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Theory of Mind Abilities and Deficits in Autism Spectrum Disorders

Yael Kimhi

Autism spectrum disorder (ASD) is a neurobiological disorder that significantly impairs children's social interaction, verbal and nonverbal communication, and behaviors. Questions about theory of mind (ToM) deficits in ASD have generated a large number of empirical studies. This article reviews current studies of the relationship between ToM and ASD, including contributions to the understanding of social and academic manifestations of ASD. Several themes emerge: Enhanced language and verbal abilities facilitate better ToM understanding; implicit ToM elements that incorporate parallel processing pose more difficulties than explicit ones; and general and multimodal interventions are more effective than specific interventions. A brief overview is followed by a review of emerging research on the role of domain-general cognitive skills (executive function) and central coherence in the development of ToM. Next, a summary of studies addressing ToM across the development and social and academic manifestations is presented. The article ends with a critical review of ToM intervention studies, which suggests that generalization may be more likely to occur when ToM is targeted as part of broader sociocognitive interventions rather than as an isolated skill. **Key words:** *ASD*, *executive function*, *intervention*, *social cognition*, *theory of mind*

AUTISM SPECTRUM DISORDER (ASD) is a neurodevelopmental condition defined by impairments in social communication skills and behavior or interests relative to the child's age and mental age (American Psychiatric Association [APA], 2013). It often presents with comorbid intellectual disability and is associated with deficits across several domains such as language (Howlin, 2003), social cognition (Baron-Cohen, Leslie, & Frith, 1985), executive function (Hill, 2004), and weak central coherence (Frith, 1989). The heterogeneity found among children with ASD may be explained by the presence of coexisting cognitive difficulties in the areas of executive function, weak central coherence, and theory of mind (ToM; Pellicano, 2013). *Executive function* is an umbrella term for cognitive processes that include working memory, inhibition, planning, and shifting. *Weak central coherence* is a term that refers to a specific cognitive style that encompasses a limited ability to understand wider contexts. According to social-cognition theory, many of the social-interpersonal and academic difficulties seen in ASD derive to some extent from weaknesses in these children's ToM. Briefly, *ToM* refers to children's ability to represent and understand others' mental states, such as goals, emotions, and beliefs (Baumingar-Zviely, 2013b).

To date, the majority of ToM-related studies have shown that individuals with ASD display deficits in ToM. That is, individuals with ASD, for the most part, perform significantly lower on tasks designed to measure ToM than individuals with typical development (Mathersul, McDonald, & Rushby, 2013;

Author Affiliations: *School of Education, Bar-Ilan University, Ramat-Gan, Israel; and Levinsky College of Education, Tel Aviv-Yafo, Israel.*

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Corresponding Author: *Yael Kimhi, PhD, School of Education, Bar-Ilan University, Ramat-Gan 52900, Israel (yael.kimhi@biu.ac.il).*

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Peterson, Wellman, & Slaughter, 2012). These deficits appear on various ToM tasks, including tasks examining false beliefs (e.g., Baron-Cohen et al., 1985), faux pas (Baron-Cohen, O'Riordan, Stone, Jones, & Plaisted, 1999), cartoon animations (Castelli, Frith, Happé, & Frith, 2002), or inference of mental states from photographs (Baron-Cohen, Jolliife, Mortimore, & Robertson, 1997). Other research has shown that the ability to succeed in such ToM tasks varies with age, IQ, and the nature of the task (Begeer, Malle, Nieuwland, & Keysar, 2010).

This article aims to provide a summary of current research concerning ToM abilities and deficits in ASD, with reference to two groups. The first is cognitively able high-functioning individuals with ASD (HF-ASD), defined operationally as having IQ of 70 and above; the second is less cognitively able individuals with ASD, defined operationally as having IQ below 70. When referring to both groups in this article, I use ASD/HF-ASD. The review includes a discussion of ToM development across the life span and focuses on the social and academic manifestations of ToM that lie at the heart of everyday life skills. Finally, various ToM interventions are presented, highlighting best practices supported by current research.

This review focuses on two levels of ToM abilities and tasks—the first explicit and formal, the second implicit. In explicit tasks, clear directions are given, as opposed to implicit tasks, in which spontaneous ToM behavior is measured. The implicit level is associated with poor social interactions (Hughes & Leekam, 2004). It is the implicit level that appears to be more problematic in ASD/HF-ASD (Frith, 2012). Current research supports the hypothesis that explicit and implicit ToM systems may indeed be separate systems (Schneider, Slaughter, Bayliss, & Dux, 2013; Senju, Southgate, White, & Frith, 2009). It may be that the explicit level relies on sequential processing (the ability to take in, store, and process information in an orderly way), whereas the implicit level requires parallel processing (the ability to process multiple items concurrently)—an ability that tends to be deficient in many people with ASD/HF-ASD.

ABILITIES UNDERLYING ToM SKILLS

Various mechanisms underlie ToM abilities. The following section discusses the relations between language, executive functioning, central coherence, and ToM.

Language

Individuals with ASD/HF-ASD who have better language skills are more likely to pass false-belief tests. Many studies have found causal relations between language and ToM, both in typical development (e.g., Astington & Jenkins, 1999) and in ASD/HF-ASD (Steele, Joseph, & Tager-Flusberg, 2003). Verbally able individuals with HF-ASD often can pass false-belief tasks; yet, even then the majority fail when expected to act spontaneously according to that knowledge (Senju, 2012). Needless to say, the majority of tasks used to evaluate ToM abilities rely on language abilities and comprehension. Better language abilities among some children with ASD (and especially HF-ASD) give those children an advantage in their ability to pass the tasks, often by "hacking out" the solutions (Hughes & Leekam, 2004). Moreover, research findings have shown that syntax competence facilitates, at least to some extent, false-belief task performance in ASD/HF-ASD (Lind & Bowler, 2009), leading to the assumption that children who do well in ToM tasks may be using compensatory linguistic strategies. According to Tager-Flusberg (2007), the understanding of the syntax and semantics of verbs (e.g., "Sarah *said* that Dan was eating") may enable the analogy of mental states to the content of speech. In addition, spontaneous conversations between a mother and her child that include frequently mentioned mental states seem to increase ToM task success in children with ASD/HF-ASD (Slaughter, Peterson, & Mackintosh, 2007). It may be that the discussion of a greater variety of situations and conditions may be more beneficial in helping

inherently implicit situations become explicit to children. Although linguistic ability may advance success on ToM tasks, this does not necessarily translate into improved performance in real life. The social aspects of pragmatic conversational skills and ToM are discussed in the section on the social manifestation of ToM.

Executive functions and central coherence

In the past few years, a growing body of research has focused on abilities other than language that underlie ToM capabilities. These findings underscore the cognitive facets of ToM abilities. Studies have shown causal relations between executive function and ToM in typical development (Carlson, Moses, & Claxton, 2004; Hughes & Ensor, 2007) and also in ASD/HF-ASD (Kimhi, Kugelmas, Agam Ben Artzi, Ben Moshe, & Bauminger-Zviely, 2014; Pellicano, 2010). False-belief ToM tasks require shifting from one's own perspective to another's; therefore, it is unsurprising that children with ASD/HF-ASD, who have difficulties in executive function and cognitive shifting (i.e., the mental ability to switch between two stimuli), also show difficulty in predicting false beliefs. In a study conducted by Kimhi et al. (2014), cognitive shifting predicted preschoolers' capacity to shift between their own belief and the presented false belief, while both predicting and explaining it. According to Pellicano (2013), executive function plays a critical role in the emergence of ToM. In a study of preschoolers with ASD/HF-ASD that Pellicano (2010) conducted over a 3-year period, early executive function and central coherence skills predicted developmental changes in ToM skills, independent of age, language, nonverbal intelligence, and earlier ToM skills.

ToM ACROSS THE LIFE SPAN: FROM EARLY CHILDHOOD TO ADULTHOOD

Important questions arise concerning developmental aspects of ToM among individuals with ASD/HF-ASD. One important question is, given their lag in ToM development, can they ultimately reach the higher, more complex levels of ToM? Does it simply take them a longer time to complete the same trajectory as individuals with typical development, thereby eventually developing both basic and complex ToM abilities, albeit more slowly?

This section of the article highlights the ToM abilities and deficits of individuals with ASD/HF-ASD compared with peers with typical development, following life span stages from preschool through adulthood. Generally, it seems that these individuals are not devoid of ToM abilities, especially at the explicit level; instead, their abilities appear to diverge from the normative trajectory and show great variability. Because some studies reviewed in this section did not separate participants by age, the subsection boundaries are not always as clear-cut as the subheadings imply.

Preschoolers

Wellman and Liu (2004) proposed a sequential model of ToM developmental stages in typically developing preschool-age children as follows: 1) diverse desires: the understanding that two persons can have different desires about the same object; 2) diverse beliefs: the understanding that two persons can have different beliefs about the same object; 3) perceptual access to knowledge: not seeing leads to not knowing where an object is hidden; 4) false belief (of location): the standard misleading container task; and 5) hidden emotion: the understanding that one can feel a different emotion than the one displayed. These progressive stages depict how simpler ToM concepts emerge and form the basis for the later and more sophisticated concepts.

Two follow-up studies with clinical samples showed that children with ASD/HF-ASD developed the first three stages in a similar, albeit delayed, fashion to typically developing and deaf children but the last two stages were reversed in sequence. This was interpreted as showing that false-belief understanding is apparently more difficult than hidden emotion understanding for the ASD/HF-ASD group

(Peterson et al., 2012; Peterson, Wellman, & Liu, 2005).

The studies that examined explicit ToM abilities in preschoolers with ASD/HF-ASD found that their performance on false-belief tasks was significantly lower than that of control groups. This was the case, whether in comparison with preschoolers with typical development (Kimhi et al., 2014) or with preschoolers with specific language impairment (Colle, Baron-Cohen, & Hill, 2007). Nonetheless, preschoolers with HF-ASD showed significant changes in ToM abilities over the preschool years, marking a similar trajectory to that of children with typical development. For example, Steele et al. (2003) found that 57 preschool- and school-age children (aged 4–14 years) with ASD or with HF-ASD (i.e., low- or high-functioning children) showed significant improvement in their ToM abilities between two time intervals 1 year apart, developing mental state concepts between the two times.

Elementary school-age children

In comparison with elementary school-age children with typical development or intellectual disabilities (chronological age [CA] = 10.50; verbal IQ = 75), matched for age and verbal ability, children with ASD/HF-ASD (CA = 10.42; verbal IQ = 75.23) perform significantly lower on ToM tasks in general, even on the basic explicit tasks designed to assess false beliefs concerning location (Lind & Bowler, 2010), parallel to Wellman and Liu's (2004) fourth stage. According to Frith's (2012) meta-analysis, the average age for passing the Sally and Anne false-belief test reveals an approximate 5-year delay for children with ASD compared with children who are neurotypical (i.e., children with ASD pass the test at the age of 9 years rather than at the age of 4 years, on average). Furthermore, elementary school children with ASD demonstrate impairment on advanced, second-order, explicit ToM tasks that examine the ability to recognize facial emotional expressions (e.g., the Eyes Test by Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001) and internal mental states (e.g., the Strange Stories task by Happé, 1994). Despite the impairments illustrated in some studies, a recent study showed conflicting results. The study (Scheeren, de Rosnay, Koot, & Begeer, 2013) examined second-order false beliefs, emotional display rule understanding, double bluff, faux pas, and sarcasm within a large sample ($N = 194$) of children ($N = 59$; CA = 10.2) and adolescents ($N = 135$; CA = 15.3) with HF-ASD and revealed intact advanced ToM abilities for both age groups, even after controlling for age. Scheeren et al. (2003) found that the adolescents in both study groups (typical development and HF-ASD) performed consistently better than the younger children, irrespective of group status. According to the authors, both verbal abilities and general reasoning capacity appeared to facilitate better advanced ToM understanding in HF-ASD.

Adolescents and adults

By adolescence, individuals with ASD, and particularly those with HF-ASD, often pass explicit conceptual ToM tasks at various levels of complexity; yet, their performance on such tasks does not predict age-appropriate social behavior in everyday settings (Begeer et al., 2010). Studies that have examined the spontaneous use of ToM have found that adults with HF-ASD do not spontaneously anticipate another person's actions, even when those adults have passed explicit false-belief tasks with ease (Senju, 2012; Senju et al., 2009).

As Baron-Cohen (2001) summarized, studies that have examined ToM abilities in adolescents and adults with HF-ASD have shown, for the most part, that they can pass explicit first-order ToM tasks, make simple ToM judgments, and sometimes can even pass explicit second-order false-belief tasks that involve embedded mental states, such as what X thinks that Y thinks. In other words, some older individuals with HF-ASD apparently possess ToM skills that resemble those of typically developing adolescents and adults (Roeyers & Demurie, 2010). Nonetheless, various studies have yielded mixed results concerning the higher order ToM abilities of adolescents

and adults with HF-ASD. One reason for the discrepancies in the findings may be the nature of the tasks themselves because some were explicit, static, unimodal tasks, whereas others were implicit, multimodal, dynamic, ecological tasks. The artificial nature of many of the static tasks does not permit them truly to address a deficit with an implicit component. Thus participants may demonstrate success in the static tasks but without that success carrying over to the dynamic situations of real life. Multimodal, dynamic, ecological tasks aim to draw a closer parallel to real-life situations (Mathersul et al., 2013).

Schneider et al. (2013) examined explicit versus implicit ToM processing in adults with HF-ASD compared with age-matched controls with typical development. During the implicit task, the participants were expected to anticipate spontaneously the action of an actor, which was examined via an eye tracking device. No differences were found on the explicit ToM measures, as opposed to sustained group differences for the implicit measures. Furthermore, spontaneous implicit learning did not occur in the ASD group. Using the Awareness of Social Inference Test, which is an authentic ecological assessment that examines audiovisual representations of social interactions, Mathersul et al. (2013) found that adults with HF-ASD revealed an impaired understanding of nonliteral expressions such as sarcasm and deception, which require advanced ToM to know that someone might say something opposite to what they intend (sarcasm) or believe (lie).

Contrary to these results, an earlier study that used a dynamic perspective-taking task (Begeer et al., 2010) showed that adolescents and adults with HF-ASD were identical to those with typical development in their ability to take another person's knowledge into account when interpreting what she or he said during a structured social interaction. According to the authors, these results demonstrate that in real-life situations, especially when they are structured, some individuals with HF-ASD can use ToM appropriately. A recent study that also used a dynamic task to examine the perspective-taking abilities of adults with HF-ASD, in comparison with those with typical development, found no significant difference between the groups, indicating the capability for psychological perspective-taking ability in individuals with HF-ASD (Au-Yeung, Kaakinen, & Benson, 2014).

Perspective taking is considered to be complex because it requires maintaining knowledge about what other people would be interested in and making use of relevant social cues to infer their mental states. On the contrary, it appears to be a different kind of complexity, because it does not require spontaneous anticipation as was required in Schneider et al.'s (2013) study or when recognizing sarcasm and lying as in Mathersul et al.'s (2013) study.

Taken altogether, research thus far has yielded mixed results as to the degree of impairment in ToM capabilities, especially within HF-ASD. In ASD, the impairment is apparently more severe. These results suggest that cognitively able individuals with HF-ASD have varying difficulties in ToM, which may become mitigated over time. That is, life experience may help some of the individuals with HF-ASD make up for the seemingly innate disabilities. In line with these findings, the next sections discuss the social and academic manifestations of ToM.

ToM SOCIAL MANIFESTATIONS

In real-life social situations, one is expected to grasp intuitively what is transpiring and how to respond spontaneously to various events. While applying ToM capabilities spontaneously, rapid "online" social information has to be processed, facilitating engagement in appropriate social activities. Constantly changing social and emotional cues demand immediate, parallel data processing. Therefore, the absence of spontaneous ToM results for the most part in social communication deficits, as often seen in individuals with ASD/HF-ASD (Loth, Gomez, & Happé, 2008; Senju, 2012). Components of ToM are interrelated, creating notions that

are combined in explanations, predictions, and justifications of behavior. Individuals with ASD/HF-ASD demonstrate difficulties in most areas necessary for appropriate social functioning (Bauminger-Zviely, 2013b) and often tend to show diminished attention to social cues (Klin, Jones, Schultz, Volkmar, & Cohen, 2002). Even when their verbal and intellectual levels are high, their social adaptive behavior is found to be lagging (Klin et al., 2007). The next section presents a review of research that investigated the relations between ToM and various social skills. It is important to note that only some social skills have been examined in relation to ToM in ASD/HF-ASD.

Symbolic play and ToM

At preschool ages, one social manifestation of ToM is symbolic play. Symbolic play is relevant because it requires children to decouple the primary representation of an object from its pretend representation (e.g., a banana cannot be a banana if one pretends it is a telephone) (Leslie, 1987). Children with ASD exhibit such marked impairments in symbolic and pretend play that these deficits were part of the diagnostic criteria for autistic disorder in the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (APA, 1994). Lam and Yueng (2011) also found that the symbolic play of a small sample of preschoolers with HF-ASD was limited compared with typically developing preschoolers and that their difficulties in mentalizing others' perspectives were at the root of their difficulties in symbolic play. One explanation is that the parallel processing necessary for symbolic play is lacking, at least at this age.

Pragmatic conversational skills and ToM

Another important aspect of social development is the ability to communicate with one's peers. Pragmatic functioning (i.e., the ways in which context contributes to meaning) is crucial in facilitating appropriate communication skills. The question is still being investigated as to whether the levels of ToM understanding that individuals with ASD/HF-ASD display on ToM tasks bear a significant relationship with their social and conversational behaviors in spontaneous everyday life. Following mixed findings concerning the relations between false-belief tests and measures of adaptive social skills using the Vineland Adaptive Behavior Scales (Sparrow, Balla, & Cicchetti, 1984), Peterson, Garnett, Kelly, and Attwood (2009) developed and validated a new caregiver report measure—the Everyday Mindreading Skills and Difficulties scale. This scale examines pragmatic social and conversational difficulties that, in theory, require a ToM-based understanding of false beliefs. The authors explored the connections between ToM tasks and everyday behavior in children with ASD/HF-ASD and found that children who passed the false-belief tasks exhibited fewer everyday social and conversational difficulties than those who failed. Furthermore, correlations showed that children's scores on standard false-belief tests were significantly linked to their everyday ToM skills, showing that children who received higher scores on ToM tasks displayed better everyday ToM abilities. Nevertheless, it is important to note that the authors found that even those children with ASD/HF-ASD who passed the ToM tasks still had poorer everyday skills than children with typical development who did not pass the ToM tasks. These results led to the conclusion that ToM success in the laboratory is insufficient to guarantee competent social and conversational interaction for a child with ASD/HF-ASD (Peterson et al., 2009).

Deficits in pragmatics are evident throughout the autism spectrum (Hale & Tager-Flusberg, 2005). Furthermore, ToM deficits intensify individuals' difficulties in taking into account the listener's perspective, thereby interfering with the ability to engage meaningfully in conversations. Children on the autism spectrum, therefore, demonstrate reciprocal social discourse of a lower quality than children with typical development. Hale and Tager-Flusberg (2005) conducted a longitudinal study that examined concurrent and predictive relationships between ToM and discourse skills in 57 children with HF-ASD (aged 4 years 0 month to 13 years

11 months). They found that the children made significant gains over time in their ability to maintain a topic of discourse and that ToM contributed unique variance in discourse skills beyond the significant contribution made by language skills. According to the authors, their findings indicate a dynamic interaction between social cognition—as manifested by ToM abilities—and social communication among children with HF-ASD.

Deception and ToM

A further important sociocognitive milestone is the ability to deceive and lie actively, as distinct from the ability to recognize lies (as discussed in the earlier section on adolescents and adults). What happens in ASD regarding the ability to generate lies? When one deceives or lies, one intentionally instills a false belief in the other's mind and therefore the ability to lie is considered an important manifestation of ToM (Li, Kelley, Evans, & Lee, 2011). Studies that have examined deception in the context of competition found that children with HF-ASD indeed show difficulties in deceiving. Nonetheless, in a study that examined school-age children's ability to tell a lie of their own volition (Li et al., 2011), children with ASD/HF-ASD were able to tell both antisocial and white lies of their own choice. They told an antisocial lie to conceal their misdeed (e.g., peeking at a gift) and also told a white lie (e.g., saying they liked their prize, even though they did not). However, when investigating the correlations between false-belief tasks and deception, the researchers found that both antisocial and white lies told by children with HF-ASD seemed to reflect scripted knowledge based on past experiences rather than fluid ToM abilities. Interestingly, although the children could generate lies, they had difficulty maintaining those lies.

Similar findings were found in a later study (Talwar et al., 2012) that scrutinized the lie-telling behavior of children with HF-ASD (average CA = 8.9) in comparison with children with typical development. Most children lied to cover a misdeed, such as peeking at a hidden toy and denying their transgression; yet, they showed difficulty in effectively concealing and maintaining the lie when asked follow-up questions. It may be that lying to cover a misdeed has an explicit nature, whereas concealing the deed in follow-up questions may be more implicit, as children do not grasp that these questions may, in fact, lead to discovery of their transgression. It is important to stress that the groups were not matched on chronological age and that the children with typical development were younger than the children with HF-ASD. Therefore, the authors emphasized that the ability to conceal false denials and misdeeds is observed in the preschool years in typical development but may develop later for children with HF-ASD. Correlations between ToM tasks and lying were not examined in this study, but children who told lies had higher first-order ToM task belief scores than those who did not, suggesting that the development of lying may be related to ToM ability (Talwar et al., 2012).

Autobiographical memories and ToM

Autobiographical memories, which include individual memories of single events, contribute to the psychological and social functioning of the individual. Recent studies have indicated that, during the process of understanding the other's mental state to understand social events, one relies on autobiographical memories (Adler, Nadler, & Eviatar, 2010). Studies have shown that individuals with HF-ASD generate fewer autobiographical memories than individuals with typical development and that ToM is related to autobiographical memory difficulties in HF-ASD (Adler et al., 2010; Crane, Goddard, & Pring, 2011). A possible explanation is that both call for parallel processing that includes the capacity to be aware of, and mentally represent, experiences from one's past into one's future concurrently. These findings underscore previous conclusions that individuals with HF-ASD have difficulties understanding both others' and their own minds (Rajendran & Mitchell, 2007).

Event schemas and ToM

Loth et al. (2008) examined the relation between ToM and event schema knowledge (generalized knowledge of what happens at common real-life events) in adolescents with HF-ASD. They found that adolescents who failed ToM tasks showed profound impairments in describing common events in a generalized manner whereas those who passed the tasks could generate event schemas, even though their descriptions and explanations were unusually concrete and rigid, impacting their problematic understanding of various aspects of social experiences.

To sum up these findings, better ToM abilities in individuals with ASD and HF-ASD lead, for the most part, to better social skills. Still, the improved social skills do not match the social skills of individuals with typical development, even when they are of the same chronological age and cognitive developmental level. As expected, social skills that demand parallel processing are more challenging in ASD/HF-ASD than those that demand only serial processing.

ToM ACADEMIC MANIFESTATIONS

In the past decade, a growing body of research has developed concerning the academic abilities of individuals with ASD/HF-ASD. In contrast with the social-communication aspects, individuals with ASD/HF-ASD show academic strengths as well as academic weaknesses, although the former have received minimal attention from researchers. The following section is a review of recent studies that examined the relationships between academic abilities and ToM.

Reading comprehension and ToM

Characteristics related to the reader, the text, and the learning situation all influence reading comprehension (Jennings, Caldwell, & Lerner, 2006). Therefore, ToM capabilities have a direct influence on reading comprehension abilities, whether in academic or leisure settings. Understanding a character's intentions and desires, especially when they are based on emotional states, can be trying when the individual reading the text has weak ToM abilities (Carnahan, Williamson, & Christman, 2011). Yet, understanding and explaining why a character, imaginary or historical, behaves in a certain manner are critical components of literary comprehension (Bauminger-Zviely & Kimhi, 2013; Constable, Garrie, Moniz, & Ryan, 2013). The ability to make predictions based on others' perspectives also influences the ability to understand a narrative text. Thus, weak ToM may lead to inaccurate predictions and inferences (Carnahan et al., 2011). Indeed, research has shown that students with HF-ASD have difficulty making inferences and comprehending information that is not factual (Saldana & Frith, 2007).

Narrative and ToM

Reading and interpreting narratives has been found to be challenging for children with ASD/HF-ASD at all cognitive levels. When retelling a story from a wordless picture book (Capps, Losh, & Thurber, 2000), few quantitative differences were found between children with ASD and control groups with typical development and developmental delays on narrative measures such as length, structure, and complexity. Nonetheless, better ToM abilities were related to better narrative abilities only within the ASD group. According to the authors, this finding is indicative of two basic aspects of narrative within ASD. The first is that narrative, as a social activity, involves monitoring and maintaining the listener's attention throughout the story. The second is that narrative provides a means to explain a character's emotions, thoughts, and actions, which are associated with ToM.

In a later study, Diehl, Bennetto, and Young (2006) reported that children with HF-ASD were able to recall the gist of narratives but had difficulty organizing events coherently. Similar findings were found in an earlier study, in which Losh and Capps (2003) examined the narrative abilities of school-age children with HF-ASD in comparison with children with typical development in both personal

and storybook narratives. They found that the children with HF-ASD had difficulty producing thematically integrated and elaborated narratives, alongside limited use of causal language in both narrative types. Surprisingly, and contrary to previous studies, ToM was not associated with narrative ability, leading the authors to surmise that the relation between ToM and narrative varies throughout the spectrum. That is, it ranges from being related to narrative competence among less cognitively able children with ASD (as found in Capps et al.'s, 2000, study) to not being related to narrative competence among children with HF-ASD (Losh & Capps, 2003).

An important aspect that combines ToM and narrative abilities is the capacity to shift between the perspectives of two interacting characters in a given story. In a study that examined the role-taking abilities of children with HF-ASD, Garcia-Perez, Hobson, and Lee (2008) found that most of the children were able to make some adjustments in their narratives according to the alternative viewpoints of the story's characters and they used terms referring to the characters' mental states. Nonetheless, they had difficulty adjusting to the perspectives of the different characters within the narratives and also in shifting from one perspective to another. It is important to stress that some of the children showed higher role-taking abilities than those who seemed to produce stories without any sign of adjustments in the characters' perspective. Although complex, in role-playing, there is time, presumably, for the player to get to know the role. For some of the children, this may, in effect, change the nature of complexity from parallel to serial, making it easier to handle.

Writing abilities and ToM

Deficits in ToM also account for many difficulties seen in the writing abilities of individuals with ASD. The intent of written discourse is to lead the reader through the written text, an intent that often escapes individuals with ASD. Furthermore, the ability to write narrative genres, along with writing about fictitious characters' thoughts and feelings, is often lacking due to ToM deficits. Brown and Klein (2011) examined the relations between ToM and writing. They also compared written narrative and expository texts of adults with HF-ASD. The results showed that both text types were of poorer quality and had poorer text structure than those of typically developing peers. Theory of mind was positively related to the length of the text and the quality composite score in both text types, showing that individuals who had better ToM skills wrote higher quality texts on measures such as structure, context, quality, and global coherence. At the narrative text, the level of complexity and insightfulness of the internal worlds of their characters was most strongly linked with ToM, thus supporting the notion that poor social understanding indeed renders narrative writing a challenging task for students with HF-ASD.

In conclusion, although the academic skills in ASD/HF-ASD have been less explored in the literature than the social communication domain, individuals on the autism spectrum exhibit many specific difficulties, including those related to ToM abilities. It is interesting to note in passing that, to date, no studies have examined the relations between ToM abilities and mathematics or science, two strongly explicit areas with apparent strengths in ASD/HF-ASD. There is a need for increased research in the field of academics and ToM to develop best practices. The following section discusses the varying sociocognitive interventions for enhancing ToM skills.

ToM INTERVENTIONS

The most important issue in ToM training is the assessment of whether training generalizes to other tasks or, more importantly, to real life. Generally, findings have demonstrated that improvement in ToM skills following specific interventions does not appear to correspond with improved social capabilities (Hadwin, Baron-Cohen, Howlin, & Hill, 1996). As discussed in this section, ToM interventions can be categorized into two major groups—specific ToM sociocognitive training that focuses on improving specific ToM skills, and more general social skills interventions

that incorporate ToM training among other social skills. Methodological issues often influence study results. A randomized controlled trial (RCT) design, with a randomized control group or wait-listed control group, is considered to be the gold standard for examining the efficacy of interventions.

Specific interventions

Theory-of-mind-specific interventions are based on the teaching of internal, subjective mental representations of oneself and others (Begeer et al., 2011), which may include developing role-playing, picturing thought bubbles, and perspective taking (Gould, Tarbox, O'Hara, Noone, & Bergstrom, 2011; Paynter & Peterson, 2013). As noted previously, however, apparently, not all the skills learned during these interventions generalize to other ToM skills or settings. Results of an intervention study that taught a basic component skill of perspective taking to children with ASD via a behavioral intervention procedure showed that although the children mastered the skill, generalization to the natural environment was limited (Gould et al., 2011).

Studies that have examined thought bubble training demonstrated mixed results. Wellman et al. (2002) showed modest success on the trained ToM tasks; yet, again, evidence for generalization to new ToM concepts was limited. A later study (Paynter & Peterson, 2013), which included a nonintervention control group of children with HF-ASD who were matched with the trained children at pretest, showed that the children with HF-ASD who had undergone training made significant gains that also generalized beyond explicit false belief (of changed location) to other ToM concepts. These gains were maintained after the intervention period ended. The authors' conclusion was that thought bubble training can facilitate and advance success on ToM abilities in children with HF-ASD. However, they could not infer that this strategy taught ToM understanding that was similar to ToM understanding of the students' typically developing peers.

Fisher and Happé (2005) taught a ToM strategy ("picture in the head" based on Swettenham, 1996) to children with ASD of varying cognitive abilities who were randomized to the experimental condition. According to the authors, the participants were randomly allocated to the ToM training group, the executive function training group, or to a control group that received no intervention. The children who underwent training showed significant improvement in their ToM performance compared with the control group, and this improvement remained stable 6 and 12 weeks later. Still, according to their schoolteachers, the training did not affect their ToM abilities in daily life (Fisher & Happé, 2005).

General interventions

General interventions that incorporate ToM training among other social skills seem to be more likely to generalize to other settings. This is not always the case, however. Begeer et al. (2011) implemented an intervention using an RCT design that involved training the children with HF-ASD on conceptual understanding of ToM. The training targeted the ability to reason about beliefs and false beliefs, the understanding of mixed and complex emotions, emotion recognition, pretense-reality distinction, and second-order reasoning. Overall, the experimental group made significant gains in their ability to reason about beliefs and false beliefs, and about the understanding of mixed and complex emotions, in comparison with the control group. Nevertheless, according to parental reports, the training did not improve the children's social skills or their self-reported empathy.

Mackay, Knott, and Dunlop (2007) described a group intervention aimed at enhancing social interaction and understanding in children and adolescents with HF-ASD. This intervention focused on social understanding and ToM skills via group discussion, role-playing, and games. The training also integrated strategies aimed at improving generalization to real-life settings such as outings to community settings, home practice, and feedback meetings with parents. In this study, the participants demonstrated

significant gains in all measures following the intervention program. Enhanced social skills that generalized into other settings were reported both by parents and by participants. Another intervention included a group curriculum that combined various social skills, with an emphasis on learning through role-playing (Tse, Strulovitch, Tagalakis, Meng, & Fombonne, 2007). After 12 weeks of intervention, the parents reported that their adolescents with HF-ASD had generalized their social skills to settings outside the treatment sessions. Although both of these studies indicated that generalization of the new social skills did occur, it is important to note that neither study used a control group and no objective observations, such as teacher views or direct observation of interactions with peers, were implemented.

Another intervention study conducted with adolescents and adults with HF-ASD targeted the development of social skills, including specific ToM skills such as analyzing how one's behaviors influence the opinions of others, as well as vocational skills (Hillier, Fish, Cloppert, & Beversdorf, 2007). In this study, the participants showed significant improvement on pretest–posttests on the Empathy Quotient questionnaire (Baron-Cohen & Wheelwright, 2004). These results indicated that the participants showed an increased awareness concerning other peoples' thoughts and feelings, alongside an improved ability in perspective taking. This study did not have a control group; yet, direct observation of the participants, including a tally of responses throughout the intervention was recorded. More relevant comments were made toward the end of the program than at the beginning.

Multimodal interventions

More sophisticated interventions take a multimodal approach, combining social interaction training along with sociocognitive abilities. Such studies aim at augmenting more holistic social functioning for children with HF-ASD (Bauminger-Zviely, 2013a). In Bauminger's (2007) cognitive-behavioral-ecological (CBE) intervention, ToM skills are not taught directly as a separate skill, as they are considered to be core skills that cross all social topics, and therefore may be enhanced in all parts of the intervention. In an investigation of the CBE intervention, Bauminger (2007) found that the intervention facilitated sociocognitive processes in general (such as defining and recognizing emotions, solving social problems, revealing a better understanding of others) and also improved ToM skills. Here too, however, a major limitation was the lack of a control group.

In summary, specific ToM sociocognitive training has been found to enhance the targeted skills; yet, generalization to other skills and settings, for the most part, has been minimal. In contrast, general and multimodal interventions seem to improve ToM skills as well as enhance generalization and social skills, although some of the experimental designs in this research have been weak. In the specific, controlled situations, the children learned how to use certain tools (e.g., "pictures in the head"), but they learned this skill outside their real-life context. Generalization to real life requires that children engage in parallel processing, as children must recognize the situation, figure out the relevant "tool," and implement it. The advantage of working with general and multimodal interventions is that the participants with HF-ASD are supported to practice skills in general settings during the intervention itself, apparently overcoming the parallel processing complexity. Notwithstanding, it is important to adapt interventions individually to the social and cognitive levels of the individual.

SUMMARY

As this review illustrated, ToM deficits affect daily social and academic life in individuals with ASD/HF-ASD. Even though social-communication impairments cannot be explained exclusively on the basis of ToM impairments (Tager-Flusberg, 2007), ToM is a crucial factor in the sociocognitive development of children. Although out of

this review's scope, it is important to note that Baron-Cohen (2009) extended the ToM deficit hypothesis and suggested that the sociocommunicative deficits in ASD/HF-ASD derive from a delay in the development of the empathizing system (i.e., the ability to identify mental states in others and to produce appropriate emotional responses), whereas their intact abilities in systemizing (i.e., the ability to construct and analyze systems) may explain the nonsocial aspects of ASD, such as their repetitive behavior and narrow interests. Following Baron-Cohen's (2009) theory, the impaired empathizing capabilities may account for the reduced ToM abilities seen in individuals with ASD/HF-ASD.

The delayed empathizing system may in fact be analogous to the spontaneous, implicit ToM level, in which parallel processing is expected, as the individual needs to recognize and identify others' mental states, reacting simultaneously, generating appropriate social and emotional responses. At the same time, the systematizing system is not impaired, as also seen for the most part in explicit ToM tasks and behaviors that entail serial processing. Hence, there is relative success when examining explicit ToM abilities such as perspective taking and role-playing. More complex social and academic behaviors such as thematically integrated narratives, social interaction, recognizing sarcasm and lying, autobiographical memory, and so forth, rely on implicit ToM abilities that involve parallel processing and coincide with the delayed empathizing system. Further research regarding the systems responsible for explicit and implicit ToM processing is necessary, as is the need to tease out the relations between the two systems.

Throughout the reviewed studies, there appears to be a consistent theme of success in explicit testing, learning, and other controlled situations that does not always translate to improved skills in everyday life. This may well be due to the fact that the controlled situations eliminate the need for parallel processing and, consequently, do not resemble real-life situations. The key to success, especially for individuals with HF-ASD, may lie in developing generalized and multimodal interventions that incorporate training of the skills acquired in general settings.

A further issue that appears in this review is that of compensatory skills. The evidence regarding success on ToM tasks, as opposed to poor social or academic manifestation, raises questions regarding the use of compensatory skills. Verbal abilities and general reasoning facilitate better ToM understanding in HF-ASD. Yet, the contribution of IQ level, memory, executive function, and attention abilities, as well as the response to intervention, requires further research to understand the mechanisms by which they facilitate ToM abilities.

It is important to note that this review did not address all fields concerning ToM, such as brain networks, skill assessments, and ToM as a mediator in the association between language abilities and developmental outcomes in ASD. Numerous areas require further research. For example, there are calls for in-depth examination of developmental effects in ToM (e.g., Pellicano, 2013), longitudinal studies examining trajectories of developmental change in ToM abilities (e.g., Steele et al., 2003), and RCT examinations of multimodal interventions. It is hoped that these will warrant greater attention in the future, leading to improved clinical interventions.

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