



Mentalization, theory of mind and socioemotional development in middle childhood

Mentalization, ToM and socioemotional skills

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Accepted: 30 January 2025 / Published online: 11 February 2025
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Abstract

Theory of Mind (ToM) and Mentalization are essential domains involved in child socioemotional development. ToM is the ability to understand people's actions and interactions as guided by internal beliefs, emotions, desires, and intentions. In contrast, mentalization is a mental process involved in interpreting human behaviour in terms of mental states related to the self and others. ToM and mentalization constructs are frequently used interchangeably, although they play distinct roles in child development. The present study explores this issue, focusing on the mentalization and ToM interactive dynamics in relation to middle childhood socioemotional skills. Participants were 112 non-clinical children from 8 to 10 y.o. assessed with Child Reflective Functioning Scale (CRFS) on Child Attachment Interview, Reading the Mind in the Eyes test and the Roberts-2 Test. Results from network analysis revealed an association between ToM and Mentalization. Mentalization is positively connected with self-help abilities and age. ToM supports mentalization, while mentalization is related to developing a sense of self-agency involved in improving psychological resources and preventing mental health impairment.

Keywords Mentalization · Theory of mind · Middle childhood · Socio-emotional development · Roberts-2

Introduction

Theory of Mind (ToM) and mentalization have been identified by previous research as two key abilities in child psychological development. Theory of Mind is defined as the child's ability to attribute mental states to self and others and to understand the goals and intentions subserving people's actions and interactions (Premack & Woodruff, 1978;

Frith & Frith, 1999; Cassetta et al., 2018). ToM is a broad multidimensional concept that encompasses cognitive and affective abilities (Baron-Cohen & Wheelwright, 2004; Blijd-Hoogewys & van Geert, 2017; Ensink & Mayes, 2010; Hughes & Leekam, 2004; Kalbe et al., 2007; Wellman, 2018; Wellman & Liu, 2004). In particular, cognitive ToM is related to false-belief reasoning: the understanding of inner beliefs, the differentiation from the external world, and the identification of the role that beliefs play in people's behaviour (Flavell, 2004; Wellman et al., 2001). Affective ToM refers to the ability to recognize and attribute emotional states to self and others; this dimension is thus typically assessed through an emotion-understanding task (Shamay-Tsoory et al., 2006).

A large body of evidence has documented a significant increase of ToM during preschool ages, with children gradually developing emotional understanding, as well as false-belief and belief-desire reasoning (e.g., Bartsch & Wellman, 1995; Harris et al., 1989; Pons et al., 2004; de Rosnay et al., 2004; Wellman, 2012). More specifically, affective ToM emerges between 3 and 4 years of age (Cassetta et al., 2018;

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Wellman et al., 2001); only later, between the ages of 4 and 5, children usually develop false-belief understanding (Kim, 2015; Pons et al., 2004; Wellman, 2012). From 6 years, children can generally match the false beliefs, desires, and emotion recognition in understanding the behaviour of self and others (Bartsch & Wellman, 1995; Bradmetz & Schneider, 1999, 2004; Harris et al., 1989; Kim, 2015; de Rosnay et al., 2004; Ruffman & Keenan, 1996; Harari et al., 2010). Furthermore, regarding sex differences in performance on theory of mind tasks, studies reveal a female superiority (Baron-Cohen & Hammer, 1997; Baron-Cohen et al., 1997; Halpern, 1992).

Although ToM is considered a central domain in understanding child psychological development, some authors consider the construct of ToM and the false-belief model too narrow (e.g., Carpendale & Chandler, 1996). In particular, these views criticize the assumption that false beliefs capture the “interpretive” dimension of mental life in preschoolers (e.g., Gopnik & Meltzoff, 1993; Perner, 1991). Indeed, ToM does not consider the relational and affect-regulation aspects involved in behaviour and mental state understanding (Klin et al., 2000; Fonagy et al., 2007; Ensink & Mayes, 2010). Therefore, research in developmental psychology has started to focus on mentalizing processes (Morton & Frith, 1995; O’Connor & Hirsch, 1999).

Mentalization is a mental process involved in interpreting human behaviour in terms of intentional mental states, such as needs, desires, feelings, beliefs, goals, purposes, and reasons (Fonagy & Allison, 2013): it thus involves both self and interpersonal components. Mentalization covers different cognitive and affective skills, including emotional states understanding, attention and effortful control, and the capacity to interpret subjective states and to think explicitly about states of mind. This complex and multifaceted process allows the child to differentiate inner from external reality, as well as mental and emotional processes from interpersonal events (Fonagy et al., 2007).

From a wider point of view, people need a representational system for mental states; they also must select states of mind in relation to specific intentions, which in turn require attentional control skills (Fonagy et al., 2007). Related to mentalization is the ability to understand the self as a mental agent: this perspective evolves from infancy through childhood into the primary attachment relationships (Fonagy, 2003). In this context, the interaction with reflective and attuned caregivers’ mature minds promotes the baby’s experience as having his/her own mind or self. Indeed, the development of child mentalization is related to parental reflective functioning: a child’s subjective experience is matched with the caregiver’s contingent and marked affective reaction, allowing the child to develop second-order representations of his/

her own subjective experiences (Fonagy & Allison, 2014; Luyten et al., 2020).

Mentalization reaches its peak during middle childhood (Busch, 2011; Ensink & Mayes, 2010; Harter, 1999; Midgley & Vrouva, 2013; Wellman, 1990). From the sixth year of life, children translate memories of intentional activities and experiences into a coherent causal-temporal organisation, leading to the formation of an extended sense of self (Midgley & Vrouva, 2013; Povinelli & Eddy, 1995). In children aged 8–12 no difference was found between boys and girls: they showed similar abilities in talking about their close relationships, themselves and the situations which upset them (Ensink & Mayes, 2010).

Both ToM and mentalization are therefore involved in children’s socio-emotional development (Baurain & Nader-Grosbois, 2012; Mitchell, 2006). Both concepts facilitate understanding and interpreting the mental states of oneself and others, which is essential for effective interpersonal problem elaboration and conflict resolution (Wu et al., 2020; Saracho, 2013). Research indicates that children’s ToM and mentalization are crucial for understanding and regulating their emotions, particularly negative ones (Macheta et al., 2023). Moreover, ToM facilitates children’s understanding of social norms and expectations, which is crucial for self-regulation and adherence to boundaries (Saracho, 2013; Ensink & Mayes, 2010). At the same time, children who can mentalize others’ perspectives are better equipped to navigate social situations and adhere to established limits (Luyten & Fonagy, 2015; Ensink & Mayes, 2010).

Separately, pre-schoolers, through affective ToM, are able to discriminate expressions of emotions in facial, gestural and verbal display. They gain the emotional understanding that predicts emotions and behaviours according to situations (Hughes & Leekam, 2004; Ketelaars et al., 2010; Nader-Grosbois, 2011a, b; Perron & Gosselin, 2009; Scharfe, 2000; Slaughter et al., 2002). Moreover, they gradually become able to think about social problem-solving, which promotes a more effective interpersonal functioning in their relationships (Dodge et al., 2002).

Mentalization seems to involve broader domains such as simulation/projection views of social cognition, conscious/unconscious imagination of self and others’ mental states, trustworthiness in others, self-reflection skills to guide inferences on others’ mental states (Mitchell, 2005). From a clinical perspective, mentalizing difficulties play a wide role in child and adolescent psychopathology (Sharp & Venta, 2013). For instance, in child depression, the clinical scenario is characterized by negative self-schemas (Zupan et al., 1987), selective attention on negative stimuli (Hammen & Zupan, 1984), maladaptive attributional style (Muris et al., 2001; Voelz et al., 2003), rumination (Nolen-Hoeksema,

2000; Park et al., 2004) and impulsive decision making (Kyte et al., 2005; Sharp & Venta, 2013).

To summarize, the scientific literature has frequently used Theory of Mind and mentalization interchangeably, as a common set of abilities related to the interpretation of the behavior of others in terms of mental contents (Hou et al., 2023; Moldovan & Visu-Petra, 2022; Sprung et al., 2022).

Yet, although some aspects of these two constructs are certainly similar, theoretical conceptualizations and empirical research, particularly concerning emotional and personality disorders, do also point to some significant divergences (Górska & Marszał, 2014; Salve et al., 2023).

ToM and mentalization playing a crucial role in understanding social cognition, while both involve interpreting mental states, they differ in focus and application. ToM refers to the cognitive ability to understand others' beliefs, intentions, and perspectives, typically developed by ages 4–6 through tasks like “false belief” tests (Saracho, 2013). Mentalization encompasses a broader range of emotional and relational understanding, focusing on the affective aspects of mental states, such as feelings and desires (Górska & Marszał, 2014). ToM may implicate perceiving the mental states driving others' behavior, while mentalization includes introspection of self and others behavior; however, it is unclear how ToM and mentalization overlaps for the component directed toward others (Salve et al., 2023).

In BPD, significant impairments in mentalization but not ToM deficits (Bora, 2021) may suggest that mentalization is crucial for emotional regulation and interpersonal relationships, whereas ToM may not fully account for the complexities of social interactions in this population (Górska & Marszał, 2014). Mentalization is rooted in secure attachment relationships and is influenced by early experiences, while ToM develops through cognitive milestones. Difficulties in these developmental processes can lead to complications in social functioning, particularly in individuals with personality disorders (Fonagy & Target, 2006; Schaafsma et al., 2015).

Moreover, little is still known about ToM and mentalization in their possible distinct roles in social-emotional development, especially during middle childhood (Sharp & Venta, 2013; Luyten et al., 2020). Understanding their differences can enhance therapeutic approaches, particularly in treating emotional and personality disorders.

On these grounds, this study investigates the possible differences between ToM and mentalization in socio-emotional development. More specifically, we hypothesize an overlap of ToM and mentalization in their association with basic socio- and emotional understanding. However, a specific role of mentalization may be observed in the development of internal resources and regulation strategy and self-agency. In line with empirical and theoretical literature,

moreover, we expect both ToM and mentalization to be substantially more developed in older children within our middle childhood sample.

Methods

Participants

We initially recruited a total of 127 children from 8 to 10 years old from private primary schools in Italy. The sample was composed of Italian native speakers, with 115 Caucasian children and 12 from other ethnicities (8 Asian, 1 African, 3 Latinos, second-generation immigrants).

The inclusion criteria of this study were as follows: children aged from 8 to 10; Italian native speaker; no intellectual disability or other neuropsychiatric pathologies. To exclude the presence of psychopathological disorders, children's parents completed the *Child Behaviour Checklist 6–18 Version* (CBCL; Achenbach & Edelbrock, 1991).

We initially recruited a total of 127 children from private primary schools in Italy (Mean age=9.40; DS=0.79) of which 72 males and 55 females, 115 Caucasian children and 12 s-generation immigrants of other ethnicities (8 Asian, 1 African, 3 Latinos).

Seven Children were excluded because their families did not complete the questionnaire. Eight more children were excluded as they showed clinical problems, 3 children were referred with internalizing and 5 children were referred with externalizing problems, with global clinical T score range from 47 to 80. Consequently, the study was focused on 112 children (Mean age=9.41; DS=0.78) of which 60 were males and 52 females. A sensitivity analysis has shown that this sample size allows for detecting Pearson bivariate correlation as small as $r = .26$ in a two-tailed test with a power of 0.80.

The study protocol was approved by the Ethical Committee of the University of Milano-Bicocca.

Measures

Child Behaviour Checklist 6–18 (CBCL; Achenbach & Edelbrock, 1991) is a tool that evaluates parents' perceptions of their children's behavioral issues. It consists of 118 items that assess both behavioral problems and social skills, with normative data provided. The CBCL demonstrates strong test-retest reliability, interparental agreement, and validity. Participants were included only if they did not exceed the clinical cutoff scores for internalizing, externalizing, or both, as defined in the Italian validation of the tool (Frigerio et al., 2004). Normative scores vary by age and gender.

Child reflective functioning scale (CRFS; Ensink et al., 2013). The CRFS is a measure of child mentalization applied to the Child Attachment Interview (CAI; Shmueli-Goetz et al., 2008; Target et al., 2000) that has been validated for the Italian general population (Bizzi et al., 2022). CAI interview asks children to describe themselves and their attachment relationships. CRFS focusses on the expression of mentalization abilities related to the sense of Self, the relationship with caregivers, anxiety, and conflictual situations.

CRFS evaluates a child's ability to understand interpersonal reactions and interactions in terms of mental states. In this study, we used the General Mentalization score, which is the mean of individual item scores and ranges from -1 , which implies the rejection of the reflective function, to 9 , which refers to an exceptionally high level of reflective ability. Inter-rater reliability of the CRFS items has been shown to be good (Ensink et al., 2014, 2015), and internal consistency in our study was good ($\alpha=0.85$, $\omega_h=0.70$, $\omega_t=0.90$).

The Reading the Mind in the Eyes Test (Baron-Cohen et al., 2001) is a ToM social-perceptual measure that assesses the ability to recognize mental states from static images of eyes.

Twenty-eight photos of the eye region of faces are shown. Children have to choose among four mental or emotional state terms (e.g., friendly, sad, surprised, worried) the one that best describes what the eyes depict. There is only one correct option per image and the test produces one overall score, which is the number of correct answers and thus ranges from 0 to 28.

Indeed, gaze perception has a salient role in the development of the ability to reason about others' intentions and feelings (Baron-Cohen, 1995), where eyes are a critical cue in interpersonal and social communication (Emery, 2000) and categorization (Zebrowitz, 2006). The present measure is widely used as a ToM task because participants are asked to recognize the cognitive and emotional states of the target rather than experiencing the emotions shown in the target's eyes (e.g., empathy). However, the test exhibited mixed reliability values in our sample ($\alpha=0.48$, $\omega_h=0.28$, $\omega_t=0.75$).

Roberts-2 (Roberts & Gruber, 2005; Parolin et al., 2020). The Roberts-2 test is a narrative performance-based test able to assess the socio-cognitive abilities of children and adolescents aged 6 to 18 years. As a culture-free tool, Roberts-2 presents three sets of cards that vary according to the ethnicity (Caucasian, African and Latin-American) and gender (male/female), for a total of 16 cards in black and white representing daily life scenes. The Roberts-2 uses a child's expressive language as an index of their social cognitive skills through a process based on systematic administration, coding and interpretative rules. Clinicians must administer the test under standardized conditions and ask for a complete story for each picture, including a recognizable

beginning, middle and end. In addition, the task requires the child to describe the characters' feelings. Each story is analysed with a comprehensive objective scoring system, expressed by 20 scales linked to specific features, that does not consider the number of words or the protocol length as a code criterion; the scoring manual highlights systematic decision rules for this purpose.

The scoring system is divided into 14 developmental scales, which include the cognitive, affective, and relational domains, and 6 clinical scales, about the possible inclusion of unusual and atypical elements within the comprehension of social situations. The present research focused only on the developmental scales, which were divided into *Socio-emotional Scales* (i.e., *Theme description*, *Problem Identification*, *Resolution*, *Anxiety*, *Aggression*, *Depression and rejection*) and *Resources Scales* (i.e., *Support Self-Feelings*, *Support Self-Advocacy*, *Support Other-Feeling*, *Support Other-Help*, *Reliance on Others and Limit setting*). All scale scores except for Problem Identification and Resolution can range from 0 to 16 and represent the number of participant-narrated stories in which the relevant scale theme emerges. The scores for the Problem Identification and Resolution scales are weighted and can range from 0 to 80. Please, refer to Table 1 for the description and reliability indices of all Roberts-2 scales as well as scoring procedures for the two weighted scales.

Good psychometric properties of the Roberts-2 have previously been demonstrated in both clinical and non-clinical samples (Parolin et al., 2020). In the present study, the scales of Theme description, Problem Identification, Resolution, Support Other-Help, Reliance on Others and Limit setting showed acceptable to good reliability (mean $\alpha=0.80$, range between 0.56 and 0.92; mean $\omega_g=73$, range between 0.62 and 0.89; mean $\omega_t=0.87$, range between 0.75 and 0.93). For these variables, at least 64% of reliable test variance was attributable to variance in a general underlying factor computed as ω_g/ω_t (see Revelle & Condon, 2019, p. 1404). The four emotional scales, *Self-Feelings*, *Support Other-Feeling*, *Support Other-Help* exhibited worse reliability (mean $\alpha=0.68$, range between 0.36 and 0.89; mean $\omega_g=0.38$, range between 0.25 and 0.59; mean $\omega_t=0.80$, range between 0.61 and 0.92). For these variables, the reliable test variance attributable to variance in a general underlying factor ranged between 33% and 89%.

Procedure

Data were collected in different primary schools. Parents were informed about the study's aims and procedures through informative meetings organized at school. No incentive or reward for participation was provided to the families. Children were allowed to participate in the study

Table 1 Roberts-2 variables

Roberts-2 Socio-emotional and Resources Scales	
Roberts-2 Scales and variable name	Coding
<i>Scales of Theme Description</i>	- <i>Popular Response</i> (Popular Response) identification of a commonplace theme of the card, related to the ability to identify the relational context. Reliability: $\alpha=0,66$, $\omega_h=0,72$ $\omega_e=0,75$.
PpR=Popular Response, CM=Complete Meaning	- <i>Complete Meaning</i> (Complete Meaning) overall complexity of the story. It may include a complete plot with antecedent factors and a positive conclusion, as well as the description of characters' emotions. Reliability: $\alpha=0,90$, $\omega_h=0,62$ $\omega_e=0,93$.
<i>Scale of Problem Identification</i>	<i>Problem Identification</i> (Problem Elaboration): Identification of the story problem. The PE scale is derived from a hierarchy of 5 subscales, each corresponding to a different level of problem elaboration: from level 1 (PID1 - Recognition), the simple and concrete description of the present situation, to level -5 (PID5 - Explanation), the full articulation of the problem and its preceding factors, including an elaboration of the characters' emotional and cognitive internal conflict. The subscales are mutually exclusive: if a story exhibits a "level- 3" problem elaboration, it will score 1 point in the PID3- Clarification subscale and zero points in the other four PID subscales. Furthermore, the odds of obtaining higher scores in the "extreme subscales" are lower than those of the "central subscales" (e.g., no one score a the PID5 level, whereas 2/3 of participants scored at the PID3 level at least once). The total scale score is thus a weighted sum of subscale scores: PE=PID1 +PID2*2+PID3*3 +PID4*4+PID5*5. Reliability: $\alpha=0,89$, $\omega_h=0,72$ $\omega_e=0,91$.
PE=Problem Elaboration	
<i>Scales of Resolution</i>	<i>Resolution</i> : elaboration of a resolution process. The PS scale is derived from a hierarchy of 5 subscales, that asses different levels of the ability to develop and elaborate a positive outcome to the story: from RES1, a simple positive ending, to RES5, a constructive resolution based on cognitive and emotional processes and possible insights. Similarly to PE subscales, these subscales are mutually exclusive, and scores are not equally distributed. The total scale score is thus a weighted sum of subscale scores: PS=RES1 +RES2*2+RES3*3+RES4*4+RES5*5. Reliability: $\alpha=0,92$, $\omega_h=0,89$ $\omega_e=0,93$.
PS=Problem Solving	
<i>Emotional Scales</i>	- <i>Anxiety</i> (Anxiety): expression of fear, anxiety, guilt. Presence of contents about illness or death. Reliability: $\alpha=0,67$, $\omega_h=0,25$, $\omega_e=0,75$.
NE=Negative Emotions	- <i>Aggression</i> (Aggression): expression of aggression as anger and rage feelings, or as a verbal (argue, make fun of somebody) or physical (attach, fight, destroy properties) act. Reliability: $\alpha=0,36$, $\omega_h=0,54$, $\omega_e=0,61$.
	- <i>Depression</i> (Depression): the presence of an emotional response such as sadness, sorrow, apathy, tiredness, crying. Reliability: $\alpha=0,28$, $\omega_h=0,67$, $\omega_e=0,83$.
	- <i>Rejection</i> (Rejection). Content related to separation, divorce, distancing and also feeling unloved, jealous, or rejected. Reliability: $\alpha=0,88$, $\omega_h=0,40$, $\omega_e=0,92$.
	N.B. These scales were summarized in a composite "Negative Emotion" score as part of this study's analyses (see "Statistical analysis" and "Results").
<i>Resources Scales</i>	Resources Scale describe the strategies used to deal with problematic situations
SF=Self-feeling	- <i>Support Self-Feelings</i> (Self-Feeling), the expression of positive feelings. Reliability: $\alpha=0,89$, $\omega_h=0,59$, $\omega_e=0,92$.
SH=Self-Help	- <i>Support Self-Advocacy</i> (Self-Help), the ability to be resourceful, to support oneself. Reliability: $\alpha=0,91$, $\omega_h=0,70$, $\omega_e=0,93$.
OF=Others-Feeling	- <i>Support Other-Feelings</i> (Others-Feeling), to characterize the support system or environment as positive, protecting and loving. Reliability: $\alpha=0,81$, $\omega_h=0,41$, $\omega_e=0,86$.
OH=Others-Help	- <i>Support Other - Help</i> (Others-Help), helpful interactions between two or more people. Reliability: $\alpha=0,58$, $\omega_h=0,33$, $\omega_e=0,86$.
OR=Others-Reliance	- <i>Reliance in Others</i> (Others-Reliance), the tendency to ask for help. Reliability: $\alpha=0,68$, $\omega_h=0,78$, $\omega_e=0,84$.
LS=Limit-Setting	- <i>Limit Setting</i> (Limit Setting), imposing rules or punishment. Reliability: $\alpha=0,56$, $\omega_h=0,73$, $\omega_e=0,74$.

only after parents provided written consent, and they were also provided by the examiners with information materials about study aims and procedures. If they agreed, a meeting with the assessors was scheduled.

Participants were engaged in the CAI, Roberts-2, and Reading the Mind in the Eyes tasks individually during school hours. CAI and Roberts-2 administration lasted

about 30 to 40 min each, while Reading the Mind in the eyes took about 10 min. Tasks were administered by examiners specifically trained, in two sessions in isolated rooms provided by the schools. For each session, the administrations were audio/videotaped, and scoring was based on the protocol transcription. The coders were 3 psychologists involved in a one-year project on the clinical use of the CAI

and Roberts-2. All coders were caucasian and italian, two females and one male.

CAI administration was preceded by intensive training of three days at the Anna Freud National Centre for Children and Adolescents in London. Afterwards, CRFS was applied after training conducted by the author of the instrument (the third author, Karin Ensink) [masked for blind review]. Interrater reliability was calculated on 30% of protocols and was good (ICCs ranging from 0.78 to 0.90).

For Roberts-2, examiners took part in monthly individual supervisions and weekly meetings conducted by one of the authors of the Roberts-2' italian validation (the first author, Francesca Locati. After the data collection, the three raters coded the same 20% protocols, and their interrater agreement was tested ($N=17$; mean Cohen's $K=0.78$; Agreement=83%).

Data analysis

Preliminary analysis To reduce the number of variables employed in the main analyses, a composite “Negative Emotion” score was used instead of the four emotional subscales. We conducted a parallel analysis to assess the underlying data structure, and a principal component analysis to extract a factor score representing the main underlying dimension. Participants' scores on the PCA-extracted components represent their Negative Emotion score.

Network analysis We examined the cross-sectional associations among scores on the CRFS, the Reading the Mind in the Eyes test and the Roberts-2 socio-emotional and resources scales simultaneously, using Network Analysis.

Network analysis can provide a clear and streamlined representation of the complex relationships inherent in a dataset. It operates by modelling a network with nodes corresponding to the variables and undirected edges, i.e., lines between nodes, corresponding to the associations between the variables. A common model in the estimation of psychological networks is the Gaussian Graphical Model (GGM), which is a regularized partial correlation network. The edges connecting nodes in a GGM correspond to the conditional dependencies between pairs of variables, equivalent to partial correlations: an edge between two nodes is drawn if they correlate after controlling for all other variables. The regularization is performed by an algorithm that selectively penalizes and excludes the weaker edges, those most likely to be caused by noise or measurement error. The result is a relatively sparse and conservative network, more accessible to theoretical interpretation and more reliable, due to the smaller number of parameters to estimate.

We modelled a network of 15 variables: Mentalization (MT) from the CRFS, Theory of Mind (ToM) from the Reading the Mind in the Eyes test, Popular Response (PpR), Complete Meaning (CM), Problem Evaluation (PE), Problem Solving (PS), Negative Emotions (NE), Self-feeling (SF), Self-Help (SH), Others-Feeling (OF), Others-Help (OH), Others-Reliance (OR), and Limit-Setting (LS) from the Roberts-2, Age and Sex. We tested the variables' skewness and kurtosis, considering absolute values greater than 0.5 as deviations from normality. Finding that most variables were not normally distributed (see Table 2 for values), we applied the nonparanormal transformation to our set of scores to meet the assumption of multivariate normality (Liu et al., 2009). The regularization was performed by the *graphical lasso* algorithm (Friedman et al., 2008), using the default value of 0.50 for the EBIC tuning hyperparameter γ (EBIC; Chen & Chen, 2008; Foygel & Drton, 2011). We further ensured the specificity of the edges by applying the Threshold parameter proposed by Jarnkova and van de Geer (2018).

We evaluated the accuracy and stability of edge estimates by examining their Confidence Intervals (CI), computed through nonparametric bootstrap on 2000 bootstrap samples. While these CI width and overlap are indicative of network accuracy, they should not be used to test whether an edge is significantly different from zero, as the regularization algorithm already excluded the smallest edges.

We furthered our analysis beyond the general network configuration to explore the relevance of individual nodes. The node centrality measures of strength, closeness and betweenness respectively represent a node's direct and indirect associations with other nodes and its ability to influence associations between other pairs of nodes. The Correlation-Stability coefficient (CS-coefficient), based on case-dropping bootstrap techniques, assesses the rank-order stability of centrality measures (Epskamp et al., 2018). To do so, it selects progressively smaller data samples and tests what proportion of cases can be dropped before the correlations between centrality indices in the full sample and in the smaller bootstrapped samples drop below 0.70 (probability level 95%). Cut-off values of 0.25 and 0.50 have been suggested to indicate sufficient and good stability, respectively. Finally, we evaluated node predictability: the proportion of variance shared with the other nodes, that can be interpreted as an R^2 and is useful in summarizing a node's within the network (Haslbeck & Waldorp, 2018).

Age differences in mentalization and theory of mind To track age differences during middle childhood, we split the sample into three age groups (i.e., 7, 8, and 9 years old) and used this age-group variable as a predictor in two one-way

Table 2 Descriptive statistics and bivariate correlations among network variables

Variable	mean	sd	skew	kurtosis	Age	Sex	ToM	MT	PpR	CM	PE	PS	NE	SF	SH	OF	OH	OR
Age	9,41	0,78	-0,87	-0,85														
Sex	0,46	0,5	0,15	-2	0,01													
ToM	16,69	3,15	-0,69	1,3	-0,07	0,20*												
MT	4,71	1,96	0,04	-1,05	42***	0,14	0,23*											
PpR	9,27	2,59	0,01	-0,63	0,22*	-0,02	0,00	35***										
CM	3,81	3,33	1,09	0,47	0,08	0,00	0,15	0,24**	50***									
PE	31,68	8	0,5	-0,19	0,02	0,28**	0,29**	0,18+	0,20*	59***								
PS	19,45	13,89	0,69	-0,51	-0,01	0,10	0,14	0,12	0,31***	0,87***	68***							
NE	0	1	0,87	0,87	32***	0,11	0,17+	0,30**	0,33***	0,35***	0,57***	32***						
SF	4,58	3,29	1,3	1,51	0,00	0,08	0,05	0,15	0,13	0,35***	0,38***	0,45***	0,22*					
SH	3,7	3,47	1,03	0,19	0,23*	0,06	0,05	0,41***	0,33***	0,52***	0,41***	0,52***	0,49***	32***				
OF	4,62	2,59	0,8	0,13	0,10	0,15	0,16+	0,21*	0,29**	0,59***	0,63***	0,67***	0,50***	0,45***	56***			
OH	2,12	2,14	1,51	2,24	0,15	0,00	0,13	0,18+	0,23*	0,59***	0,47***	0,62***	0,40***	0,34***	0,56***	55***		
OR	1,96	2,17	1,51	2,07	0,15	0,09	0,13	0,12	0,09	0,34***	0,40***	0,46***	0,48***	0,16+	0,51***	0,49***	53***	
LS	2,99	2,32	0,86	0,09	0,07	0,11	0,19*	0,15	0,18+	0,35***	0,35***	0,39***	0,34***	0,08	0,51***	0,31***	0,41***	50***

Sex was coded 0 for males and 1 for females

MTMentalization, ToMTheory of Mind, PpR Popular Response, CMComplete Meaning, PEProblem Evaluation, PSProblem Solving, NENegative Emotions, SFSelf-Feeling, SH=Self-Help, OFOthers-Feeling, OHOthers-Help, OROthers-Reliance, LSLimit-Setting

Pearson bivariate correlations. * $p \leq 0,05$, ** $p \leq 0,01$, *** $p \leq 0,001$

ANOVA: the first with ToM as a dependent variable, and the second with MT as a dependent variable.

Statistical packages All analysis were performed in R version 4.1.2 (R Core Team, 2021). The *huge.npn* function from R package *huge* (Zhao et al., 2012) was used for non-paranormal data transformation. Network estimation was performed using function *estimateNetwork* and accuracy and stability analysis were performed by function *bootnet*, all from package *bootnet* (Epskamp et al., 2018). Network visualization was obtained through the function *qgraph* and centrality and predictability estimate from function *centrality*, all from package *qgraph* (Epskamp et al., 2012).

Results

Preliminary analysis

The initial parallel analysis suggested a single-component structure for the Roberts-2 emotional scale. The standardized loadings of individual scale scores on this first component were high, between 0.64 and 0.78, indicating a substantial amount of shared variance among them. The latent component explained 49% of the observed variance. We saved participants' score on this component as their Negative Emotion score.

Network analysis

Table 2 reports descriptive statistics and bivariate correlations among network variables. The network is presented in Fig. 1, edge CIs are reported in Table 3 and illustrated in Supplementary Figure S1. Comparison among edges should be conducted with care, as the CIs were often overlapping and quite broad.

The network is sparse, with 19 nonzero edges out of 105 (18.09%), and an average absolute edge weight of 0.27. A visual inspection shows that MT is positively associated with the Roberts-2 Resources Self-Help sub-scale, with ToM, and with age. This means that older children tend to show greater mentalization. Irrespective of age and all other variables in the model, greater mentalization also correlates with greater activation of resources related to the Self (i.e., Self-help) and with better Theory of Mind. ToM scores, on the other hand, are positively associated with Mentalization, but not with other measures. The five socio-emotional scales are all closely and positively related to each other, with the exception of the NE and the PS nodes that are connected by the only negative edge in the network. The Resources subscales don't appear to cluster together. The SF and OF subscales correlate positively with PS and PE, respectively,

whereas SH and OH both correlate with CM. Finally, OR is positively associated with PS. Sex is not associated to any of the other nodes.

The CS-coefficient of the Strength, Closeness and Betweenness centrality index were 0.25, < 0.05, and < 0.05, respectively. This means that only strength centrality was stable enough to warrant discussion, whereas the relative ordering of node Closeness and Betweenness was too unstable, and these indices will not be further analysed. The estimates of node centrality are presented in Supplementary Figure S2 and Table 4 (the latter also includes predictability estimates). PS and CM are the nodes with the highest strength centrality (1.48 and 1.42, respectively) and predictability ($R^2=0.76$ and $R^2=0.77$, respectively). The Sex node, disconnected from the rest of the network, has null centrality and predictability. Among the interconnected nodes, ToM and LS have the lowest centrality (0.29 and 0.30) and predictability ($R^2=0.12$ and $R^2=0.14$).

Age differences in mentalization and theory of mind

The first ANOVA, testing for age differences in ToM, did not show any significant effect of age [$F(2,109) < 1$, $p = .772$]. On the contrary, the second ANOVA, testing for age differences in Mentalization, showed a significant effect of age [$F(2,109) = 15.41$; $p < .001$]. Here, the post-hoc (Turkey correction) revealed that Mentalization was significantly greater at age 10 compared to both ages 8 and 9 (respectively, $t = -3.966$, $p < .001$ and $t = -4.771$, $p < .001$), whereas differences between the 8- and 9-years age groups were not significant.

Discussion

The present study investigated the contribution of ToM and mentalization to socio-emotional abilities, as well as their developmental trend in middle childhood, on a non-clinical sample of children from 8 to 10 years old. The regularized network highlighted those pairwise associations that were still relevant even when controlling for all the other variables within the network, thus helping to clarify the relations among this closely connected set of socio-cognitive factors. The present findings showed that ToM was only associated with the Mentalization measure, whereas the latter correlated positively also with the Roberts-2 *Support Self-Advocacy* (Self-Help) scale and with age. Thus, ToM appeared to be associated with mentalization skills, but Mentalization was the one independently connected to socio-emotional factors in the storytelling performance. The correlation with Self-help, in particular, indicated Mentalization's key role as a self-agency function.

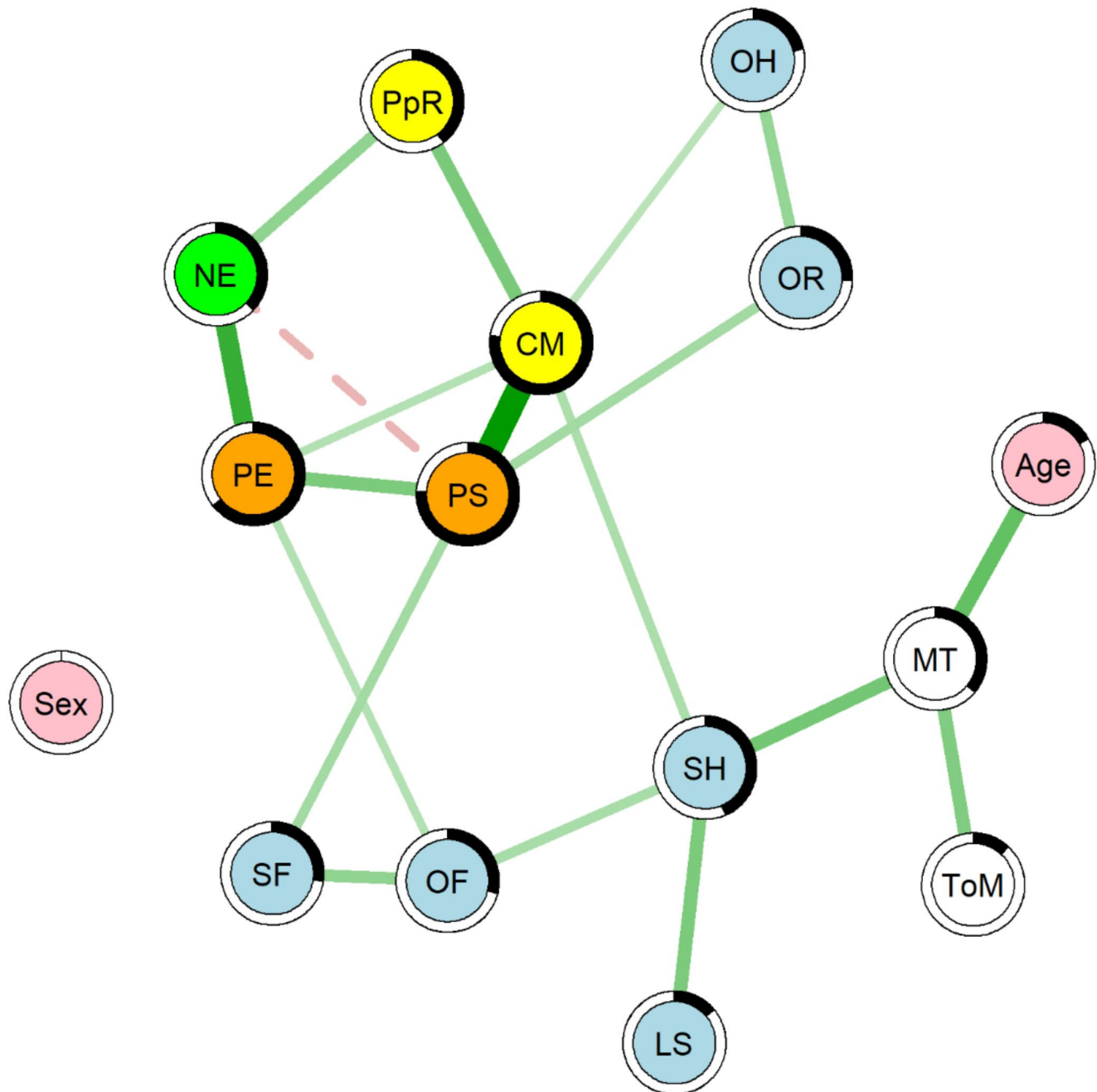


Fig. 1 Network of mentalization, theory of mind, Roberts-2 socio-emotional and resources scales, age, and sex. *Note.* green solid lines represent positive associations, red dashed lines represent negative associations. The black portion of the pie chart surrounding each node represents node predictability. MT=Mentalization, ToM=Theory of

Mind, PpR=Popular Response, CM=Complete Meaning, PE=Problem Evaluation, PS=Problem Solving, NE=Negative Emotions, SF=Self-feeling, SH=Self-Help, OF=Others-Feeling, OH=Others-Help, OR=Others-Reliance, LS=Limit-Setting

Self-help, in turn, was conditionally associated with both socio-emotional and coping strategies scales: Complete Meaning, Limit Setting, and Others-Feeling. Complete Meaning (CM), the ability to integrate both cognitive and emotional aspects of interpersonal narratives, was one of the most central nodes in our network, and its predictability index showed that the majority of its variance (76%) was

explained by its association with other nodes. Besides Self-help, CM correlated also with Popular Response, Problem Solving, Problem Elaboration and Others-Help. The edge connecting Self-help to CM represented Self-help's indirect involvement in this wide range of socio-emotional skills: the ability to recognize and select the adequate meaning of a social situation, to solve interpersonal problems, to

Table 3 Network edge weights and 95% confidence intervals

Node1	Node2	Edge	Value [95% CI]
CM	PS	CM–PS	0.59 [0.43, 0.74]
PE	NE	PE–NE	0.46 [0.31, 0.61]
Age	MT	Age–MT	0.36 [0.05, 0.67]
MT	SH	MT–SH	0.32 [0.07, 0.57]
PpR	CM	PpR–CM	0.3 [0.1, 0.51]
SH	LS	SH–LS	0.3 [0.02, 0.58]
PE	PS	PE–PS	0.3 [0.15, 0.45]
ToM	MT	ToM–MT	0.29 [-0.04, 0.63]
PpR	NE	PpR–NE	0.26 [-0.05, 0.56]
SF	OF	SF–OF	0.26 [-0.05, 0.56]
OH	OR	OH–OR	0.25 [-0.04, 0.53]
PS	OR	PS–OR	0.21 [0, 0.42]
PS	SF	PS–SF	0.21 [-0.03, 0.45]
SH	OF	SH–OF	0.2 [-0.05, 0.45]
CM	SH	CM–SH	0.19 [-0.02, 0.41]
CM	PE	CM–PE	0.17 [-0.03, 0.38]
PE	OF	PE–OF	0.17 [-0.05, 0.39]
PS	NE	PS–NE	-0.17 [-0.38, 0.04]
CM	OH	CM–OH	0.16 [-0.06, 0.37]

See Table 1 note for acronym interpretation

Table 4 Node centrality values

Node	Strength	Closeness*	Betweenness*	Predictability
Age	0,36	0,01	0	0,17
CM	1,42	0,01	39	0,77
LS	0,3	0,01	0	0,14
MT	0,97	0,01	23	0,36
NE	0,89	0,01	2	0,37
OF	0,63	0,01	5	0,29
OH	0,4	0,01	0	0,21
OR	0,46	0,01	0	0,26
PE	1,11	0,01	12	0,65
PpR	0,56	0,01	0	0,4
PS	1,48	0,01	30	0,76
Sex	0	0	0	0
SF	0,47	0,01	2	0,27
SH	1,02	0,01	41	0,44
ToM	0,29	0,01	0	0,12

*The estimates were not stable enough to allow interpretation

understand causes and consequences of social situations, and to accept help from others. Literature has shown that these variables affect numerous psychological phenomena. For instance, the detection, decoding, and reasoning about mental states (Sabbagh, 2004), that are themselves linked with the understanding of social dynamics, and with the ability to predict behaviours (Hughes & Leekam, 2004; Ketelaars et al., 2010; Nader-Grosbois, 2011a, b; Perron & Gosselin, 2009; Scharfe, 2000; Slaughter et al., 2002). Moreover, the interpersonal elaboration integrated with emotional states indirectly contributes to more effective social functioning in terms of interpersonal problem-solving skills (Dodge et al., 2002).

The association between Self-help and coping strategies is in accordance with previous literature that has found Self-help to correlate with an internalized sense of limitation, as well as with moral development and regulatory strategy (Lane et al., 2010). According to Wellman and Miller (2008), a harmonized understanding of mental states is necessary to consider one's actions as socially appropriate. Additionally, in its positive association with Other-Feelings, Self-help arguably supported the maintaining of a positive, safe, and secure relationship with others (Meins et al., 2002). This, in turn, is instrumental to guide the child from the attachment relationship to peer interpersonal dynamics during middle childhood (Obeldobel & Kerns, 2020).

Therefore, being linked with Self-help, and in its self-agency role, Mentalization may activate both elaborative and resilience functions. Taking these findings together, the development of the “self as a mental agent” in middle childhood seems determinant to the activation of a wide range of psychological resources that prepare the passage into preadolescence.

ToM and Mentalization diverged in their relationship with age: while ToM was stable across middle childhood (Perner & Lang, 1999; Southam-Gerow & Kendall, 2002; Gamannossi & Pinto, 2014), mentalization skills were greater in older children. This finding suggests that mentalization develops as the ability to integrate aspects of the self and interpersonal reality, such as a wider range of emotional expression, an ambivalent attribution to the Self, or a growing self-awareness (Midgley et al., 2017; Ensink et al., 2015; Harter, 2012).

Gender, on the other hand, had no association with either Mentalization or TOM. This is in line with mentalization theory, and in contrast with previous findings related to ToM (Baron-Cohen & Hammer, 1997; Baron-Cohen et al., 1997; Halpern, 1992). However, participants' age may explain this discrepancy: the gender differences that characterize ToM development may balance out in middle childhood, once the competence is mature.

To summarize, ToM allows children to identify relational context and emotions. It appears already achieved in middle childhood, without differences between males and females. ToM correlates positively with Mentalization, which in turn is directly associated with the possibility to develop a complete vision of the inner and outer world and integrate elements of interpersonal context.

In this direction, the relation between mentalization and the construction of self-agency may be a key determinant in promoting socio-emotional competencies and regulation strategies that involve the representation of the self and the others. Through its influence on self-agency, successful mentalizing supports the flexible capacity to use skills as a “toolbox” approach, that requires the integration of social

knowledge into a coherent representation of another's mind (Mitchell, 2006). Mentalization as a sophisticated function supports the evolutionary development of a more complex interpretative skill (Ensink & Mayes, 2010). In these findings, the differences between ToM and mentalization confirm the conceptualization of mentalization in the context of a “dialectical perspective of self-development”, where the caregiver-infant relationship aim is the “internalisation of the thinking self from within the containing object” (Fonagy & Target, 1996, p. 230). From this perspective, mentalization, in its comprehensive role of self- and other-representation, shapes the narratives while we can express, elaborate, and share our experience in either an adaptive or maladaptive way (Ensink & Mayes, 2010). This last finding assumes further importance in relation to the developmental trend of socio-emotional and coping strategies (Ensink & Mayes, 2010; Parolin et al., 2020). In fact, abilities and resources based on the self (i.e., Self-Help), become crucial during adolescence (Sugarman, 2018). This supports the idea that mentalization fosters socio-emotional skills and coping strategies focused on a self-regulatory dynamic that will be paramount later in life (Hansen & Jessop, 2017). Mentalization may thus play a fundamental role in promoting mental health on a wider scope and has indeed been discussed as a common factor of therapeutic change in middle childhood (Bateman & Fonagy, 2004; Goodman et al., 2016; Knox, 2010).

Indeed, the present study provides potential guidelines for preventive interventions in the context of early childhood. Targeting emotional theory of mind appears to facilitate the activation of mentalization capacities. Moreover, interventions focusing on emotional recognition seem to have a broader impact on the child's socioemotional system when coupled with mentalization of relational episodes. Engaging in reflective processes regarding critical interpersonal situations, while integrating suppressed emotions and mental states related to the self and others, may promote a sense of agency that enhances more mature cognitive processing as well as the ability to express negative emotions. Simultaneously, integrated work on theory of mind (ToM) and mentalization enhances the capacity for interpersonal engagement, particularly in terms of mutual support and help-seeking in moments of difficulty. A deeper understanding of the differentiation and relationship between ToM and mentalization can inform clinical practice with children, both in preventive and therapeutic settings.

It is necessary to note a few limitations of the present study. First, our sample, while far from small, allowed the stable estimation of only one centrality index (i.e., strength centrality). Replicating the study on an independent, larger sample would ideally result in more reliable closeness and betweenness estimates, providing a richer and more

nuanced representation of relations among socio-emotional skills. Second, we focused on a single ToM measure (i.e., the Reading the Mind in the Eyes Test), whereas including a cognitive measure of ToM may allow a more comprehensive view of its progress during development. Furthermore, the Reading the Mind in the Eyes test has shown significant limitation in ToM assessment (Higgins et al., 2023) and even in our case, its reliability was uncertain. Moreover, alternative explanations, such as shared method variance and the similar nature of the stimuli, may clarify why socio-cognitive abilities correlated more strongly with Mentalization than with ToM. Third, some of the Roberts-2 subscales did not achieve acceptable internal consistency. The complex nature of the instrument leaves space to interpret this finding: further research will need to investigate whether it may be due to true multidimensionality of the scale scores, to systematic differences in the picture-stimuli (e.g. some could more easily elicit a specific negative emotion in our population of interest), or simply to issues of sample size and power in the computation of ω reliability coefficients for scales of dichotomous items.

In conclusion, this work represents an interesting stepping stone in the theoretical definition of mentalization. The findings of our network analysis testify to the distinct roles of mentalization and Theory of Mind in child socio-emotional development. Future studies in the field may benefit from a wider scope, considering several ToM components as well as the role of attachment in relation to socioemotional abilities in children. On a similar note, it may be informative to explore these dynamics at different ages, such as preadolescence and adolescence, to detect specific effects related to the developmental stage. Investigating such issues could, for instance, clarify the developmental trajectory of mentalization, revealing whether it continues to develop beyond adolescence and into adulthood.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s12144-025-07475-x>.

Funding Open access funding provided by Università degli Studi di Pavia within the CRUI-CARE Agreement.

Data availability The data that support the findings, together with a brief data dictionary, are openly available in OSF at https://osf.io/3a82f/?view_only=378f070e66254df5b5e6eeb21afad251.

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