interpret actions, behaviors, attribute to themselves and other mental states, promoting the development of ToM

The acquisition of explicit ToM skills at the age of 4-6 years of the child, marks a milestone in his social development because it introduces new skills that help him effectively navigate the complex social world (Teglasi, Caputo, & Scott, 2022).

Gradually, as the child grows older, he realizes himself and utilizing his potential, develops his ability to reflect on the perspectives of others and to discern reliable sources of information. It then evaluates the knowledge he acquires and his cognitive capacities with the contribution of metacognitive function (Hughes, & Devine, 2015a).

The evolution of ToM is a predictor of children's interplay, the development of social, cognitive, and metacognitive learning strategies (Wellman, 2018).

Executive skills and language skills are probably the links between children's social experiences and their differences in ToM. Studies show the existence of an interaction between language, executive function, and ToM. Specifically, language skills enrich the functioning of the executive system, which in turn promotes the evolution of TOM. This finding is consistent with Vygotsky's theory, which predicted that language ability allows children to develop higher cognitive skills related to controlling thought and action (Hughes, & Devine, 2015a).

Mindfulness is a higher-level cognitive function, is directly related to higher known skills, and can be used as a means of improving ToM, emotional and cognitive abilities, providing positive results in the development of interpersonal and social relationships (Drigas, & Karyotaki, 2018).

An important role is played by the environmental influence in the development of ToM skills, such as the quality of early family interactions, socializing with peers, exposing children to a stimulus-language environment, and the intercultural contrasts observed in its development. In addition, genetic factors influence the creation of social experiences that are necessary for the formation of ToM (Hughes, & Devine, 2015b).

While ToM is evolving worldwide following parallel development paths, social, cultural, and linguistic factors cause different timelines in its evolution (Liu, Wellman, Tardif, & Sabbagh, 2008).

Several studies signal that an improvement in ToM abilities is achieved at any age even in adulthood, as long as individuals have the appropriate experiences that stimulate and enhance

their functioning, such as quality social interactions and the mutual exchange of rich language inputs (Meinhardt-Injac, Daum, & Meinhardt, 2020).

In addition, the integration of ICTs in a learning environment [100-112], which promotes interactivity and self-directed learning, contributes to the development of cognitive and metacognitive skills such as attention, concentration, memory, self-regulation, creativity, flexibility, critical logic, communication, skills necessary for the development and strengthening of ToM (Drigas, & Karyotaki, 2014).

Summarizing 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. Its effective operation requires the cooperation and harmonious involvement of social and cognitive skills, especially the executive ones, the cultivation of which strengthens its performance on a cognitive and metacognitive level. The evolutionary course of ToM is mainly affected by the combination of social experiences, genetic, biological, and environmental factors, the influence of which is involved in the strengthening of the linguistic and executive process. Supplementary, the integration of ICTs both in the educational process and daily life of the individual enriches and dynamically supports the course of ToM as well as his social-emotional, cognitive, and metacognitive development. In conclusion, the study of ToM has occupied the research community for many years, due to the fundamental importance it plays a part in the social adjustment and integration of the individual. Despite this, ToM can be considered the "harbinger" of Metacognition, and therefore, future studies must examine the interaction between them.

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