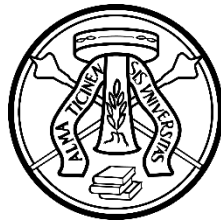


UNIVERSITY OF PAVIA – IUSS SCHOOL FOR ADVANCED STUDIES PAVIA

**Department of Brain and Behavioral Sciences (DBBS)
MSc in Psychology, Neuroscience and Human Sciences**



**UNIVERSITÀ
DI PAVIA**



IUSS

Beyond Academic Difficulties: A Systematic Review and Meta-Analysis of Theory of Mind in Children and Adolescents with Specific Learning Disorders

Supervisors:

Prof. Sara Mascheretti

Prof. Serena Lecce

Prof. Sarah Nazzari

**Thesis written by
Carlotta Recupero**

Academic year 2024/2025

Index

Abstract	4
Chapter 1 – Introduction	5
1.1 Specific Learning Disorders.....	5
1.1.1 Definition and diagnostic criteria.....	5
1.1.2 Clinical characteristics and heterogeneity.....	6
1.1.3 Comorbidity	9
1.2 Types of SLD.....	10
1.2.1 Dyslexia.....	10
1.2.2 Dyscalculia	12
1.2.3 Dysgraphia and dysorthography.....	13
1.3 Theory of Mind	15
1.3.1 Definition of ToM	15
1.3.2 Dimensions of ToM: cognitive and affective components.....	16
1.3.3 Development of ToM across childhood and adolescence	18
1.3.4 The relationship between executive functions and ToM.....	20
1.3.5 ToM and academic achievement	22
1.4 Measures and assessment of ToM	23
1.4.1 First-order false-belief measures	23
1.4.2 Second-order false-belief measures	25
1.4.3 Advanced ToM measures	26
1.4.4 Verbal and non-verbal assessment of ToM: limitations and alternatives	29
1.5 Theory of Mind in children and adolescents with SLD	30
1.5.1 Language and social difficulties in children with SLD.....	30
1.5.2 Empirical findings on ToM in children and adolescents with SLD	30
1.5.3 Limitations and gaps in the existing literature	31
1.6 Rationale and aims of the present meta-analysis	32
Chapter 2 – Method	34
<i>Literature search</i>	<i>34</i>
<i>Data selection.....</i>	<i>35</i>

<i>Data extraction</i>	37
<i>Statistical analysis</i>	45
Chapter 3 – Results	46
3.1 Sample characteristics	46
3.2 Characteristics of ToM measures and ToM levels	46
3.3 Meta-analytic results	48
Chapter 4 – Discussion	52
4.1 Overview of meta-analytic findings	52
4.2 ToM performance in SLD	53
4.3 Interpretation of the observed heterogeneity	55
4.4 Developmental considerations	59
4.5 Clinical and educational implications	61
4.6 Limitations	64
4.7 Future research	65
Chapter 5 – Conclusion	68
Bibliography	69

Abstract

Children and adolescents with Specific Learning Disorders (SLD) frequently show difficulties that extend beyond academic domains, and a small but growing body of research has examined whether these difficulties also involve Theory of Mind (ToM), the ability to attribute and reason about others' mental states. However, no previous study has attempted to quantitatively synthesize this evidence. The present study aimed to systematically review the available literature and to conduct a meta-analysis estimating the pooled difference in ToM performance between children and adolescents with SLD and their typically developing peers, while also mapping the diagnostic profiles, populations, and methodological approaches represented across studies. Following PRISMA guidelines, a systematic search of Scopus, Web of Science, and PubMed yielded twelve eligible studies, comprising a total of 1,279 participants (574 with SLD, 705 typically developing), with eligible ages ranging from 6 to 18 years. A random-effects model was fitted to thirty extracted effect sizes. Results showed a large and statistically significant pooled effect, indicating that children and adolescents with SLD performed substantially worse than controls on ToM tasks. However, heterogeneity across studies was high, which may partly reflect task characteristics, particularly the linguistic and executive demands of the measures employed. No clear evidence of publication bias was found. These findings indicate that ToM difficulties represent a consistent, though not fully understood, feature of the SLD profile, with implications for how socio-cognitive functioning is assessed and supported in this population alongside academic difficulties.

Key words: Specific Learning Disorders; Theory of Mind; Social Cognition; Children; Adolescents

Chapter 1 – Introduction

1.1 Specific Learning Disorders

1.1.1 Definition and diagnostic criteria

Specific Learning Disorders (SLD) are neurodevelopmental disorders that affect the acquisition and use of basic academic skills, including reading, writing, and mathematics. These difficulties usually become evident during formal education and are characterized by persistent and impairing problems in learning academic skills, despite adequate educational opportunities and targeted support. SLD are considered “specific” because the difficulties are limited to one or more academic domains and are not better explained by intellectual disability, sensory impairments, neurological conditions, psychosocial adversity or emotional difficulties, inadequate educational instruction, or insufficient proficiency in the language of instruction. In terms of prevalence, SLD are relatively common in school-age children, with estimates suggesting that they affect approximately 5% to 15% of children across different cultures and languages (American Psychiatric Association, 2013; McDowell, 2018; Nemati et al., 2025).

A central feature of SLD is that the learning difficulty is unexpected when compared with the child’s overall intellectual functioning and opportunities for learning. In other words, children with SLD may show typical development in many areas but experience significant and persistent difficulties in specific academic skills (McDowell, 2018; Muktamath et al., 2021).

According to DSM-5 criteria, the diagnosis of SLD requires persistent difficulties in at least one academic area for more than six months, despite the provision of appropriate interventions. These difficulties may appear as slow or inaccurate word reading,

difficulty in understanding written text, spelling problems, difficulties with written expression, poor mastery of number sense or calculation, or difficulties with mathematical reasoning. The affected academic skills must be substantially and quantifiably below what is expected for the individual's chronological age and must interfere with school achievement, occupational performance, or daily activities. In addition, the difficulties must begin during the school-age years, although they may become fully evident only when academic demands increase (American Psychiatric Association, 2013; McDowell, 2018; Muktamath et al., 2021).

1.1.2 Clinical characteristics and heterogeneity

Despite sharing common diagnostic criteria, individuals with Specific Learning Disorders show considerable heterogeneity in symptom presentation, severity, and cognitive functioning. Difficulties may involve reading, writing, mathematical reasoning, or multiple academic domains simultaneously. Furthermore, SLD are not considered a single and uniform condition, but rather a broad neurodevelopmental category including different profiles of impairment and diverse neuropsychological characteristics. Clinical manifestations may vary according to the affected academic domain, developmental stage, and the presence of associated cognitive difficulties, contributing to the complexity and variability observed among individuals with SLD (Muktamath et al., 2021).

Such heterogeneity is reflected in the different clinical manifestations associated with specific academic domains. Reading difficulties are commonly associated with dyslexia, which is considered the most prevalent form of SLD. Children with dyslexia often show problems in reading fluency, word recognition, decoding, spelling, and reading

comprehension. These impairments are frequently linked to deficits in phonological processing, which interfere with the ability to identify and manipulate speech sounds efficiently (Muktamath et al., 2021).

Difficulties in written expression may involve both dysgraphia and dysorthographia. Dysgraphia mainly affects handwriting and graphomotor skills, including letter formation, spacing, writing fluency, and spatial organization on the page. Children with dysgraphia may produce illegible handwriting, show difficulties in graphomotor organization during writing tasks, and experience difficulties organizing written content. Dysorthographia, instead, primarily refers to spelling and orthographic errors, such as omissions, substitutions, inversions, or incorrect separation of letters and syllables (Muktamath et al., 2021; Shembaretska & Yatsenko, 2024).

Mathematical difficulties are typically associated with dyscalculia. This condition involves impairments in number sense, arithmetic reasoning, and calculation abilities. Children with dyscalculia may also experience difficulties in understanding fundamental mathematical concepts and in memorizing numerical information.

In practical terms, these difficulties often manifest as struggles with performing calculations, understanding numerical sequences, and solving mathematical problems. Such impairments can significantly interfere with academic achievement and, in many cases, tend to persist over time (Muktamath et al., 2021; Shembaretska & Yatsenko, 2024).

In addition to academic impairments, children with SLD frequently show variability in cognitive and neuropsychological functioning. Neuropsychological evidence has highlighted differences in phonological processing, working memory, attention,

visuospatial abilities, and executive functioning among individuals with SLD. These cognitive processes may contribute to the heterogeneity observed in symptom presentation and academic performance (Flores, 2025).

Neuropsychological research suggests that different forms of SLD may involve partially distinct cognitive mechanisms. For example, dyslexia has been associated with deficits in phonological processing and visuospatial attention, whereas dyscalculia has been linked to impairments in numerical processing and estimation abilities. Dysgraphia, particularly in its motor forms, has also been related to difficulties in working memory, planning, inhibition, and graphomotor organization (Flores, 2025).

Overall, the interaction between cognitive deficits may vary considerably across individuals, supporting the view of SLD as complex and multidimensional neurodevelopmental conditions characterized by broad neuropsychological variability (Flores, 2025).

Children and adolescents with SLD frequently experience not only academic difficulties, but also significant socio-emotional challenges. Persistent learning problems may negatively affect self-esteem, academic motivation, and emotional well-being, especially when children repeatedly experience failure or frustration in school settings. Difficulties in reading, writing, or mathematics can interfere with classroom participation and understanding of school activities, often leading to feelings of inadequacy, anxiety, and low self-confidence (Shembaretska & Yatsenko, 2024).

Several studies have also reported increased vulnerability to psychosocial difficulties among children with SLD, including symptoms of anxiety, depressive mood, social withdrawal, and behavioral problems. These socio-adaptive difficulties are often

considered secondary consequences of persistent academic struggles and may further interfere with social relationships and school adjustment (Shembaretska & Yatsenko, 2024).

In addition, the socio-educational impact of SLD may persist across development if adequate support and intervention are not provided. Timely identification and access to targeted support and intervention are therefore considered essential to reduce the negative academic and emotional consequences associated with SLD and to promote better long-term outcomes (Flores, 2025).

1.1.3 Comorbidity

Comorbidity is highly frequent in children and adolescents with Specific Learning Disorders and contributes to the complexity and variability of clinical presentations. Several studies have shown that SLD may co-occur with other neurodevelopmental, emotional, and behavioral conditions, including attention-deficit/hyperactivity disorder (ADHD), anxiety disorders, depressive symptoms, conduct disorder, and language disorders (Shah & Somaiya, 2025; Flores, 2025).

Different disorders are characterized by partially distinct cognitive profiles. Dyslexia is commonly associated with phonological deficits, difficulties in lexical access, and impairments in verbal working memory, whereas dyscalculia is mainly related to deficits in numerical representation and numerical-semantic processing (Flores, 2025).

In cases of comorbidity, cognitive deficits may interact and accumulate, leading to greater clinical severity and more complex functional difficulties. For example, the co-occurrence of dyslexia and ADHD or dyslexia and dyscalculia may increase learning difficulties and negatively affect academic achievement, adaptive functioning, and

emotional well-being. For this reason, multidimensional assessment and integrated intervention approaches are considered essential in the evaluation and treatment of children with SLD and comorbid conditions (Shah & Somaiya, 2025; Flores, 2025).

1.2 Types of SLD

1.2.1 Dyslexia

Dyslexia, also referred to as a reading disorder, is one of the most common forms of Specific Learning Disorder (Muktamath et al., 2021).

The term dyslexia derives from the Greek words dys (“difficulty”) and lexis (“word” or “language”) (Intriago et al., 2021). It is among the most prevalent learning disabilities in school-aged children. It primarily affects reading and language-related processing abilities, including decoding skills, reading accuracy, reading rate and fluency, reading comprehension, recall, and, in some cases, speech (Muktamath et al., 2021).

Dyslexia is considered a heterogeneous and multifaceted disorder whose manifestations may vary considerably among individuals. It can range from mild to severe and frequently coexists with other specific learning difficulties. Moreover, dyslexia is generally described as a hereditary and lifelong condition (Shembaretska & Yatsenko, 2024).

Epidemiological studies conducted in Europe and Asia have reported prevalence rates ranging from 3,5% to 11% among school-aged children, although variability depends on the diagnostic criteria and assessment methods adopted (Flores, 2025).

Neurobiological evidence suggests that dyslexia is associated with alterations in left temporo-parietal phonological networks and, in some cases, in the dorsal magnocellular-visual pathway, supporting the view of dyslexia as a multisystemic disorder (Flores, 2025).

Two major models have been proposed to explain the disorder. The phonological deficit hypothesis proposes that impairments in left temporo-parietal and frontal neural networks involved in phonological processing contribute to the development of dyslexia (Flores, 2025). From a clinical perspective, individuals with dyslexia commonly experience difficulties in accurate word recognition, spelling, and decoding skills, particularly in processing speech sounds. They may also experience difficulties in phonemic segmentation and sound blending during reading, which can negatively affect reading comprehension (Muktamath et al., 2021).

In contrast, the magnocellular-dorsal pathway model suggests deficits in temporal visual processing and visuospatial attention, processes that are essential for the rapid sequential scanning of graphemes during reading. Studies based on neuroimaging and psychophysical assessments have identified impairments in visuospatial attention and motion perception among individuals with dyslexia, and these alterations may predict reading difficulties even before formal reading education begins (Flores, 2025).

The heterogeneity of dyslexia is also reflected in the presence of different patterns of reading impairment. Phonological dyslexia is mainly characterized by difficulties in grapheme-to-phoneme conversion, leading individuals to rely predominantly on the lexical route and to experience difficulties in reading unfamiliar words or pseudowords. In contrast, individuals with superficial dyslexia rely predominantly on phonological

decoding and experience difficulties recognizing words as whole units (Intriago et al., 2021).

Overall, the literature suggests that dyslexia should be considered a multisystemic disorder in which phonological and visual-attentional deficits may coexist and interact differently across individuals. Consequently, clinical assessment should evaluate both phonological and attentional-visual components through an integrated approach (Vidyasagar & Pammer, 2010; Vidyasagar, 2013).

1.2.2 Dyscalculia

Dyscalculia is a specific learning disorder affecting the acquisition and development of mathematical abilities and numerical processing skills. It is characterized by persistent difficulties in understanding numbers, learning arithmetic facts, and performing mathematical operations accurately, which may significantly interfere with academic achievement (Muktamath et al., 2021). The disorder, sometimes referred to as “mathematical dyslexia,” interferes with the comprehension of abstract numerical concepts and with the ability to follow sequential mathematical procedures and apply formulas correctly (Intriago et al., 2021).

The clinical manifestations of dyscalculia are heterogeneous and may involve both basic and more complex mathematical skills. Children with dyscalculia frequently experience difficulties in associating numbers with the quantities they represent, memorizing numerical sequences, comparing quantities, and identifying the correct position of numbers on a number line. Common signs also include confusion between visually similar numbers, such as 6 and 9, and difficulties in learning multiplication tables, mathematical formulas, and procedural rules (Shembaretska & Yatsenko, 2024).

In addition, many students struggle to select appropriate calculation strategies, distinguish relevant from irrelevant information within mathematical problems, and evaluate whether the obtained solution is correct (Muktamath et al., 2021). Difficulties may further extend to temporal and spatial processing, including understanding concepts such as “before” and “after,” estimating durations, and reading clocks (Shembaretska & Yatsenko, 2024).

Several studies estimate that dyscalculia affects approximately 3–6% of school-age children, although prevalence rates may vary depending on the diagnostic criteria and age groups considered (Intriago et al., 2021; Flores, 2025). Children with dyscalculia generally demonstrate mathematical abilities significantly below those expected for their age, educational level, and intellectual functioning, which may negatively affect academic achievement and prevent them from keeping pace with their peers in mathematics-related tasks (Intriago et al., 2021).

From a neurobiological perspective, dyscalculia has been associated with dysfunction of the intraparietal sulcus (IPS) and altered connectivity between numerical and mnemonic brain networks. During typical development, the IPS progressively specializes from general visuospatial functions toward more specialized mathematical processing; however, this specialization appears to be impaired in individuals with dyscalculia, potentially explaining deficits in numerical estimation, symbolic processing, and calculation abilities. Evidence from studies on parietal lesions further supports the relationship between damage to the left intraparietal sulcus and impairments in numerical cognition and estimation processes (Flores, 2025).

1.2.3 Dysgraphia and dysorthography

Dysgraphia is a specific learning disorder that affects handwriting abilities, written expression, and fine motor coordination. It is characterized by writing skills that are significantly below those expected for the child's age, intellectual functioning, and educational level, often interfering with academic achievement and everyday activities. Difficulties may involve both transcription processes and text composition, including impairments in handwriting fluency, spelling, grammar, punctuation, and spatial organization on the page. Children with dysgraphia frequently struggle to manage the simultaneous demands of generating ideas and producing written text, a difficulty that has been associated with deficits in visual–motor integration and fine motor skills (Muktamath et al., 2021).

The manifestations of dysgraphia are heterogeneous and may become more evident once children have acquired basic writing instruction, typically during the second or third year of primary school. Common signs include excessive pressure while holding a pen or pencil, rapid fatigue during writing activities, disproportionate or poorly formed letters, and difficulties organizing words and letters correctly on the page. Children may also confuse graphically similar letters, omit spaces between words, and fail to use punctuation marks appropriately. In some cases, despite careful and effortful writing, children may struggle to understand their own writing. Dysgraphia frequently co-occurs with dyslexia, although the two disorders may also appear independently (Shembaretska & Yatsenko, 2024).

Dysorthography specifically refers to spelling errors that do not derive from a lack of knowledge of grammatical rules, but rather from difficulties in the cognitive processes underlying writing, such as letter inversions, omissions, and sound substitutions.

From a neuropsychological perspective, dysgraphia may involve either linguistic impairments, such as phonological–orthographic deficits, or motor impairments associated with developmental coordination disorder (DCD), also referred to as dyspraxia. Research highlights the important role of working memory and executive functions, including planning, inhibition, and cognitive flexibility, in the development and automatization of writing abilities. In particular, the quality of written production, including legibility, spelling accuracy, and sequencing, is strongly associated with verbal working memory and executive processes supporting graphomotor control (Flores, 2025).

1.3 Theory of Mind

1.3.1 Definition of ToM

Social cognition is a branch of social psychology that examine how individuals interpret and process mental states — including beliefs, desires, hopes and emotions — in order to adapt to changing social environments and to define their own place within the social world (Şahin et al., 2018). More broadly, the term encompasses a spectrum of cognitive skills required to recognize and appropriately use socially salient information; it ranges from basic perceptual processes, such as face processing, gaze processing and affect recognition, to more complex functions, including social judgment, the detection of social cues, and the attribution of mental states to others (Pastorino et al., 2021).

Among these higher-order social cognitive processes, Theory of Mind (ToM) occupies a central role. In its most classical formulation, ToM is defined as the capacity to attribute mental states — such as beliefs, intentions, desires and emotions — to others (Quesque

& Rossetti, 2020; Eyuboglu et al., 2017). This capacity allows individuals to recognize that other people's mental states may differ from their own and to draw appropriate inferences based on those states (Şahin et al., 2018). The capacity to infer others' beliefs and intentions is essential for anticipating and interpreting human behaviour, thereby playing a crucial role in daily social interactions and communication (Cassetta et al., 2018; Şirin et al., 2026).

Beyond its classical formulation, ToM encompasses a broad set of abilities, including the understanding of false beliefs, indirect communication such as hints and metaphor, humor, irony and deception (Şahin et al., 2018). More recent theoretical and empirical work has expanded this definition to include the capacity to represent how another person perceives the surrounding world, thereby highlighting a perspective-taking dimension that complements the traditional focus on beliefs and intentions (Quesque & Rossetti, 2020).

1.3.2 Dimensions of ToM: cognitive and affective components

A significant theoretical advancement in the ToM literature has been the distinction between two core components: cognitive ToM and affective ToM. While cognitive ToM refers to the capacity to reason about the beliefs and motivations of others, affective ToM concerns the ability to make inferences about their emotional states (Cassetta et al., 2018; Shamay-Tsoory & Aharon-Peretz, 2007).

These two dimensions rely on partially distinct neural substrates. Cognitive ToM has been associated with activity in the dorsolateral prefrontal cortex, whereas affective ToM has been linked to the ventromedial prefrontal cortex (Cassetta et al., 2018; Kalbe et al., 2010). Consistent with this, studies involving adolescents aged 10 to 16 years

have reported greater activation in the right amygdala and right anterior insula during affective ToM tasks compared to cognitive ToM tasks, further supporting the neural differentiation between the two components (Cassetta et al., 2018; Sebastian et al., 2012).

From a developmental perspective, recent research suggests that cognitive ToM emerges earlier than affective ToM. This temporal gap has been explained by the greater processing demands associated with affective ToM, which requires the simultaneous integration of both cognitive and emotional information. According to this view, cognitive ToM and both cognitive and affective empathy are considered necessary prerequisites for the development of affective ToM (Cassetta et al., 2018).

Further support for the later emergence of affective ToM comes from research on puberty and emotional processing. Pubertal development, particularly between the ages of 10 and 13, has been associated with enhanced neural responsiveness to emotional stimuli and with improved integration of complex cognitive and emotional information (Cassetta et al., 2018; Moore et al., 2012). These maturational changes suggest that affective ToM may undergo more substantial development during adolescence, while cognitive ToM abilities appear to stabilize at younger ages (Cassetta et al., 2018).

Behavioral evidence also supports this developmental trajectory. Children typically pass second-order false-belief tasks, which measure cognitive ToM, by around 6 or 7 years of age. In contrast, tasks requiring second-order understanding of emotional states, such as recognizing a social faux pas, tend to be mastered later, between 9 and 11 years of age. Moreover, affective ToM abilities have been found to be significantly more advanced in

adults than in adolescents, whereas no comparable differences have been observed for cognitive ToM across the same age groups (Cassetta et al., 2018).

The distinction between cognitive and affective ToM also carries implications for social functioning. Research has shown that these two components relate differentially to social outcomes: affective ToM is associated with empathy, whereas cognitive ToM does not appear to share this link (Shamay-Tsoory et al., 2005). Finally, sex differences have been identified in the developmental timing of affective ToM, with girls demonstrating earlier gains than boys, while no such differences have been observed for cognitive ToM (Cassetta et al., 2018).

1.3.3 Development of ToM across childhood and adolescence

While it is broadly accepted that humans possess an innate capacity to develop Theory of Mind, the precise trajectory through which ToM matures across development remains less well understood, as does the relationship between ToM reasoning and other domains of functioning at different ages (Cassetta et al., 2018). A large body of ToM research has concentrated on the earliest stages of ToM emergence, with the majority of studies focusing on children below the age of five and relatively few examining older children and adolescents.

Basic ToM competencies, begin to emerge around the ages of three to four. At this point, children demonstrate a reliable ability to attribute false beliefs, that is, beliefs that contradict reality, representing a foundational step in mental state understanding. First-order false-belief reasoning, which involves attributing a mistaken belief about a real-world event, is generally mastered during the preschool years, approximately between three and five years of age. Second-order false-belief reasoning—understanding what

one person thinks about another's mental states—develops subsequently and is typically acquired between five and seven years of age (Cassetta et al., 2018; Gabriel et al., 2019). Gabriel et al. (2019) further note that rudimentary third-order representations begin to appear around age seven, suggesting that the hierarchical scaffolding of belief reasoning continues well into middle childhood.

Importantly, ToM development does not conclude in early childhood but extends throughout adolescence and into young adulthood (Cassetta et al., 2018; Gabriel et al., 2019). Multiple empirical studies support this view: perspective-taking ability was found to improve continuously from childhood into adolescence, the understanding of others' intentions followed a linear trajectory between ages 9 and 18, and advances in interpreting social behavior from silent films were documented in children aged 8 to 13 (Cassetta et al., 2018).

Concerning cognitive ToM during adolescence and emerging adulthood, findings in the literature are not entirely consistent. Some studies indicate that emerging adults outperform adolescents, particularly on higher-order tasks such as third-order belief reasoning, while other studies report no significant differences across this age window. A notable methodological limitation in this area is the tendency to compare only two age groups to represent early and late adolescence, which may obscure finer-grained developmental changes (Gabriel et al., 2019). With respect to gender, the available evidence suggests that girls tend to show more advanced ToM reasoning than boys in younger age groups (Cassetta et al., 2018), and greater social awareness more broadly during adolescence, though no consistent gender differences have been identified for affective ToM (Gabriel et al., 2019).

The protracted maturation of the neural structures underlying ToM provides further support for its extended developmental trajectory. The prefrontal cortex, closely implicated in ToM reasoning, continues to mature into early adulthood, and between ages 13 and 18 widespread changes occur across multiple brain regions — including hippocampal, amygdalar, temporal, cingulate, and subcortical areas — alongside increasing connectivity between prefrontal, temporal, and temporoparietal networks (Gabriel et al., 2019). Concurrent shifts in the serotonergic and dopaminergic systems add a further layer of neurobiological complexity to this period. These maturational processes unfold alongside significant social transitions, such as growing peer influence and the expansion of digital communication, which may in turn shape the practical expression of ToM abilities in real-world contexts (Cassetta et al., 2018).

1.3.4 The relationship between executive functions and ToM

Executive functions (EF) encompass the cognitive processes that underpin goal-directed behavior (Aboulafia-Brakha et al., 2011; Carlson et al., 2013) and problem solving, including working memory, cognitive flexibility, inhibitory control, and self-monitoring (Anderson, 2002; Carlson, 2005; Wade et al., 2018). These capacities enable the conscious and effortful regulation of thoughts and actions, and their impairment, alongside deficits in ToM, is observed across a range of neurodevelopmental and psychiatric conditions (Wade et al., 2018).

The relationship between ToM and EF has long attracted the attention of developmental psychologists, partly because the two capacities appear to emerge in parallel. Extensive cross-sectional research conducted during the preschool period has consistently documented associations between ToM and EF performance, yet the precise nature of

this relationship remains a matter of ongoing debate. Three theoretical proposals continue to guide current thinking on this topic: that EF is a prerequisite for ToM ($EF \rightarrow ToM$), that ToM is a prerequisite for EF ($ToM \rightarrow EF$), or that the two are mutually interdependent owing to shared neural substrates ($ToM \leftrightarrow EF$; Wade et al., 2018).

The first proposal holds that EF capacities such as inhibitory control and self-monitoring are necessary for understanding one's own and others' mental states. Self-monitoring, in particular, has been argued to underlie self-awareness, which is itself considered a precondition for ToM. The ability to suppress one's own perspective and shift to that of another is similarly regarded as essential for mental state attribution. In line with this view, longitudinal research has consistently shown that early EF is a reliable predictor of subsequent ToM reasoning in childhood (Wade et al., 2018).

The second proposal inverts this directionality, suggesting that the capacity to represent mental states is what enables the strategic control of thoughts and behavior. According to this account, understanding that mental states causally influence actions allows children to exert executive control over competing or unwanted response tendencies. This process first requires the ability to distinguish self from other, followed by the development of meta-representational awareness, that is, an understanding of the relationship between mental states and behavior. While the majority of behavioral evidence supports the primacy of EF in predicting later ToM, a number of longitudinal studies indicate that early ToM, or its precursors, also forecasts later EF development (Wade et al., 2018).

The third proposal posits a common neural basis for both capacities, an idea originally advanced in the context of autism research, where pronounced and concurrent deficits in

ToM and EF were observed. These co-occurring impairments led researchers to propose that shared prefrontal cortical networks support both domains, which would imply a reciprocal and mutually predictive relationship between ToM and EF across development. Empirical evidence consistent with this bidirectional account has also been reported (Wade et al., 2018).

1.3.5 ToM and academic achievement

Although Theory of Mind has traditionally been studied in relation to children's social development, accumulating evidence suggests that mentalizing abilities may also contribute meaningfully to academic functioning (Lecce & Devine, 2022). While the association between ToM and school performance is considered well-established, its magnitude tends to be modest and varies across studies and academic domains (Smogorzewska et al., 2022).

Researchers have proposed multiple mechanisms through which ToM may shape academic outcomes. One line of reasoning focuses on metacognition: children who demonstrate stronger mentalizing skills tend to be more aware of the limits of their own cognitive resources, which motivates them to seek and apply more effective learning strategies (Smogorzewska et al., 2022). A second line emphasizes the importance of the teacher-child relationship: the ability to understand others' mental states may help children decode their teachers' communicative intentions more accurately, enabling them to move beyond passive reception of information toward a more active and collaborative construction of knowledge (Smogorzewska et al., 2022).

Building on these accounts, Lecce and Devine (2022) outline three broader pathways connecting ToM to academic achievement — one operating through improved social

relationships and school engagement, one through enhanced metacognitive awareness, and one through greater sensitivity to the mental state and figurative language embedded in educational discourse.

Of the various academic outcomes examined, reading comprehension has emerged as the domain most consistently linked to ToM. This connection is theoretically grounded in the demands of text understanding: going beyond surface-level decoding requires constructing an internal representation of what is not explicitly stated, a process that draws heavily on the capacity to attribute intentions and perspectives to others, including authors and fictional characters (Lecce & Devine, 2022). Longitudinal research has provided support for a reciprocal relationship between ToM and reading comprehension in middle childhood, with stronger early mentalizing predicting subsequent gains in reading comprehension, which in turn appeared to further refine ToM abilities. Importantly, this pattern was not replicated for mathematics, suggesting a degree of domain specificity in the academic consequences of ToM development (Lecce & Devine, 2022). That said, longitudinal studies indicate that ToM proficiency in the preschool and early school years may carry consequences for a wider range of academic and social outcomes over time (Smogorzewska et al., 2022).

1.4 Measures and assessment of ToM

1.4.1 First-order false-belief measures

Given the breadth of definitions and conceptualizations surrounding ToM, it comes as no surprise that researchers have drawn on a wide array of paradigms and assessment tools to investigate the construct. Although children must develop the capacity to

interpret a diverse range of mental states, including emotions, knowledge, intentions, beliefs, and desires, the existing measurement landscape is notably skewed toward one particular domain: the assessment of false-belief reasoning (Beaudoin et al., 2020).

First-order ToM skills represent the earliest and most foundational level of ToM development, involving the capacity to understand that another person may hold beliefs or thoughts that differ from reality (Şirin et al., 2026). At their most basic, first-order false-belief skills can be described as the ability to recognize what one person knows that another does not — that is, the capacity to attribute mistaken beliefs about the world to another individual (Şahin et al., 2018).

Two of the most widely used paradigms for assessing first-order false-belief understanding are the Sally-Anne task and the Smarties task.

In the Smarties task, participants are shown a box typically associated with a well-known candy and asked what they believe it contains. Upon discovering that the box actually holds a pencil, they are then asked to predict what another child — one who has never seen the box — would expect to find inside. A correct response, indicating that the other child would anticipate the usual contents rather than the pencil, is awarded one point (Şahin et al., 2018).

The Sally-Anne task follows a similar logic. A child is presented with a short narrative, typically enacted with dolls or illustrated cards, in which a character named Sally places a marble in a basket and then leaves the scene. In her absence, another character, Anne, moves the marble to a different container. When Sally returns, the child is asked where she would look for her marble. To respond correctly, the child must set aside their own knowledge of the marble's actual location and instead reason from Sally's perspective —

recognizing that she would search in the basket, where she left it, since she was not present when it was moved (Beaudoin et al., 2020; Şahin et al., 2018; Şirin et al., 2026). Success on this task indicates that the child is capable of representing another person's mental state as distinct from reality, which is considered a hallmark of ToM (Beaudoin et al., 2020).

Children typically pass false-belief tasks of this kind between the ages of three and five (Wellman et al., 2001), an observation that has historically been taken as evidence that this developmental window marks the emergence of ToM (Beaudoin et al., 2020).

1.4.2 Second-order false-belief measures

Second-order ToM skills represent the next level of development beyond first-order reasoning, and involve the capacity to understand what one person thinks about what another person thinks. Compared to first-order tasks, second-order false-belief paradigms are structurally more complex, as they introduce additional characters into the narrative and require the participant to draw inferences based on one character's knowledge of a third party's mental state (Şirin et al., 2026).

At their core, second-order false-belief tasks assess the ability to predict what a second person believes about the thoughts or beliefs of a third person. Participants are typically presented with a short story, often accompanied by illustrated cards, involving two children, and are subsequently asked to reason about one character's belief regarding another's belief. Two commonly employed paradigms of this type are the Ice Cream Truck Task and the Chocolate Bar Task. In both cases, after listening to the story, participants are asked to make a prediction that requires attributing a mental state to one character about another character's mental state. Performance on these tasks is generally

scored in a pass/fail format: a score of zero is assigned when no mental state attribution is produced, while a score of one is awarded when mental states are correctly attributed to both characters. In some research contexts, scores across first- and second-order tasks are combined into a composite measure, the Total False Belief Level, to provide an overall index of false-belief reasoning ability (Şahin et al., 2018; Şirin et al., 2026).

From a developmental standpoint, the ability to succeed on second-order false-belief tasks typically consolidates between the ages of five and six. Beyond this point, children continue to develop increasingly sophisticated forms of social-cognitive reasoning, including the understanding of sarcasm, faux pas, and white lies, which mature progressively throughout adolescence (Beaudoin et al., 2020; Miller, 2009).

1.4.3 Advanced ToM measures

Beyond false-belief reasoning, a number of tasks have been designed to assess higher-order ToM abilities that emerge later in development. These measures move beyond the attribution of simple false beliefs and instead target more nuanced capacities, such as inferring communicative intentions, recognizing social gaffes, and reading emotional states from facial cues.

The Hinting Task represents a more advanced measure of ToM (Corcoran et al., 1995), targeting the ability to infer the true communicative intention behind an indirect or ambiguous utterance. Following exposure to a short story, participants are asked to identify what a character truly meant to convey, beyond the literal content of their words. If the initial response is incorrect, a follow-up question containing a more explicit hint is provided. Scoring reflects the level of support required to reach the correct answer: two points are awarded for an unprompted correct response, one point if

the correct answer is given only after the additional hint, and zero points if neither question is answered correctly (Şahin et al., 2018).

The Faux Pas Test is employed to assess high-level mental state reasoning (Baron-Cohen et al., 1999). Recognizing a faux pas is considered one of the most developmentally advanced ToM skills and is regarded as a particularly sensitive measure of the construct. A faux pas occurs when an individual inadvertently says something inappropriate, without awareness of its potential impact. Detecting such a social misstep requires the simultaneous representation of two distinct mental states, drawing on both cognitive and affective components of ToM. After listening to each story, participants are asked a series of four questions probing their comprehension and understanding of the social situation. To be credited with detecting a faux pas, the child must answer all questions correctly, demonstrate comprehension of the story, and recognize that the faux pas arose from a false belief held by one of the characters. In control stories, the child must correctly identify that no faux pas occurred. Failure on any single question results in a score of zero for that story. The children's version of the Faux Pas Recognition Test was administered in Turkish, comprising five faux pas stories and five control stories, for a maximum total score of ten points (Şahin et al., 2018).

The Reading the Mind in the Eyes Task (RMET) is another widely used measure of advanced ToM abilities. The task presents participants with a series of photographs depicting only the eye region of the face, and asks them to select, from a set of four options, the mental state or emotion that best corresponds to each image. In doing so, the RMET assesses the degree to which an individual is capable of adopting another person's perspective and inferring their internal mental state (Baron-Cohen et al., 2001)

on the basis of subtle facial cues, integrating both facial perception and emotion recognition (Şahin et al., 2018; Şirin et al., 2026). Originally developed by Baron-Cohen and colleagues, the task was subsequently revised in 2001 to make it suitable for use with children, using photographs of the eyes of 28 male and female individuals. Each correct response is awarded one point, yielding a maximum total score of 28 points (Şahin et al., 2018).

The Comprehension Test (CT) is an 11-item instrument assessing the ability to understand another person's emotional response in a given situational context (Dyck, 2012; Eyuboglu et al., 2017), covering a broad range of basic and complex emotions. The Unexpected Outcomes Test (UOT) is a 12-item measure targeting empathic reasoning (Dyck et al., 2001; Eyuboglu et al., 2017), in which participants must account for a story character's unexpected emotional reaction by providing additional contextual information (Eyuboglu et al., 2017).

The Theory of Mind subtest from the NEPSY-II battery assesses an individual's capacity to attribute beliefs, emotions, and intentions to others, as well as their understanding that other people hold their own distinct mental states. The subtest comprises two components. The verbal task evaluates perspective-taking ability by presenting descriptions or visual scenarios and asking participants to consider another individual's point of view (maximum raw score = 17 points). The contextual task, by contrast, requires participants to match appropriate emotional responses to depicted social situations: for each of eight trials, participants are shown a social scene alongside four facial expressions and must select the emotion that best fits the context (maximum raw score = 8 points) (Wang et al., 2025).

1.4.4 Verbal and non-verbal assessment of ToM: limitations and alternatives

Most tasks designed to assess Theory of Mind are verbal in nature, requiring children to process a narrative or a set of instructions in order to attribute mental states to other individuals. Performance on these linguistically demanding tasks does not solely reflect the child's level of ToM development; rather, it is also shaped by a range of additional cognitive and linguistic abilities, including memory, attention, comprehension of the specific wording of test questions, and an adequate command of linguistic resources encompassing understanding, processing, and production (Bloom & German, 2000; Burnel et al., 2018; Šimleša et al., 2021).

The importance of non-verbal alternatives in ToM assessment has long been recognized, leading to the development and investigation of a number of such tasks. Among these are studies employing the widely used battery proposed by Wellman and Liu (2004). However, even the tasks included in this battery are not entirely free from linguistic demands, as children are still required to engage with some form of verbal narrative. As a result, performance on these supposedly non-verbal tasks may still be subject to the influence of a child's language comprehension abilities (Burnel et al., 2018; Šimleša et al., 2021).

Given the limitations associated with many conventional ToM measures, the Animated Triangles Task (AT), also referred to as the Frith-Happé Animations, was designed as an alternative tool to address these shortcomings. The task presents participants with computer-generated animations depicting the movements and interactions of two geometric shapes and asks them to interpret what is occurring in the scenes. Because the stimuli are entirely non-verbal and consist of geometric figures, mental state attribution

relies solely on the movement of the shapes, eliminating any influence from verbal information or facial expressions. An additional methodological strength of the AT lies in the inclusion of control conditions that do not require mentalizing abilities, allowing researchers to account for performance differences unrelated to ToM. Owing to these characteristics, the AT has become one of the most extensively used instruments for assessing ToM (Andersen et al., 2022).

1.5 Theory of Mind in children and adolescents with SLD

1.5.1 Language and social difficulties in children with SLD

Only in recent years have social cognition difficulties been identified in children with neurodevelopmental disorders such as SLD (Pastorino et al., 2021), and the examination of SLD within the broader field of social cognition research has remained insufficient (Şahin et al., 2018). During the developmental period, children with SLD commonly present with language delays, pragmatic and semantic difficulties, problems in understanding metaphorical language, and challenges in social relationships, all of which are thought to be closely linked to ToM and empathy abilities (Eyuboglu et al., 2017). Furthermore, children with SLD often struggle in the socio-emotional domain, with repercussions on self-esteem, social functioning, and the possible development of psychiatric comorbidities; deficits in social cognition are thought to represent a crucial factor driving these difficulties (Şahin et al., 2018).

1.5.2 Empirical findings on ToM in children and adolescents with SLD

Consistent with this theoretical framework, a growing body of empirical studies has documented ToM impairments in children and adolescents with SLD. Eyuboglu et al.

(2017) found that children with SLD demonstrated weaker empathy and ToM abilities relative to their typically developing peers. Similarly, Şahin et al. (2018) reported that children with SLD showed ToM deficits associated with difficulties in communicating and engaging effectively with others. Özyurt et al. (2024) provided further evidence of reduced ToM performance particularly among children diagnosed with developmental dyslexia, while Ciray and Turan (2024) showed that adolescents with SLD obtained markedly poorer results compared to typically developing peers on tasks involving emotional face recognition and executive functioning.

1.5.3 Limitations and gaps in the existing literature

Despite this emerging body of evidence, an important limitation persists: existing studies have not systematically investigated whether ToM deficits differ across SLD subtypes. This gap is particularly relevant given that individuals with dyslexia, dysgraphia, and dyscalculia may be characterized by different neurocognitive features (Şirin et al., 2026). Moreover, since SLD subtypes frequently co-occur within the same individual, identifying the specific contribution of each subtype to social cognition deficits represents a methodological challenge for research in this area (Şahin et al., 2018).

Overall, the evidence reviewed in this chapter converges in suggesting that ToM is compromised in children and adolescents with SLD. However, individual studies in this area differ considerably in their methodologies and findings, and no attempt has yet been made to combine these results statistically into a single, quantitative estimate. As a result, it remains unclear how large or how consistent ToM difficulties truly are in this population.

1.6 Rationale and aims of the present meta-analysis

The evidence reviewed in the preceding sections points to a consistent, though not yet quantified, association between SLD and difficulties in ToM. At the same time, investigations into social cognition in this population remain considerably less numerous than those conducted in other neurodevelopmental conditions, and the studies that are available differ widely in the diagnostic criteria, age ranges, and ToM measures employed. This heterogeneity, combined with the absence of any attempt to pool results across studies, means that the actual size and stability of group differences in ToM performance cannot be inferred from any single investigation, nor estimated by simply comparing studies side by side.

This question is not only of theoretical interest: understanding the extent of ToM difficulties in SLD also has practical implications. The social and emotional adjustment of individuals with SLD is known to be compromised in ways that often persist over time, and if difficulties in mentalizing form part of this picture, this would point to a dimension of functioning that purely academic interventions are unlikely to capture. A clearer picture of ToM functioning in SLD could therefore help inform how this population is assessed and supported.

Against this background, the present study pursued two complementary aims. On one hand, it involved a systematic search and screening of the available literature, following a structured and predetermined set of eligibility criteria, in order to obtain a comprehensive overview of how ToM has been studied in pediatric SLD samples to date, including the diagnostic profiles represented, the populations sampled, and the methodological choices made across studies. On the other hand, it involved combining

the effect sizes obtained from eligible studies within a random-effects meta-analytic model, in order to derive a single, pooled estimate of the difference in ToM performance between children and adolescents with SLD and typically developing peers, a step that no prior study in this area had taken, despite the growing number of individual investigations.

In addition to this primary aim, the present meta-analysis sought to characterize the nature of this body of evidence in greater detail, by examining how studies were distributed across different SLD diagnoses (including mixed presentations of SLD and developmental dyslexia) and across different types of ToM tasks, distinguishing between verbal and non-verbal stimuli and between basic and more advanced levels of mentalizing. Mapping this variability was considered a necessary step toward understanding the sources of heterogeneity that might affect the overall pooled estimate.

Building on this background, the analysis was guided by the expectation that ToM abilities in the SLD group would fall substantially below those observed in typically developing peers, to a degree large enough to be considered clinically and statistically meaningful.

Chapter 2 – Method

Literature search

A systematic search of the literature to identify empirical studies published between 1978 (the year in which Premack and Woodruff first coined the term ‘theory of mind’) and 2025 was conducted in May 2025 to examine theory of mind (ToM) in children and adolescents with specific learning disabilities. The following databases were searched: Scopus, Web of Science, and PubMed. The search was performed in titles, abstracts, and keywords using the following Boolean string: (“theory of mind” OR “mentalising” OR “mentalizing” OR “mind reading” OR “mind perception” OR “cognitive empathy” OR “empathic accuracy” OR “mental state attribution” OR “folk psycholog*” OR “perspective taking” OR “false belief*” OR “advanced theory of mind” OR “belief-desire”) AND (“reading comprehension difficult*” OR “reading comprehension disorder*” OR “developmental dyslexia” OR “dyslexia” OR “reading disorder*” OR “reading difficult*” OR “specific learning disorder*” OR “specific learning disabilit*” OR “specific math* disorder*” OR “developmental dyscalculia” OR “dyscalculia” OR “math* difficult*”) AND (“child*” OR “adolescen*”).

Our search followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (Page et al., 2021). The search yielded a total of 656 records, including 30 from Scopus, 620 from Web of Science, and 6 from PubMed. After duplicate removal, 634 records were retained. To check agreement among the authors, an initial subset of 150 records, corresponding to approximately 23% of the total records screened, was assessed independently and blindly by three reviewers (C.R., N.G., and K.B.). An initial percentage agreement of 96% was found. After this

agreement check, the remaining 484 records were screened independently according to the predefined inclusion and exclusion criteria. Any doubtful cases were discussed collectively until consensus was reached. Title and abstract screening led to the retention of 19 articles for full-text assessment.

Four of these studies were excluded because they did not meet the eligibility criteria (i.e., two were conducted in the wrong population and two did not collect the requested measures). In addition, five studies did not provide all the data required for effect size calculation. Therefore, the corresponding authors were contacted to request the missing information. Data were successfully obtained for two studies, whereas the authors of three studies were unable to provide the required information. These three studies were therefore excluded, resulting in a final sample of twelve included studies.

Data selection

Studies were included if they met the following criteria: 1) written in English; 2) reported empirical data (no reviews, opinion papers, or meta-analyses were included); 3) included a sample of children or adolescents with a clinical diagnosis of specific learning disabilities and a control group of typically-developing participants without a diagnosis; 4) explicitly assessed theory of mind providing at least one behavioral measure of ToM; and 5) included participants aged between 6 and 18 years. The explicit assessment of learning skills was considered optional rather than mandatory.

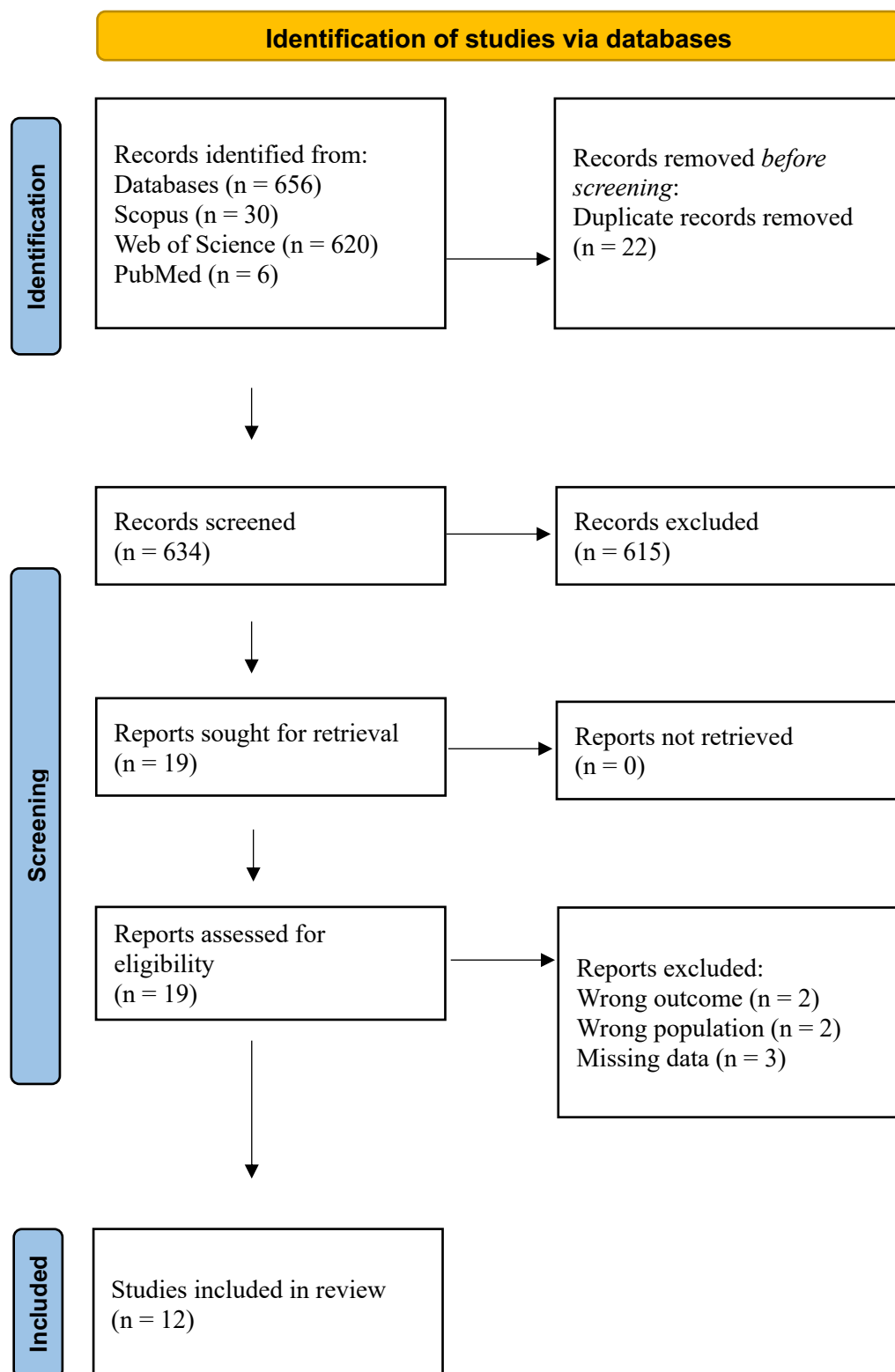


Fig. 1. Flow diagram of the identification and selection of studies based on PRISMA guidelines.

Data extraction

Data were extracted from the 12 included studies and organized in a standardized Excel spreadsheet. The extraction was aimed at comparing ToM performance between children and adolescents with SLD and typically-developing control groups.

For each study, the following information was recorded when available: (1) year of publication; (2) region of study; (3) type of clinical diagnosis of SLD group; (4) sample size of each group (children with SLD and typically-developing subjects; (5) participants' age (mean and standard deviation); (6) gender of the participants of each group (percentage of males); and, (7) ToM measures. When available, additional information on matching variables, such as non-verbal IQ, school grade, socioeconomic indicators, or parental education level, was also extracted.

For each ToM measure reported in the included studies, we extracted the name of the task or subtest, the assessed ToM level, the stimulus modality, the assessed mental state category, the response format, the minimum and maximum possible score, and reliability indices when reported. When a study included more than one ToM task or subscale, each outcome was entered separately in the database. The main data extracted for the analyses were the mean scores and standard deviations of ToM performance separately for children and adolescents with SLD and for typically-developing controls. When studies reported data for specific diagnostic subgroups, such as developmental dyslexia, reading comprehension difficulties, mathematical difficulties, or mixed SLD, group-specific sample size, means and standard deviations were extracted separately. Standardized effect size estimates and *p*-values were also recorded when available.

Sample characteristics of the included studies are reported in Table 1. Table 2 reports details about the used ToM measures and their descriptive statistics.

Table 1. Sample characteristics of the included studies.

<i>Authors</i>	<i>Year</i>	<i>Diagnosis Group</i>	<i>N_Total Sample</i>	<i>N_Controls</i>	<i>N_SLD</i>	<i>Controls_ M_Age</i>	<i>Controls_ Age_SD</i>	<i>SLD_M_ Age</i>	<i>SLD_ Age_ SD</i>	<i>Controls Boys (%)</i>	<i>SLD Boys (%)</i>
<i>Albayrak et al.</i>	<i>2022</i>	<i>Mixed SLD</i>	<i>93</i>	<i>43</i>	<i>50</i>	<i>9,40</i>	<i>—</i>	<i>9,40</i>	<i>—</i>	<i>0,56</i>	<i>0,74</i>
<i>Sahin et al.</i>	<i>2018</i>	<i>Mixed SLD</i>	<i>48</i>	<i>24</i>	<i>24</i>	<i>10,00</i>	<i>—</i>	<i>9,00</i>	<i>—</i>	<i>0,83</i>	<i>0,66</i>
<i>Cardillo et al.</i>	<i>2018</i>	<i>Dyslexia</i>	<i>42</i>	<i>21</i>	<i>21</i>	<i>9,35</i>	<i>0,50</i>	<i>9,14</i>	<i>0,57</i>	<i>0,476</i>	<i>0,619</i>
<i>Ciray et al.</i>	<i>2024</i>	<i>Mixed SLD</i>	<i>86</i>	<i>43</i>	<i>43</i>	<i>14,88</i>	<i>1,61</i>	<i>13,72</i>	<i>1,47</i>	<i>0,72</i>	<i>0,744</i>
<i>Eyuboglu et al.</i>	<i>2017</i>	<i>Mixed SLD</i>	<i>83</i>	<i>43</i>	<i>40</i>	<i>9,30</i>	<i>1,30</i>	<i>9,30</i>	<i>1,50</i>	<i>0,60</i>	<i>0,62</i>
<i>Kouklari, Tsermentseli, Pavlidou</i>	<i>2024</i>	<i>Mixed SLD</i>	<i>135</i>	<i>94</i>	<i>41</i>	<i>8,84</i>	<i>6,71</i>	<i>8,99</i>	<i>7,88</i>	<i>0,48</i>	<i>0,66</i>

<i>Operto et al.</i>	2020	<i>Mixed SLD</i>	95	32	63	11,78	3,87	11,70	5,05	—	—
<i>Özyurt et al.</i>	2024	<i>Dyslexia</i>	135	68	67	14,05	1,37	13,76	1,58	0,53	0,51
<i>Pastorino et al.</i>	2021	<i>Mixed SLD</i>	124	61	63	11,56	3,28	11,51	2,83	0,52	0,54
<i>Sabag-Shushan & Katzir</i>	2023	<i>Mixed SLD</i>	136	123	13	—	—	—	—	—	—
<i>Kouvava et al.</i>	2025	<i>Dyslexia</i>	128	64	64	9,67	1,15	9,82	1,15	0,48	0,52
<i>Wang et al.</i>	2025	<i>Dyslexia</i>	174	89	85	9,40	0,56	9,31	0,51	0,69	0,63

Note. SLD = Specific Learning Disorder; SD = Standard Deviation.

Table 2. Theory of Mind measures and extracted outcomes.

<i>Authors</i>	<i>ToM_Measure_NameOfTheTest</i>	<i>Controls_ToM_M</i> <i>± SD</i>	<i>SLD_ToM_M</i> <i>± SD_jamovi</i>	<i>Cohen's</i> <i>d</i>
<i>Albayrak et al.</i>	<i>RMET</i>	<i>19,48 ± 2,91</i>	<i>15,34 ± 4,34</i>	<i>1,15</i>
<i>Sahin et al.</i>	<i>RMET</i>	<i>19,44 ± 3,43</i>	<i>12,55 ± 5,41</i>	<i>1,35</i>
<i>Sahin et al.</i>	<i>TFBL Total False Belief Level</i> <i>(First-order + Second-order scores)</i>	<i>3,39 ± 0,78</i>	<i>2,41 ± 1,22</i>	<i>0,97</i>
<i>Sahin et al.</i>	<i>SOFB Second-order False Belief Score (Chocolate + Icecream)</i>	<i>1,39 ± 0,78</i>	<i>0,82 ± 0,91</i>	<i>0,53</i>
<i>Sahin et al.</i>	<i>Hinting Task</i>	<i>7,00 ± 1,75</i>	<i>2,96 ± 2,08</i>	<i>2,54</i>
<i>Sahin et al.</i>	<i>FOFB First-order False Belief Score (SallyAnne + Smarties)</i>	<i>2,00 ± 0,00</i>	<i>1,59 ± 0,59</i>	—
<i>Sahin et al.</i>	<i>Faux Pas</i>	<i>7,83 ± 0,99</i>	<i>3,55 ± 2,50</i>	<i>2,02</i>
<i>Cardillo et al.</i>	<i>ToM subtest from the NEPSY-II battery: contextual task</i>	<i>6,50 ± 1,20</i>	<i>6,90 ± 1,00</i>	—
<i>Cardillo et al.</i>	<i>ToM subtest from the NEPSY-II battery: verbal task</i>	<i>16,20 ± 1,00</i>	<i>14,60 ± 1,60</i>	<i>1,24</i>
<i>Ciray et al.</i>	<i>RMET</i>	<i>22,13 ± 1,84</i>	<i>21,95 ± 1,81</i>	<i>0,10</i>

<i>Authors</i>	<i>ToM_Measure_NameOfTheTest</i>	<i>Controls_ToM_M</i> <i>± SD</i>	<i>SLD_ToM_M</i> <i>± SD_jamovi</i>	<i>Cohen's</i> <i>d</i>
<i>Ciray et al.</i>	<i>Faux Pas</i>	<i>7,63 ± 0,98</i>	<i>7,39 ± 1,03</i>	<i>0,24</i>
<i>Eyuboglu et al.</i>	<i>False-belief Tasks: total</i> <i>(first+second-order) ToM</i>	<i>5,65 ± 0,69</i>	<i>4,53 ± 1,22</i>	<i>1,14</i>
<i>Eyuboglu et al.</i>	<i>False-belief Tasks: second-order</i> <i>ToM</i>	<i>2,81 ± 0,39</i>	<i>2,28 ± 0,68</i>	<i>0,97</i>
<i>Eyuboglu et al.</i>	<i>Comprehension test</i>	<i>12,07 ± 2,72</i>	<i>9,15 ± 1,78</i>	<i>1,26</i>
<i>Eyuboglu et al.</i>	<i>Unexpected outcomes test</i>	<i>14,65 ± 2,76</i>	<i>10,70 ± 3,62</i>	<i>1,23</i>
<i>Eyuboglu et al.</i>	<i>False-belief Tasks: first-order</i> <i>ToM</i>	<i>2,84 ± 0,43</i>	<i>2,25 ± 0,84</i>	<i>0,89</i>
<i>Kouklari,</i> <i>Tsermentseli,</i> <i>Pavlidou</i>	<i>RMET</i>	<i>15,60 ± 3,60</i>	<i>13,50 ± 4,20</i>	<i>0,41</i>
<i>Kouklari,</i> <i>Tsermentseli,</i> <i>Pavlidou</i>	<i>False Belief Task: Sandbox first</i> <i>order</i>	<i>2,00 ± 3,10</i>	<i>1,90 ± 2,80</i>	<i>0,11</i>
<i>Operto et al.</i>	<i>Nepsy II - Social Cognition</i> <i>subtest (identification of</i> <i>emotions through facial</i> <i>expressions (AR))</i>	—	—	—

<i>Authors</i>	<i>ToM_Measure_NameOfTheTest</i>	<i>Controls_ToM_M</i> <i>± SD</i>	<i>SLD_ToM_M</i> <i>± SD_jamovi</i>	<i>Cohen's</i> <i>d</i>
<i>Operto et al.</i>	<i>Nepsy II - Social Cognition subtest (the ability to decode and interpret the intentions of others and their points of view and understand how these affect behavior (TM))</i>	<i>9,69 ± 2,01</i>	<i>6,21 ± 2,87</i>	<i>1,40</i>
<i>Özyurt et al.</i>	<i>Faces test - To recognize emotions from faces</i>	<i>16,59 ± 0,99</i>	<i>15,13 ± 1,16</i>	<i>1,35</i>
<i>Özyurt et al.</i>	<i>RMET</i>	<i>22,51 ± 1,45</i>	<i>20,64 ± 1,31</i>	<i>1,35</i>
<i>Özyurt et al.</i>	<i>Comprehension</i>	<i>18,16 ± 1,30</i>	<i>17,12 ± 1,33</i>	<i>0,79</i>
<i>Özyurt et al.</i>	<i>Faux Pas</i>	<i>7,47 ± 0,95</i>	<i>6,88 ± 0,84</i>	<i>0,66</i>
<i>Özyurt et al.</i>	<i>Unexpected outcomes</i>	<i>18,03 ± 1,67</i>	<i>16,79 ± 1,26</i>	<i>0,84</i>
<i>Pastorino et al.</i>	<i>Nepsy II - Social cognition subtests of discrimination; recognition and contextualization of emotions through facial expressions</i>	<i>10,36 ± 1,08</i>	<i>4,59 ± 2,52</i>	—
<i>Pastorino et al.</i>	<i>Nepsy II - Subtest that evaluates the ability to understand mental</i>	<i>9,67 ± 1,74</i>	<i>6,21 ± 2,87</i>	<i>1,45</i>

<i>Authors</i>	<i>ToM_Measure_NameOfTheTest</i>	<i>Controls_ToM_M</i> $\pm SD$	<i>SLD_ToM_M</i> $\pm SD_{jamovi}$	<i>Cohen's</i> <i>d</i>
	<i>functions such as beliefs, intentions, deceptions, and emotions</i>			
<i>Sabag-Shushan & Katzir</i>	<i>Faux Pas</i>	$84,85 \pm 19,74$	$60,93 \pm 17,81$	—
<i>Kouvava et al.</i>	<i>ToM—Second-order false belief tasks</i>	$7,78 \pm 2,61$	$3,23 \pm 3,03$	$1,61$
<i>Kouvava et al.</i>	<i>Strange stories</i>	$25,61 \pm 4,52$	$18,39 \pm 4,26$	$1,64$
<i>Wang et al.</i>	<i>Nepsy II - individual's ability to comprehend and attribute beliefs, emotions, and intentions to others, as well as their awareness that others possess their own distinct thoughts and feelings</i>	$21,98 \pm 2,35$	$13,92 \pm 2,75$	$1,23$

Statistical analysis

The analysis was carried out using the standardized mean difference as the outcome measure. A random-effects model was fitted to the data. The amount of heterogeneity (i.e., τ^2), was estimated using the restricted maximum-likelihood estimator (Viechtbauer 2005). In addition to the estimate of τ^2 , the Q-test for heterogeneity (Cochran 1954) and the I² statistic are reported. In case any amount of heterogeneity is detected (i.e., $\tau^2 > 0$, regardless of the results of the Q-test), a prediction interval for the true outcomes is also provided. Studentized residuals and Cook's distances are used to examine whether studies may be outliers and/or influential in the context of the model. Studies with a studentized residual larger than the $100 \times (1 - 0.05/(2 \times k))$ th percentile of a standard normal distribution are considered potential outliers (i.e., using a Bonferroni correction with two-sided $\alpha = 0.05$ for k studies included in the meta-analysis). Studies with a Cook's distance larger than the median plus six times the interquartile range of the Cook's distances are considered to be influential. The rank correlation test and the regression test, using the standard error of the observed outcomes as predictor, are used to check for funnel plot asymmetry. All the analyses were run in Jamovi.

Chapter 3 – Results

3.1. Sample characteristics

The final sample included 12 studies, with a total of 1,279 participants. Across the included studies, 574 participants were children and adolescents with SLD, whereas 705 participants were typically-developing controls. Sample sizes ranged from 42 to 174 participants across studies. The clinical samples included children and adolescents with either mixed SLD (N=8 studies) or developmental dyslexia (N=4 studies). Overall, studies conducted in mixed SLD samples included 337 participants with a clinical diagnosis and 463 controls, while studies conducted in samples with developmental dyslexia included 237 participants with a clinical diagnosis and 242 controls.

Overall, mean age ranged from 8.84 to 14.88 years in the control groups and from 8.99 to 13.76 years in the SLD groups; participants were around 10–11 years old (mean age of 10.66 years and standard deviation of 2.01 in the control groups; mean age of 10.72 years and standard deviation of 1.76 in the SLD groups).

Across these studies, boys were generally slightly more represented in the SLD groups than in the control groups.

3.2. Characteristics of ToM measures and ToM levels

Across the 12 included studies, the ToM measures were heterogeneous and included false-belief tasks (N=8 effect sizes), NEPSY-II Social Cognition subtests (N=7 effect sizes), the Reading the Mind in the Eyes Test (RMET; N=5 effect sizes), Faux Pas tasks

(N=4 effect sizes), Comprehension tests (N=2 effect sizes), Unexpected Outcomes tests (N=2 effect sizes), the Faces Test (N=1 effect size), the Hinting Task (N=1 effect size), and Strange Stories (N=1 effect size).

With regard to stimulus modality, most ToM outcomes used verbal stimuli. Specifically, 22 outcomes were based on verbal material, including false-belief tasks, Faux Pas test, the Hinting Task, Strange Stories, Comprehension tests, Unexpected Outcomes tests, and verbal NEPSY-II ToM subtests. The remaining 9 outcomes were based on non-verbal stimuli, including the RMET, the Faces Test, and some NEPSY-II emotion recognition subtests.

Response formats also varied across measures. Overall, 23 outcomes used open or open-ended response formats, whereas 7 outcomes used closed-response formats, such as forced-choice responses. The response format was not specified for one outcome.

The extracted measures also differed in the mental state category assessed. The most common category was mixed mental states, including tasks that assessed more than one type of mental state, such as emotions, cognitive states and intentions. Mixed mental state tasks appeared in 12 outcomes, cognitive mental states appeared in 8 outcomes, emotional mental states appeared in 7 outcomes, whereas intentions were assessed in 4 outcomes.

Finally, ToM levels were classified as basic or advanced. Among the 30 effect sizes included in the meta-analysis, 16 were classified as basic ToM, including 3 effect sizes labelled as “Basic?”, and 14 were classified as advanced ToM. Basic ToM tasks included the RMET, the Faces Test, first-order false-belief tasks, and some NEPSY-II subtests. Advanced tasks included the Faux Pas test, the Hinting Task, Strange Stories,

Comprehension and Unexpected Outcomes tests, second-order false-belief tasks, and other NEPSY-II ToM subtests.

3.3. Meta-analytic results

The meta-analysis was conducted on 30 effect sizes extracted from the 12 included studies. The observed standardized mean difference was used as the outcome measure, and a random-effects model was fitted to the data. The observed standardized mean differences ranged from -0.355 to 3.143, with the majority of estimates being positive (97%). The random-effects model showed a significant overall effect, with an estimated standardized mean difference of 1.155 ($SE = 0.137$, $z = 8.41$, $p < .001$, 95% CI [0.886, 1.424]).

Table 3. *Random-Effects Model*

Random-Effects Model ($k = 30$)

	Estimate	se	Z	p	CI Lower Bound	CI Upper Bound
Intercept	1.16	0.137	8.41	< .001	0.886	1.424

Nota. Tau² Estimator: Restricted Maximum-Likelihood

Therefore, the average outcome differed significantly from zero ($z = 8.410$, $p < 0.001$). This indicates that, overall, typically-developing control groups showed significantly higher ToM performance than participants with SLD. The size of the overall effect was

large. However, the results also showed high heterogeneity. The Q-test was significant, $Q(29) = 286.431$, $p < .001$, and the heterogeneity index was high, $I^2 = 90.524\%$.

Table 4. *Heterogeneity Statistics*

Heterogeneity Statistics

Tau	Tau²	I²	H²	df	Q	p
0.710	0.5041 (SE = 0.1485)	90.52%	10.553	29.000	286.431	< .001

Therefore, although the overall effect was significant, the size of the effect varied across studies and ToM tasks. The 95% prediction interval ranged from -0.262 to 2.573. This suggests that, although the average effect was positive, the size of the effect may differ across studies and tasks. An examination of the studentized residuals revealed that none of the studies had a value larger than ± 3.144 and hence there was no indication of outliers in the context of this model. However, according to the Cook's distances, one study (Wang et al., 2025) could be considered to be overly influential.

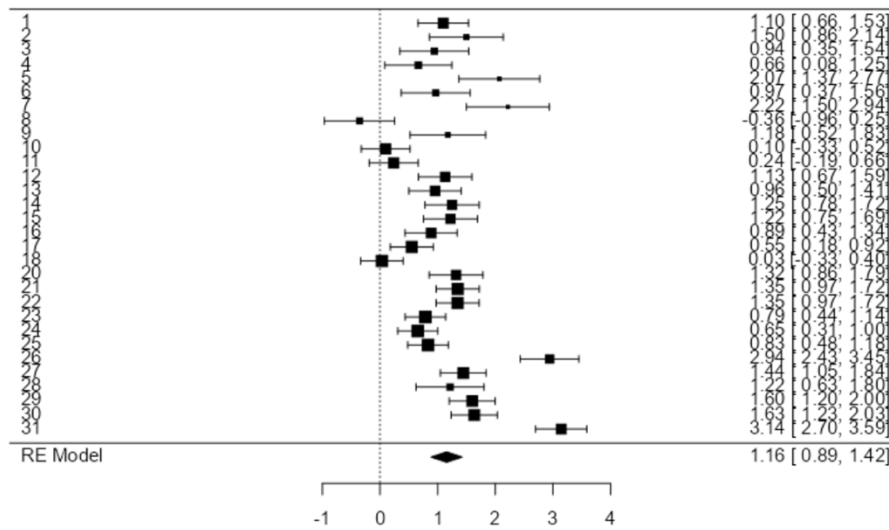


Fig. 2. Forest plot of standardized mean differences in Theory of Mind performance between SLD and control groups.

Publication bias was examined using funnel plot asymmetry tests. Begg and Mazumdar's test ($p = .068$) and Egger's regression test ($p = .242$) were not significant, suggesting no clear evidence of funnel plot asymmetry. The Trim and Fill procedure did not identify any missing studies. Overall, these results did not suggest clear evidence of publication bias.

Table 5. Publication Bias Assessment

Publication Bias Assessment

<i>Test Name</i>	<i>value</i>	<i>p</i>
<i>Fail-Safe N</i>	<i>7700.000</i>	<i>< .001</i>
<i>Begg and Mazumdar Rank Correlation</i>	<i>0.237</i>	<i>0.068</i>
<i>Egger's Regression</i>	<i>1.171</i>	<i>0.242</i>
<i>Trim and Fill Number of Studies</i>	<i>0.000</i>	<i>.</i>

Nota. Fail-safe N Calculation Using the Rosenthal Approach

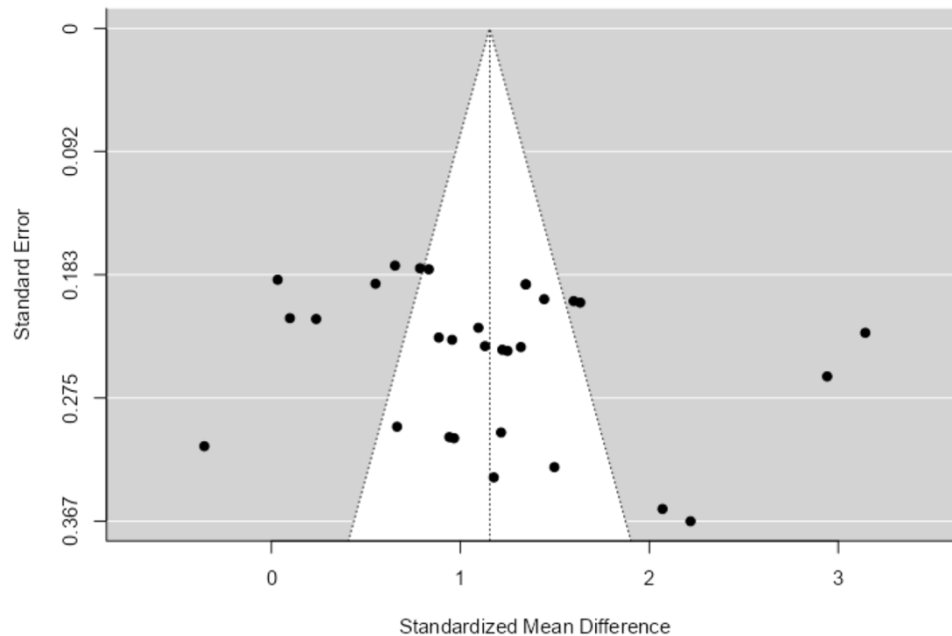


Fig. 3. Funnel plot for the assessment of publication bias.

Chapter 4 – Discussion

4.1. Overview of meta-analytic findings

Overall, the meta-analysis shows a large and significant difference in ToM performance between children and adolescents with SLD and their typically developing peers, with the controls performing better. However, the high heterogeneity indicates that this difference was not equally strong across all outcomes.

Considering this variability first, the 30 effect sizes were extracted from 12 studies and 1,279 participants. The high heterogeneity index ($I^2 = 90.52\%$) indicated that the effects differed substantially across studies, to an extent that goes well beyond what random variation between samples would produce. The 95% prediction interval was consistent with this: it ranged from -0.262 to 2.573 , so although the average effect was positive, in some studies the true effect could be much smaller.

The pooled estimate must therefore be interpreted against this background of variability. Under a random-effects model, the average effect was large and statistically significant ($SMD = 1.155$, 95% CI $[0.886, 1.424]$, $p < .001$), indicating that, once the effect sizes were combined, children and adolescents with SLD performed well below their typically developing peers on ToM measures. The diagnostic checks did not undermine this estimate. No study exceeded the threshold for a studentized-residual outlier, although Cook's distances flagged one study (Wang et al., 2025) as potentially influential. Tests for funnel plot asymmetry showed no clear evidence of publication bias (Begg and Mazumdar, $p = .068$; Egger, $p = .242$), and the Trim and Fill procedure

imputed no additional studies. The effect is therefore unlikely to be an artefact of selective reporting.

To our knowledge, no previous study in this area had attempted to pool the available evidence into a single estimate, despite a steadily accumulating set of individual investigations. The value of doing so lies less in the overall figure itself than in the questions it raises: if ToM performance is reliably reduced in SLD at the group level yet varies considerably in magnitude across studies, the next question concerns the sources of this variability. The following sections address this in turn, considering first the meaning of the central difference, then the study and task features that may account for its variability, and finally its developmental, clinical, and educational implications, before turning to the limitations of the present synthesis and the directions it opens for future research.

4.2. ToM performance in SLD

The central finding of this meta-analysis is that children and adolescents with SLD perform more poorly than their typically developing peers on tasks assessing Theory of Mind, and that this disadvantage is highly consistent in direction: of the thirty effect sizes examined, all but one were positive, favouring the control groups. Difficulties in mentalizing therefore appear alongside the reading, writing, and arithmetic difficulties that define SLD, suggesting that the impact of the disorder extends beyond the academic domain. This is consistent with evidence that socio-cognitive difficulties are not confined to autism spectrum conditions but are also found in other neurodevelopmental profiles, including SLD (Şahin et al., 2018).

The implication is that SLD may affect a domain that is easy to overlook when attention is focused on academic skills. Mentalizing supports a child's capacity to interpret a teacher's intentions, to read peers' reactions, and to sustain the relationships on which classroom learning partly depends (Smogorzewska et al., 2022); a group-level reduction in this capacity therefore has a reach that goes beyond performance on ToM tasks themselves. Several of the included studies are informative in this respect: using the NEPSY-II, both Operto et al. (2020) and Pastorino et al. (2021) found that children with SLD were less accurate than controls in recognising and interpreting others' mental and emotional states, suggesting that the difficulty is not limited to a single, narrowly defined ToM component.

How this group difference should be interpreted, however, is less straightforward than its size alone might suggest. Most ToM tasks place substantial demands on language and on executive resources, and these are precisely the areas in which children with SLD tend to be vulnerable (Šimleša et al., 2021; Wade et al., 2018). Verbal and more advanced tasks require following a narrative, holding several pieces of information in mind, and expressing an inference in words, so that weak performance may partly reflect these processing demands rather than a circumscribed difficulty in representing mental states. The included studies again illustrate the point: Cardillo et al. (2018) reported that children with dyslexia struggled with the verbal demands of ToM assessment and with the pragmatic aspects of language, while Kouklari et al. (2024) examined the poorer ToM performance of the SLD group in relation to the executive demands of the tasks. On this reading, the lower scores in the SLD group may reflect the demands that ToM tasks place on language and executive functioning, rather than a primary difficulty in mentalizing as such.

The present data cannot adjudicate between these two accounts: a genuine mentalizing deficit on the one hand, and a difference driven by the verbal and executive load of the tasks on the other. The deficit at the group level is robust and unlikely to be an artefact; what remains open is its underlying nature, since both mechanisms would produce the pattern observed here, and the two are not mutually exclusive. The cross-sectional design of the included studies adds a further layer of caution. It is plausible that the relationship is reciprocal over time: limited mentalizing may hamper the comprehension of texts and social exchanges, while restricted access to these same experiences may in turn slow the refinement of ToM, so that the two difficulties reinforce one another across development (Lecce & Devine, 2022). This possibility is consistent with the present results but cannot be tested with them, and it is best regarded as a hypothesis to be examined directly in future longitudinal work.

4.3. Interpretation of the observed heterogeneity

The pooled effect reported earlier was accompanied by a striking degree of variability: with an I^2 of 90.52% and a prediction interval extending from below zero into strongly positive values (−0.262 to 2.573), it is clear that, while children and adolescents with SLD were almost always at a disadvantage, the size of that disadvantage was far from uniform across the studies brought together here. A value of this kind is not something that random differences between samples could produce on their own, and it invites a closer look at what set these studies apart from one another. Several features of the studies, and of the way ToM was measured in them, offer plausible explanations.

The most obvious place to start is with the tasks themselves, which were anything but uniform. As described in the Results, the effect sizes came from a wide assortment of instruments, and these differed along several dimensions at once. The clearest of these is stimulus modality: the great majority of outcomes, twenty-two of them, relied on verbal material, asking children to follow a spoken or written narrative and then draw an inference into words, while only nine drew on non-verbal stimuli such as the eyes of the RMET or the faces of the emotion-recognition tasks. This matters because the two kinds of task do not make the same demands. A verbal task asks a child not only to reason about another person's mind but also to hold a story in memory, parse its language, and produce a verbal answer. These are precisely the skills on which children with SLD, and particularly those with dyslexia, tend to struggle. A difference observed on such a task may therefore reflect the linguistic packaging as much as the mentalizing underneath it. Where the balance falls between these two contributions likely varied from study to study, and with it the size of the measured effect.

A related distinction concerns the level of the task. Of the thirty outcomes, sixteen tapped basic mentalizing, such as first-order false belief, simple emotion recognition, and the like, while fourteen called on more advanced reasoning, of the sort required by the Faux Pas Test, Strange Stories, or the Hinting Task. Advanced tasks ask a child to coordinate several mental states at once, to weigh context, and to manage the inferential load that comes with it; they are, almost by design, harder and more dependent on the cognitive and linguistic resources that are uneven in this population. It would be unsurprising, then, if studies leaning more heavily on advanced measures produced larger gaps than those built around simpler ones. The measures also varied in the kind of mental state they targeted: twelve assessed a mix of states, eight focused on cognitive

states, seven on emotions, and four on intentions. They differed too in their response format, with twenty-three using open or open-ended answers, seven a closed, forced-choice format and the format of one outcome left unspecified. Each of these choices shapes what a task actually captures, and the sheer assortment of instruments used across the literature is, in itself, a natural source of the spread seen in the results.

Variability did not stop at the tasks. The clinical groups differed too, and in ways that are hard to set aside. Eight of the twelve studies recruited mixed SLD samples, in which different learning difficulties were combined under a single label, while the remaining four focused specifically on developmental dyslexia. There is good reason to suspect that ToM does not look quite the same across these profiles: a child whose difficulties centre on reading might be expected to find verbal mentalizing tasks especially taxing, whereas the link between mathematical difficulty and ToM is far less obvious. When several subtypes are folded into one group, as happened in most of the included studies, any differences between them are effectively masked, and the resulting estimate may sit higher or lower depending on the particular mix of children involved.

How the groups were assembled, and what was controlled for, added a further layer of difference. Some studies were careful in this respect. Pastorino and colleagues (2021), for instance, matched their groups not only on age and sex but also on intellectual level, maternal education, and socioeconomic status, while others did much less. In one case the groups were not matched at all: Albayrak and colleagues (2022) reported a significant difference in the proportion of boys between their SLD and control groups, and Kouklari and colleagues (2024) noted that their control children had higher IQ than those with SLD. Differences of this sort can push an effect size up or down quite

independently of any real difference in mentalizing, and when they are present in some studies but not others they feed directly into the heterogeneity of the pooled estimate.

A related concern is comorbidity. ADHD co-occurs with SLD more often than chance would predict (Shah & Somaiya, 2025; Flores, 2025), and ASD, too, is recognised as a possible comorbidity; difficulties in ToM, moreover, have been documented in both autism and other neurodevelopmental conditions (Wade et al., 2018), so the way a study handles them is not a trivial detail. The included studies were inconsistent in this respect: some set out explicit criteria for excluding children with ASD and ADHD, whereas others described no comorbidity screening at all, or reported their exclusion criteria in terms too general to tell. Where such conditions were not ruled out, it remains possible that some children counted within an SLD group also met criteria for a co-occurring disorder, and that a portion of the ToM difficulty attributed to SLD in those samples in fact reflected ASD or ADHD. Insofar as this varied from study to study, it offers another plausible reason why the size of the effect was so uneven across the literature.

Finally, age deserves a mention. The samples ranged from the early school years into adolescence, with average ages spanning from about nine to fifteen years, and this is a stretch of development over which mentalizing is still changing in important ways (Cassetta et al., 2018; Gabriel et al., 2019). As children grow, the ToM tasks considered appropriate for them tend to become more demanding, which could widen the gap between groups in older age. On the other hand, older children have also had longer to develop strategies that soften the everyday impact of their difficulties, which might narrow that difference instead. Which of these pulls dominates likely depends on the

particular combination of age and task in each study, and so age, too, belongs on the list of things that may have helped produce the variability observed here.

4.4. Developmental considerations

Age was introduced in the preceding section as a potential source of heterogeneity among others. It deserves, however, more than that role alone. The developmental window covered by the included studies, roughly nine to fifteen years, is not a neutral stretch of time: it is a period in which mentalizing is still actively changing, and this matters for how any observed group difference should be read.

As discussed in section 1.3.3, ToM development does not end in early childhood. The foundational competencies, such as first- and second-order false-belief reasoning, are broadly in place between five and seven years of age, but the more sophisticated forms of mentalizing, such as understanding sarcasm, faux pas, and indirect communicative intentions, continue to mature well into adolescence. Perspective-taking ability improves continuously at least through age eighteen. This behavioral trajectory is mirrored at the neural level: the prefrontal cortex, which is central to mentalizing, does not reach full maturity until early adulthood, and between ages thirteen and eighteen widespread maturational changes occur across prefrontal, temporal, and temporoparietal networks (Gabriel et al., 2019). This is not background detail. It means that the children and adolescents included across these studies were at genuinely different maturational stages, and treating them as a single homogeneous age band introduces a simplification that is difficult to overlook.

Within this broader trajectory, the distinction between cognitive and affective ToM, discussed in section 1.3.2, is particularly relevant for interpreting the present results. Cognitive ToM, the capacity to reason about others' beliefs and intentions, stabilizes relatively early in development. Affective ToM, which concerns the ability to infer others' emotional states, matures more slowly and undergoes its most substantial development during adolescence. This is because affective ToM requires the simultaneous integration of cognitive and emotional information, a process that depends on the maturation of structures that are still developing across the age range covered here. The practical consequences are real: tasks like the Faux Pas Test, which require coordinating a cognitive and an emotional representation at the same time, are typically not mastered until between nine and eleven years of age, and affective ToM abilities remain significantly less developed in adolescents than in adults. For children with SLD, whose profile already includes weaknesses in working memory and executive functioning, this kind of integration may be particularly demanding at the very point in development when it is still consolidating in the normative trajectory.

As for how age interacts with the size of the gap between children with SLD and controls, there is no straightforward answer. Two plausible mechanisms pull in opposite directions. As children get older, the tasks administered to them become more complex and draw more heavily on the verbal, executive, and inferential resources that are unevenly distributed in this population, and this might be expected to widen the gap in older samples, particularly when advanced measures like the Faux Pas Test, the Hinting Task, or Strange Stories are used. At the same time, older children have had more time to build compensatory strategies that may soften the impact of their difficulties in everyday life, such as learning to read context, relying on social scripts, and applying

pragmatic rules more deliberately, even when the underlying mentalizing capacity remains limited.

Which of these two pulls dominates likely depends on the specific combination of sample age and task type in each study. The cross-sectional design of the studies included here does not allow this tension to be resolved.

All of this has direct implications for assessment. Because mentalizing is still in motion across this age range, the choice of instrument is not a neutral one. A task that is well-calibrated for a nine-year-old may be too easy or too demanding for a fourteen-year-old, depending on how it is constructed. And the problem is compounded with SLD: as discussed in section 1.4.4, most available ToM measures are heavily verbal, which means that scores reflect not only a child's mentalizing level but also their language comprehension, narrative memory, and verbal production, precisely the areas where children with SLD tend to struggle most. A child who fails a verbal ToM task may do so because their capacity to represent mental states is genuinely limited, or because the linguistic demands of the task exceed their available resources, or for both reasons at once. Tasks calibrated to the mentalizing level expected at a given age, alongside non-verbal measures that reduce the linguistic load, would offer a considerably sharper picture, a point that will be taken up more fully in the discussion of future research directions. Keeping these developmental considerations in mind is also essential when thinking about how findings from this literature translate into practice, which is the focus of the following section.

4.5. Clinical and educational implications

The results of this meta-analysis point to something that goes beyond a statistical finding: children and adolescents with SLD carry a social-cognitive burden that remains largely unaddressed in current clinical and educational practice. Addressing this gap requires changes at multiple levels, from how these children are understood, to how they are evaluated, to how they are supported in the contexts where they spend most of their time.

The first and perhaps most fundamental shift concerns how the profile of a child with SLD is conceptualized. The evidence reviewed here suggests that SLD is not simply a disorder of academic skill acquisition, but a condition that may affect the child's capacity to navigate the social world as well. As discussed in section 1.5.1, children with SLD frequently encounter difficulties in pragmatic language, in understanding metaphorical communication, and in social relationships, all of which are closely tied to mentalizing ability. Recognizing ToM difficulties as a potential component of the SLD profile, rather than as an unrelated or secondary concern, changes the questions that clinicians and educators ask about these children and broadens the lens through which their difficulties are interpreted. A child who struggles socially or emotionally is not necessarily unmotivated or behaviorally difficult; they may be navigating a social environment that places demands on capacities that are genuinely compromised.

This reconceptualization has direct consequences for evaluation. The pooled effect size obtained in this meta-analysis was large and statistically significant, suggesting that ToM difficulties in children with SLD are not a marginal or occasional finding but a consistent feature of the group profile. A finding of this magnitude makes it difficult to justify evaluations that leave social-cognitive functioning entirely unexamined. If mentalizing difficulties are as prevalent and substantial as the present results suggest,

then a developmental assessment that does not include any measure of ToM is providing an incomplete picture of the child. This matters not only for diagnosis but for what follows from it: knowing that a child with SLD may also struggle with inferring others' intentions or navigating implicit social meaning opens up possibilities for support that a purely academic assessment would never identify. As discussed in section 1.3.5, ToM abilities are linked to how children engage with their teachers, how they access the metacognitive resources that support learning, and how they interpret the figurative and implicit language that characterizes educational contexts, all areas that are directly affected when mentalizing is compromised. Identifying these difficulties early gives clinicians and educators the opportunity to intervene before their consequences become more difficult to reverse.

The third level concerns what actually happens in the child's daily life. In educational settings, a child who struggles to infer a teacher's communicative intentions, to grasp the implicit meaning behind a peer's comment, or to follow the unspoken rules that govern classroom dynamics, is at a disadvantage that goes unnoticed when attention is focused exclusively on academic output. At home, the same reasoning applies: a child's mentalizing development does not happen in isolation from their everyday environment, and caregivers who understand the social-cognitive dimensions of their child's profile are better placed to recognize when difficulties in social situations reflect something deeper than simple behavioral problems. This understanding does not require specialist knowledge, it requires a shift in how the child's difficulties are framed and interpreted, one that this meta-analysis, we hope, contributes to making possible.

4.6. Limitations

The present study has a number of limitations that should be taken into account when interpreting its findings.

The first concerns the size of the evidence base. Twelve studies is a small number for a meta-analytic synthesis, and this had practical consequences for the analysis. It was not possible to conduct reliable comparisons across subgroups, whether by age, SLD diagnosis, or type of ToM task, because subdividing such a limited set of studies would not have left enough data in each group to draw meaningful conclusions.

Another limitation concerns the composition of the clinical groups. Most studies recruited mixed SLD samples rather than children with a single, clearly defined diagnosis. No study examined dyscalculia as a distinct diagnostic category, which means that the present findings say little about children whose difficulties are primarily mathematical. Given that different SLD subtypes are associated with at least partially distinct cognitive profiles, their relationship with ToM may also differ across diagnoses, and this remains a question that the present synthesis cannot answer.

The majority of the included studies were cross-sectional in design. This means that the present findings can establish that children with SLD perform differently from their typically developing peers on ToM measures, but cannot clarify how this difference emerges or whether ToM difficulties precede, follow, or develop alongside academic difficulties.

Comorbidity represents a further concern. Not all included studies applied explicit exclusion criteria for conditions such as ADHD and ASD, both of which are independently associated with differences in social cognition. Where these conditions

were not ruled out, it is difficult to determine whether the ToM differences observed between groups reflect SLD specifically or the influence of a co-occurring diagnosis.

As already noted in sections 1.4.4 and 4.4, most ToM measures used across the included studies relied heavily on language. Many tasks required children to follow a spoken or written narrative and to respond verbally, which means that scores may have reflected language difficulties as much as mentalizing ability. This makes it harder to determine how much of the observed group difference stems from a genuine difficulty in understanding others' mental states and how much from linguistic demands of the tasks themselves.

The geographic distribution of the included studies is also worth noting. Most samples were recruited in Turkey and Italy, which means that the findings regarding ToM in children with SLD may not generalize equally well to those educated in different linguistic contexts. Children learning to read in English, for example, face considerably greater orthographic complexity than those learning in Turkish or Italian.

4.7. Future research

The findings of this meta-analysis open several directions that future research should pursue, going beyond what the limitations of the present synthesis alone would suggest.

A first direction concerns the theoretical question that the results themselves raise but cannot answer: whether the ToM disadvantage observed in children with SLD reflects a genuine difficulty in representing others' mental states, or whether it is partly an artefact of the heavy linguistic demands that most available tasks place on participants. The Animated Triangles Task, for instance, is a well-established instrument that was notably

absent from all studies included in the present synthesis. More broadly, developing and validating implicit ToM measures specifically for populations with SLD would represent a valuable methodological advance.

Alongside this, the development of instruments better calibrated to the mentalizing level expected at different ages would also be valuable, since the same task may be too easy or too demanding depending on the child's developmental stage.

A further direction involves SLD subtypes. The present synthesis rested predominantly on mixed samples, and no study isolated dyscalculia as a distinct group. Given that dyslexia, dysgraphia, and dyscalculia are associated with partially different neurocognitive profiles, their relationship with ToM may not be uniform. Studies recruiting single-diagnosis groups and comparing subtypes directly would clarify whether the disadvantage documented here is a general feature of SLD or something that varies meaningfully across diagnostic profiles.

Future research should also aim for greater geographic and linguistic diversity. As noted in section 4.6, the studies included here were conducted predominantly in Turkey and Italy, both of which use relatively transparent orthographies. Whether the social-cognitive profile associated with SLD looks similar in children learning to read in more opaque orthographic systems, such as English, remains an open question.

Comorbidity is a related issue that future studies should handle more systematically. For example, ADHD frequently co-occurs with SLD (Shah & Somaiya, 2025; Flores, 2025) and is independently associated with social-cognitive difficulties. Where these conditions go unscreened, the ToM differences attributed to SLD may be at least partly driven by co-occurring diagnoses rather than by the learning disorder itself. Future

studies should therefore apply more consistent and explicit exclusion criteria when recruiting clinical samples.

Longitudinal designs are perhaps the most pressing need. The cross-sectional studies included here establish that a difference exists, but they cannot tell us when it emerges, whether it grows over time, or in which direction the influence runs. As discussed in sections 1.3.5 and 4.2, evidence points to a reciprocal relationship between mentalizing and reading comprehension in middle childhood, with each capacity feeding back into the other over time (Lecce & Devine, 2022). Testing this hypothesis directly in children with SLD, and following them longitudinally from before formal reading instruction into early adolescence, would offer a new picture of how academic and social-cognitive development interact in this population.

Finally, the size of the effect reported here provides a clear rationale for intervention research. If ToM difficulties are as consistent and substantial as the present results suggest, the question of whether they are responsive to targeted support becomes both scientifically relevant and practically important. This represents perhaps the most direct bridge between the findings of this meta-analysis and their potential implications for clinical and educational practice.

Chapter 5 – Conclusion

The present meta-analysis has brought together the available evidence on ToM performance in children and adolescents with SLD. This population shows substantially lower performance than typically developing peers on tasks that require reasoning about others' beliefs, intentions, and emotions, although the size of this disadvantage varies considerably across studies and tasks. Whether this reflects a genuine difficulty in mentalizing, the linguistic and executive demands of existing ToM measures, or both, remains an open question for future research to address.

What emerges clearly, in any case, is that the social-cognitive dimension of SLD deserves more attention than it currently receives, given its impact beyond the classroom on these children's everyday social relationships. ToM difficulties appear to be a consistent, if not yet fully understood, component of the SLD profile, and deserve to be recognized and supported alongside the academic difficulties that typically bring these children to clinical attention.

Future research will be needed to clarify how this disadvantage develops and whether it can be meaningfully addressed through targeted support.

Bibliography

Aboulafia-Brakha, T., Christe, B., Martory, M. D., & Annoni, J. M. (2011). Theory of mind tasks and executive functions: a systematic review of group studies in neurology. *Journal of neuropsychology*, 5(1), 39-55.

<https://doi.org/10.1348/174866410X533660>

Albayrak, Z. S., Kadak, M. T., Gürbüz, H. G. A., & Doğangün, B. (2022). Emotion recognition skill in specific learning disorder and attention-deficit hyperactivity disorder. *Alpha Psychiatry*, 23(6), 268.

<https://doi.org/10.5152/alphapsychiatry.2022.22219>

American Psychiatric Association. (2013). Diagnostic and Statistical Manual of Mental Disorders (5th ed.). American Psychiatric Publishing.

<https://doi.org/10.1176/appi.books.9780890425596>

Andersen, N. K., Rimvall, M. K., Jeppesen, P., Bentz, M., Jepsen, J. R. M., Clemmensen, L., ... & Olsen, E. M. (2022). A psychometric investigation of the multiple-choice version of Animated Triangles Task to measure Theory of Mind in adolescence. *Plos one*, 17(3), e0264319.

<https://doi.org/10.1371/journal.pone.0264319>

Anderson, P. (2002). Assessment and development of executive function (EF) during childhood. *Child neuropsychology*, 8(2), 71-82.

<https://doi.org/10.1076/chin.8.2.71.8724>

Baron-Cohen, S., O'Riordan, M., Jones, R., Stone, V., & Plaisted, K. (1999). A new test of social sensitivity: Detection of faux pas in normal children and children with Asperger syndrome. *Journal of Autism and Developmental Disorders*, 29(5), 407-418.

Baron-Cohen, S., Wheelwright, S., Spong, A., Scahill, V., & Lawson, J. (2001). Are intuitive physics and intuitive psychology independent? A test with children with Asperger Syndrome. *Journal of developmental and learning disorders*, 5(1), 47-78.

Beaudoin, C., Leblanc, É., Gagner, C., & Beauchamp, M. H. (2020). Systematic review and inventory of theory of mind measures for young children. *Frontiers in psychology*, 10, 2905.

<https://doi.org/10.3389/fpsyg.2019.02905>

Bloom, P., & German, T. P. (2000). Two reasons to abandon the false belief task as a test of theory of mind. *Cognition*, 77(1), B25-B31.

[https://doi.org/10.1016/S0010-0277\(00\)00096-2](https://doi.org/10.1016/S0010-0277(00)00096-2)

Burnel, M., Perrone-Bertolotti, M., Reboul, A., Baciou, M., & Durrleman, S. (2018). Reducing the language content in ToM tests: A developmental scale. *Developmental psychology*, 54(2), 293.

<https://doi.org/10.1037/dev0000429>

Cardillo, R., Garcia, R. B., Mammarella, I. C., & Cornoldi, C. (2018). Pragmatics of language and theory of mind in children with dyslexia with associated language difficulties or nonverbal learning disabilities. *Applied Neuropsychology: Child*, 7(3), 245-256.

<https://doi.org/10.1080/21622965.2017.1297946>

Carlson, S. M. (2005). Developmentally sensitive measures of executive function in preschool children. *Developmental Neuropsychology*, 28(2), 595-616.

https://doi.org/10.1207/s15326942dn2802_3

Carlson, S. M., Koenig, M. A., & Harms, M. B. (2013). Theory of mind. *Wiley Interdisciplinary Reviews: Cognitive Science*, 4(4), 391-402.

<https://doi.org/10.1002/wcs.1232>

Cassetta, B. D., Pexman, P. M., & Goghari, V. M. (2018). Cognitive and affective theory of mind and relations with executive functioning in middle childhood. *Merrill-Palmer Quarterly*, 64(4), 514-538.

<https://dx.doi.org/10.13110/merrpalmquar1982.64.4.0514>.

Ciray, R. O., & Turan, S. (2024). Searching the underlying mechanisms of specific learning disorder: An emotion recognition and social cognition aspect for Turkish clinical youth population. *Applied neuropsychology. Child*, 13(3), 239–245.

<https://doi.org/10.1080/21622965.2022.2156290>

Cochran, W. G. (1954). The combination of estimates from different experiments. *Biometrics*, 10(1), 101-129.

<https://doi.org/10.2307/3001666>

Corcoran, R., Mercer, G., & Frith, C. D. (1995). Schizophrenia, symptomatology and social inference: investigating “theory of mind” in people with schizophrenia. *Schizophrenia research*, 17(1), 5-13.

[https://doi.org/10.1016/0920-9964\(95\)00024-G](https://doi.org/10.1016/0920-9964(95)00024-G)

Dyck, M. J. (2012). The ability to understand the experience of other people: development and validation of the emotion recognition scales. *Australian Psychologist*, 47(1), 49-57.

<https://doi.org/10.1111/j.1742-9544.2011.00047.x>

Dyck, M. J., Ferguson, K., & Shochet, I. M. (2001). Do autism spectrum disorders differ from each other and from non-spectrum disorders on emotion recognition tests?. *European child & adolescent psychiatry*, 10(2), 105-116.

<https://doi.org/10.1007/s007870170033>

Eyuboglu, D., Bolat, N., & Eyuboglu, M. (2018). Empathy and theory of mind abilities of children with specific learning disorder (SLD). *Psychiatry and Clinical Psychopharmacology*, 28(2), 136-141.

<https://doi.org/10.1080/24750573.2017.1387407>

Flores, L. G. (2025). Specific Learning Disorders: Neurobiological Foundations, Differential Diagnosis, and Educational Implications. *Neurodivergences*, 4, 268-268.

<https://doi.org/10.56294/neuro2025268>

Gabriel, E. T., Oberger, R., Schmoeger, M., Deckert, M., Vockh, S., Auff, E., & Willinger, U. (2021). Cognitive and affective Theory of Mind in adolescence: developmental aspects and associated neuropsychological variables. *Psychological research*, 85(2), 533-553.

<https://doi.org/10.1007/s00426-019-01263-6>

Intriago, K. E. C., Rodríguez, L. M. A., & Cevallos, L. A. T. (2021). Specific learning difficulty: autism, dyscalculia, dyslexia and dysgraphia. *International Research Journal of Engineering, IT and Scientific Research*, 7(3), 97-106.

<https://doi.org/10.21744/irjeis.v7n3.1539>

Kalbe, E., Schlegel, M., Sack, A. T., Nowak, D. A., Dafotakis, M., Bangard, C., ... & Kessler, J. (2010). Dissociating cognitive from affective theory of mind: a TMS study. *cortex*, 46(6), 769-780.

<https://doi.org/10.1016/j.cortex.2009.07.010>

Kouklari, E. C., Tsermentseli, S., & Pavlidou, A. (2026). Hot and cool executive function and theory of mind in children with and without specific learning disorders. *Applied Neuropsychology: Child*, 15(1), 42–51.

<https://doi.org/10.1080/21622965.2024.2375659>

Kouvava, S., Antonopoulou, K., Kokkinos, C. M., & Ralli, A. M. (2025). Social understanding and friendships in children with attention deficit/hyperactivity disorder or dyslexia. *Behavioral Sciences*, 15(2), 216.

<https://doi.org/10.3390/bs15020216>

Lecce, S., & Devine, R. T. (2022). Theory of mind at school: Academic outcomes and the influence of the school context. *Infant and Child Development*, 31(1), e2274.

<https://doi.org/10.1002/icd.2274>

McDowell M. (2018). Specific learning disability. *Journal of paediatrics and child health*, 54(10), 1077–1083.

<https://doi.org/10.1111/jpc.14168>

Miller, S. A. (2009). Children's understanding of second-order mental states. *Psychological bulletin*, 135(5), 749.

<https://doi.org/10.1037/a0016854>

Moore III, W. E., Pfeifer, J. H., Masten, C. L., Mazziotta, J. C., Iacoboni, M., & Dapretto, M. (2012). Facing puberty: associations between pubertal development and neural responses to affective facial displays. *Social cognitive and affective neuroscience*, 7(1), 35-43.

<https://doi.org/10.1093/scan/nsr066>

Muktamath, V. U., Hegde, P. R., & Chand, S. (2022). *Types of specific learning disability. Learning Disabilities-Neurobiology, Assessment, Clinical Features and Treatments*, 10.

<https://doi.org/10.5772/intechopen.100809>

Nemati, S., Jamei, R., & Jafari, M. (2025). Meta-analysis of the Effectiveness of Teaching Emotion Regulation on Specific Learning Disability. *Journal of Learning Disabilities, 14*(2), 49-64.

<https://doi.org/10.22098/jld.2025.15066.2168>

Operto, F. F., Pastorino, G. M. G., Padovano, C., Scuoppo, C., Vivenzio, V., & Coppola, G. (2021). Social cognition in neuropsychiatric disorders in pediatric age. *BRAIN. Broad Research in Artificial Intelligence and Neuroscience, 11*(3Sup1), 81-88.

<https://www.brain.edusoft.ro/index.php/brain/article/view/1055>

Özyurt, G., Öztürk, Y., Turan, S., Çıray, R. O., Tanıgör, E. K., Ermiş, Ç., ... Akay, A. (2024). Are Communication Skills, Emotion Regulation and Theory of Mind Skills Impaired in Adolescents with Developmental Dyslexia? *Developmental Neuropsychology, 49*(3), 99–110.

<https://doi.org/10.1080/87565641.2024.2325338>

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., ... Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ, 372*, n71.

<https://doi.org/10.1136/bmj.n71>

Pastorino, G. M. G., Operto, F. F., Padovano, C., Vivenzio, V., Scuoppo, C., Pastorino, N., ... & Coppola, G. (2021). Social cognition in neurodevelopmental disorders and epilepsy. *Frontiers in Neurology, 12*, 658823.

<https://doi.org/10.3389/fneur.2021.658823>

Premack, D., & Woodruff, G. (1978). Does the chimpanzee have a theory of mind? *Behavioral and Brain Sciences*, 1(4), 515-526.

<https://doi.org/10.1017/S0140525X00076512>

Quesque, F., & Rossetti, Y. (2020). What do theory-of-mind tasks actually measure? Theory and practice. *Perspectives on psychological science*, 15(2), 384-396.

<https://doi.org/10.1177/1745691619896607>

Sabag-Shushan, T., & Katzir, T. (2024). Emotional understanding in reading comprehension at the text, task, and reader levels: a comparison of diverse struggling readers. *Reading & Writing*, 37(8), 1905.

<https://doi.org/10.1007/s11145-023-10447-x>

Şahin, B., Karabekiroğlu, K., Bozkurt, A., Usta, M. B., Aydın, M., & Çobanoğlu, C. (2018). The relationship of clinical symptoms with social cognition in children diagnosed with attention deficit hyperactivity disorder, specific learning disorder or autism spectrum disorder. *Psychiatry investigation*, 15(12), 1144.

<https://doi.org/10.30773/pi.2018.10.01>

Sebastian, C. L., McCrory, E. J., Cecil, C. A., Lockwood, P. L., De Brito, S. A., Fontaine, N. M., & Viding, E. (2012). Neural responses to affective and cognitive theory of mind in children with conduct problems and varying levels of callous-unemotional traits. *Archives of general psychiatry*, 69(8), 814-822.

<https://doi.org/10.1001/archgenpsychiatry.2011.2070>

Shah, H., & Somaiya, M. (2025). Specific learning disorders (reading, writing, arithmetic, and mixed) and motor coordination disorders. In S. Malhotra & N. Gupta (Eds.), *Clinical handbook of child and adolescent psychiatry* (pp. 93–118). Jaypee Brothers Medical Publishers.

Shamay-Tsoory, S. G., & Aharon-Peretz, J. (2007). Dissociable prefrontal networks for cognitive and affective theory of mind: a lesion study. *Neuropsychologia*, 45(13), 3054-3067.

<https://doi.org/10.1016/j.neuropsychologia.2007.05.021>

Shamay-Tsoory, S. G., Tomer, R., Berger, B. D., Goldsher, D., & Aharon-Peretz, J. (2005). Impaired “affective theory of mind” is associated with right ventromedial prefrontal damage. *Cognitive and Behavioral Neurology*, 18(1), 55-67.

<https://doi.org/10.1097/01.wnn.0000152228.90129.99>

Shembaretska, O., & Yatsenko, S. (2024). LEARNING DIFFICULTIES OF YOUNG SCHOOLCHILDREN: SIGNS AND CHARACTERISTICS. *Zhytomyr Ivan Franko state university journal. Pedagogical sciences*, (4 (119)), 141-154.

[https://doi.org/10.35433/pedagogy.4\(119\).2024.12](https://doi.org/10.35433/pedagogy.4(119).2024.12)

Šimleša, S., Hacin, K., Capanec, M., & Ivšac-Pavliša, J. (2021). Importance of language for children’s theory of mind: Comparison of verbal and nonverbal theory of mind tasks. *Psihologija*, 54(2), 123-135.

<https://doi.org/10.2298/PSI190924023S>

Şirin, H., Akdağ, B., Uzun, M. E., Kasap, T., Doğançelik, N., & Kaymaz, N. (2026). Exploring Theory of Mind in Specific Learning Disorder: Subtype Differences and the Role of ADHD Comorbidity. *International Journal of Developmental Neuroscience*, 86(2), e70116.

<https://doi.org/10.1002/jdn.70116>

Smogorzewska, J., Szumski, G., Bosacki, S., Grygiel, P., & Karwowski, M. (2022). School engagement, sensitivity to criticism and academic achievement in children: The predictive role of theory of mind. *Learning and Individual Differences*, 93, 102111.

<https://doi.org/10.1016/j.lindif.2021.102111>

Vidyasagar, T. R. (2013). Reading into neuronal oscillations in the visual system: implications for developmental dyslexia. *Frontiers in Human Neuroscience*, 7, 811.

<https://doi.org/10.3389/fnhum.2013.00811>

Vidyasagar, T. R., & Pammer, K. (2010). Dyslexia: a deficit in visuo-spatial attention, not in phonological processing. *Trends in cognitive sciences*, 14(2), 57-63.

<https://doi.org/10.1016/j.tics.2009.12.003>

Viechtbauer, W. (2005). Bias and efficiency of meta-analytic variance estimators in the random-effects model. *Journal of Educational and Behavioral Statistics*, 30(3), 261-293.

<https://doi.org/10.3102/10769986030003261>

Wade, M., Prime, H., Jenkins, J. M., Yeates, K. O., Williams, T., & Lee, K. (2018). On the relation between theory of mind and executive functioning: A developmental cognitive neuroscience perspective. *Psychonomic bulletin & review*, 25(6), 2119-2140.

<https://doi.org/10.3758/s13423-018-1459-0>

Wang, L. C., Cheng, M. C., & Tsai, H. J. (2025). The role of theory of Mind in facial recognition of Chinese children with dyslexia. *Learning Disabilities Research & Practice*, 40(3), 138-148.

<https://doi.org/10.1177/09388982251321539>

Wellman, H. M., & Liu, D. (2004). Scaling of theory-of-mind tasks. *Child development*, 75(2), 523–541.

<https://doi.org/10.1111/j.1467-8624.2004.00691.x>

Wellman, H. M., Cross, D., & Watson, J. (2001). Meta-analysis of theory-of-mind development: The truth about false belief. *Child development*, 72(3), 655-684.

<https://doi.org/10.1111/1467-8624.00304>