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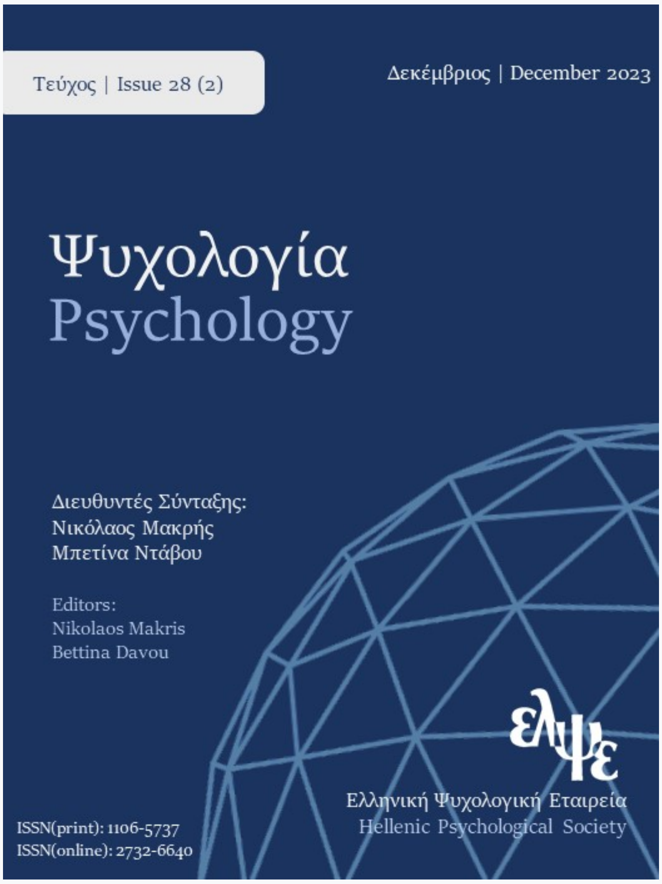

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ΒΙΒΛΙΟΓΡΑΦΙΚΗ ΑΝΑΣΚΟΠΗΣΗ | REVIEW PAPER

The relationship between Theory of Mind and Executive Functioning in typically developing children: A systematic review

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KEYWORDS

Theory of Mind (ToM), mental state understanding, executive functions, cognitive development, typical development, children

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ABSTRACT

The development of Theory of Mind (ToM) constitutes a central topic in the study of human cognitive development. During the last decades, researchers representing different theoretical approaches have been trying to explore the emergence and development of mental state understanding and the potential contribution of other complex cognitive mechanisms in this developmental process. The relationship between ToM and Executive Functions (EFs) has been assessed in the context of various experimental designs. Despite the significant number of existing studies and the variety of relevant theories proposed, there is still no agreement about the exact nature of the ToM-EFs relationship. The main aim of this paper is to review relevant research results on typically developing children. It attempts to disentangle the factors that can potentially explain the contradictory findings reported in the literature. The results, overall, support the ToM-EFs relationship and suggest EFs' important role in ToM development. However, the exact nature of this relationship seems obscured by the diversity of approaches, operationalization of the theoretical constructs, methods and ages included in the studies. It is, therefore, suggested that for building a unified picture and an explanatory account of the dynamic developmental relationship between these two complex theoretical constructs, a refinement in the conceptual definitions and methodological approaches is crucial.

Introduction

In the general research area on the development of children's knowledge about the mental world, Theory of Mind constitutes one of the most prominent domains of theoretical and empirical inquiry. The theoretical construct of Theory of Mind (ToM) encompasses the awareness of the representational character of the other's mind or the human mind in general (Flavell, 2004). Recently, a vast body of research on ToM development has pointed to its potential relationship with Executive Functions (EFs). Primarily reported for Autism Spectrum Disorder populations (Russel et al., 1991), findings concerning the similar developmental trajectory of ToM and EFs, as well as regarding their joint impairment, sparked a scientific debate on their relationship and became a hot topic in neurodevelopmental psychology. Despite the great number of studies, both on typically and atypically developing children and adults, the exact nature and extent of ToM and EFs interconnection remain controversial. The lack of a unifying conceptual framework for both ToM and EFs, the use of a great variety of tasks to assess their various components, and the varying ages of the samples included in relevant studies are only some of the factors that could potentially underlie this controversy.

Given the inherent theoretical interest of the topic, as well as its importance for understanding children's cognitive development, the present paper aims to systematically review the existing research results concerning the relationship between ToM and EFs in an attempt to disentangle the factors that underlie -and can potentially explain- the contradictory findings reported in the literature.

Theory of Mind: conceptualisation and development

ToM, referred to in the literature also as 'mind-reading', 'mentalizing', or 'mental state attribution' (Kemp et al., 2012), is the capacity to attribute desires, knowledge, intentions, beliefs, and emotions to the self and to others. To do so, a person must construct different abstract representations of reality and navigate between them while distinguishing between their own mental representations and those of others (Wimmer & Perner, 1983). Given its implications for an individual's social and cognitive functioning, ToM has become a pervasive research topic in various disciplines, such as social psychology, cognitive psychology, neuropsychology, developmental psychology, social neuroscience, or speech therapy.

This multidisciplinary inquiry into ToM has yielded numerous operationalisations of the theoretical construct. Depending on their particular research interests and ages of inquiry, researchers from different scientific backgrounds focused on different aspects of ToM development, linking different sub-categories of abilities to the theoretical construct of ToM. In their systematic review, Beaudoin et al. (2020) summarized seven (7) basic categories and 39 sub-categories of abilities linked by different researchers to ToM: (a) intentions (intention explanations, completion of failed actions, discrepant intentions, prediction of actions, intention attribution to visual figures), (b) beliefs (location false beliefs, identity false beliefs, second-order false beliefs, content false beliefs, belief based actions/emotions, sequence false beliefs), (c) desires (discrepant desires, desire-action contradiction, multiple desires, desires influences on emotions and actions), (d) emotions (moral emotions, typical emotional reactions, atypical emotional reactions, mixed emotions, emotion regulation, discrepant emotions, hidden emotions), (e) knowledge (knowledge-attention links, percepts-knowledge links, information-knowledge links, knowledge-pretend play links), (f) mentalistic understanding of non-literal communication (white lies, irony/sarcasm, egocentric lies, faux pas, humor, involuntary lies), and (g) percepts (auditory perspective taking, percept-action link, complex visual perspective taking, simple visual perspective taking). As it becomes apparent, ToM is an umbrella term encompassing a wide range of abilities and concepts, ranging from simple desire understanding to more complex social behaviours (e.g., lying, irony and humour).

Overall, the timeline of "ToM development" seems to vary among studies, depending on the exact aspect of ToM that each researcher -explicitly or implicitly- includes under the umbrella concept of ToM and the respective methodological tools they chose for its evaluation (German & Cohen, 2012). It is generally accepted that infants seem to understand desires, intentions, and the causal relation between a person's emotions and goals as early as around 14-18 months of age (Yott & Poulin-Dubois, 2016). The explicit attribution of False Belief (FB), recognized as a cognitively demanding capacity, is not achieved until 3 to 5 years of age (Wellman et al., 2001). Pre-schoolers have also been shown to distinguish their beliefs and knowledge of the world from others (Brüne & Brüne-Cohrs, 2006). Five to 6-year-old children can realize that someone may hold beliefs about another person's beliefs (Wimmer & Perner, 1983). Finally, more complex social behaviours like using metaphors, irony, jokes, and the capacity to judge socially inappropriate behaviours appear to emerge in middle childhood and early adolescence (Brüne & Brüne-Cohrs, 2006).

However, the above plurality in the conceptualisations of ToM and the resulting disparity in the measurement tools (in theory, all measuring ToM, but in reality assessing different asynchronously developing aspects of it) has indirectly obscured the attempts to investigate how ToM relates to other cognitive abilities, as is the case discussed in this paper. As will be seen later, research looking into associations between ToM and EFs usually (and often implicitly) addresses associations between one or two concrete aspects of ToM and one or two aspects of EFs in different ages, making comparisons and generalisation of the findings a challenging task.

Executive Functions: conceptualisation and development

Executive functions (EFs) have been widely approached as a critical factor for ToM development for at least the past 20 years (Dahlgren et al., 2017; Hughes, 1998). However, the term EFs is also an umbrella concept, encompassing a variety of cognitive processes: planning, working memory, self-monitoring, self-regulation, initiation, inhibition, and attention (Goldstein et al., 2014). In general, the term EFs refers to all those cognitive processes that support complex, goal-directed behaviour, particularly in situations that are novel or require conscious effort (Diamond, 2006; Zelazo et al., 2003). Among the most well-known and widely accepted models, Miyake et al. (2000) propose that there are three main EF aspects: a) shifting (SH) between mental states or tasks, b) updating and monitoring of Working Memory (WM) representations, and c) inhibition of dominant and prepotent responses, also known as inhibitory control (IC).

It is not surprising, therefore, that there is not a single timeline of "EFs development". Shifting, also referred to as mental flexibility, gradually reaches the level of adult performance by age 12 (Crone et al., 2009). Working memory, the system responsible for actively processing and maintaining information for a short time, follows a linear pattern of age-related improvement from 4 to 15 years (Gathercole et al., 2004). Self-regulation, which according to Luria (1959), constitutes a prerequisite for inhibition, emerges between 3 and 5 years of age, while inhibition, the cognitive ability responsible for suppressing a dominant response (Diamond, 2006), exhibits a significant improvement between 5 and 11 years of age (Romine & Reynolds, 2005). In 2004, Kerr and Zelazo proposed a further distinction of the broad notion of EFs by introducing the terms *hot* and *cool* EFs. While cool EFs are responsible for problem-solving in decontextualized situations, hot executive functioning gets involved when motivation and emotions can influence a behavioural decision (Zelazo et al., 2005). Despite the small number of research assessing the development of hot EFs, children seem to be able to successfully regulate their behaviour, considering an upcoming reward by the age of 5 years (Bunch & Andrews, 2012).

Overall, depending again on the exact aspect of EF being researched and the methodological tools used for its evaluation, the timeline of EF development may differ among studies, covering an extended period from infancy to young adulthood (Wilson et al., 2018). Using an umbrella term, sometimes without an explicit definition and informed selection of its aspects chosen to address or without a precise interpretation of its findings, can undermine the attempts to investigate how EFs relate to other concurrently developing cognitive abilities. As mentioned earlier and will be examined in detail in the results, research looking into associations between EFs and ToM most of the time (and often implicitly) addresses associations between one or two EFs and one or two concrete aspects of ToM. This fragmentary approach makes comparisons and generalisation of the findings challenging.

The relationship between ToM and EF: theoretical background

During the last decades, researchers representing different theoretical and scientific backgrounds have tried to pinpoint the cognitive mechanisms that may be related to and affect ToM development (Devine et al., 2016). Studies evaluating the cognitive profile of non-typically developing children, principally of individuals with Autism Spectrum Disorder (ASD), offered perhaps the first indications of an EFs - ToM relationship (Baron-Cohen et al., 1999). Russell et al. (1991) and Hughes and Russell (1993) first noted that improvements in executive performance might contribute to subsequent ToM development. Subsequently published data further highlighted the existence of significant correlations between ToM and EFs (Carlson & Moses, 2001; Oh & Lewis, 2008; Sabbagh, Moses et al., 2006). An association between EFs and ToM, or, more specifically, False Belief understanding (FBU), was also detected in meta-analytic works (Devine et al., 2016; Perner and Lang, 1999, 2000). However, negative results concerning the EF – ToM relationship are also reported in the literature (e.g., Dahlgren et al., 2017).

In parallel with these developments, several contemporary studies aimed to dig into the nature of this relationship and propose a theoretical explanation. Two principal accounts have been proposed to explain ToM and EFs interconnection. The "expression" account (Moses, 2003), on the one hand, suggests that children understand mental states but, for some reason, fail to manifest this understanding. For example, it is claimed that in an unexpected location task, where an object is moved in the absence of the task's main character, children may fail to report the character's beliefs about the object's location because they find it hard to suppress their own knowledge concerning the object's actual location (Carlson et al., 2014). This account received support from several studies showing that decreasing a task's executive demands could improve performance in pre-schoolers (Leslie & Polizzi, 1998). On the other hand, the "emergence" account (Moses, 2003) suggests that EFs are necessary for acquiring ToM concepts. According to this approach, setting aside one's point of view requires inhibitory control and is considered a prerequisite for simultaneously taking into account distinct perspectives. Longitudinal studies showing that earlier EFs performance predicts later ToM skills have supported the "emergence theory" (Hughes & Ensor, 2005; Müller et al., 2012).

Again, the lack of a consensus regarding the theoretical basis of a potential EFs-ToM relationship could be attributed to the complex nature of both theoretical constructs. As mentioned earlier, the concrete dimensions of ToM and EFs that each researcher chooses to include in their study may significantly affect the results. The underlying conceptualisation of the terms may set barriers to the generalisability of results, even indirectly, as it is directly linked with the tasks selected to measure each construct. In the same vein, the wide variety of measures developed for assessing ToM and EFs do not necessarily target the same abilities, nor are they all psychometrically validated (German & Cohen, 2012). Finally, the varying ages of the participants combined with the differing conceptualisations of ToM and EFs may lead to completely different results given the different developmental trajectories for the various dimensions included in them.

Aim of the systematic review

Based on the above rationale, the picture of the ToM - EFs relationship often seems partial or fragmentary. In our view, important questions remain unanswered in the literature. For instance, when one claims that ToM is related to EFs, for which of their dimensions is this claim valid? All of them? Some of them? In all ages? In some ages? As far as we know, there is still no clear answer.

The main aim of this paper is to review research results on the nature of the ToM - EFs relationship in typically developing children, considering and accounting for the important diversity of approaches, conceptualisations, methods and ages included in the studies reviewed. We believe this is a necessary first step towards obtaining an unfragmented picture of the relationship between the two constructs, as well as a prerequisite step for gaining a clearer understanding of the cognitive and developmental processes that underlie this relationship.

Method

Data reported in this study were extracted in November 2022, and all studies published by that time were included in the sample. Three research strategies were used to include a representative sample of studies in the current systematic review. Key electronic databases (Scopus, Pubmed, EBSCO and Google Scholar) were systematically searched for papers assessing the relationship between ToM and EFs. In addition, the "Cognitive Development Society" members were asked to participate in this research by sharing their relevant experimental results. Finally, every review and book chapter retrieved from databases was further examined as a new source of possibly relevant articles.

Aiming to include all papers studying the interconnection between ToM and EFs in typically developing populations, ToM and EFs have been included in this search using multiple equivalent terms. More specifically, the following key search terms have been searched in titles, keywords and abstracts: (1) ToM, (2) EFs, (3) children, and (4) typical development were adequately combined, as follows: (1) ("Theory of Mind" OR "mental state attribution" OR "mind-reading"), (2) ("executive functions" OR "inhibition" OR "mental flexibility" OR "working memory" OR "planning"), (3) ("children"). The combination of the three research strategies resulted in a total of 4725 articles.

Exclusion criteria were adopted to ensure the inclusion of all empirical papers reporting on the relationship between EFs and ToM in typically developing children while excluding results on atypical development or other extraneous factors, as well as to ensure the methodological rigour of the studies included in the review. Therefore, studies focusing on neurodevelopmental disorders, neurological pathologies, sensory disabilities, and cognitive impairment were excluded unless they had a control group and separately reported results on EFs and ToM relationship in the typically developing controls. Therefore, 42 studies not having a control group in their experimental design were excluded (e.g., Kenny et al., 2019; Tager-Flusberg et al., 2005; Yu et al., 2021). In addition, the family context was taken into consideration, given the existing data showing a relationship between secure attachment and ToM performance (Arranz et al., 2002). For this reason, three studies, including institutionalized children, were eliminated as not representative of the general population (Colvert et al., 2008; Etel & Yagmurlu, 2014; Selcuk & Yucel, 2017). One study was excluded due to the behavioural difficulties reported in the sample, which could potentially affect the results (Hughes et al., 1998). A prevalent issue in the papers retrieved was that several studies did not report on the relationship between EFs and ToM directly. Thus, in many papers, the principal research question was focused either on the mutual impact of EFs and ToM on other social or cognitive skills (e.g., sharing, general cognitive development) or on the contribution of some other cognitive mechanisms (e.g., phonological awareness) on EFs and ToM performance. Among those cases, 45 papers, after being carefully evaluated, were excluded for reporting results exclusively on the relationship of ToM with the third involved variable and not providing data on the relationship between ToM and EFs (e.g., Demetriou et al., 2021; Matthews et al., 2018; Liu et al., 2016; Venkadasalam et al., 2022; Wang et al., 2022).

Next, to ensure the empirical quality of the papers included in the review, the use of neuropsychological/experimental tests for assessing both EFs and ToM was considered a prerequisite for inclusion. Despite presenting a moderate level of ecological validity (Chaytor & Schmitter-Edgecombe, 2003), neuropsychological/experimental tests are considered to offer more reliable results. Therefore, eight studies following a different approach for evaluating sample performance (e.g., assessment via mobile application tests, Klindt et al., 2017) were excluded. Another quality criterion for inclusion consisted of adopting a minimum sample size of fifty (50) participants since it is considered the minimum sample size to guarantee a reasonable power in a within-participants design (Brysbaert, 2019). Therefore, 114 studies were excluded as their sample-size was lower than fifty (e.g., Dahlgren et al., 2017; Farrar & Ashwell, 2012; Kloo et al., 2010). Additionally, two case studies (Markiewicz et al., 2009; Goukon et al., 2006) and two papers published in a non-English language (Karakelle & Ertuglur, 2012; Thommen et al., 2016) were also excluded. Finally, 87 non-empirical publications (book chapters, reviews) were also excluded.

Table 1 contains a brief presentation of the inclusion and exclusion criteria set before the beginning of our research. Figure 1 constitutes a PRISMA Flow Chart describing the process followed and the number of eliminated papers in every selection phase.

The screening and classification process was performed independently by two authors. The reliability of the decisions in both cases was excellent (91% and 93.5%, respectively). The papers for which there was a disagreement between the two independent evaluators were decided by mutual consensus.

Table 1
Inclusion and exclusion criteria of the systematic review

Inclusion criteria	**Exclusion criteria**
Typically developing children	Non-typically developing children
Absence of variables that could bias the results (family context, individual characteristics)	Presence of variables that could bias the results (family context, individual characteristics)
Empirical studies (longitudinal, cross-sectional, training programs/protocols)	Case studies, book chapters, reviews, systematic reviews
Studies using neuropsychological tests/experimental tasks	Studies not using neuropsychological tests/experimental tasks
Number of participants ≥ 50	Number of participants <50
Presence of statistical indices concerning the relationship between EFs and ToM	Absence of statistical indices concerning the relationship between EFs and ToM
Papers published in English	Papers published in other languages

For a total of 111 papers that were finally included, the following data have been gathered: sample size, age range of participants, country, number and duration of sessions in training programs, interval between different assessment time points in longitudinal studies, tasks used for the assessment of EFs, and finally, results. These data were used to classify the studies and interpret their results and will be further discussed in the following section.

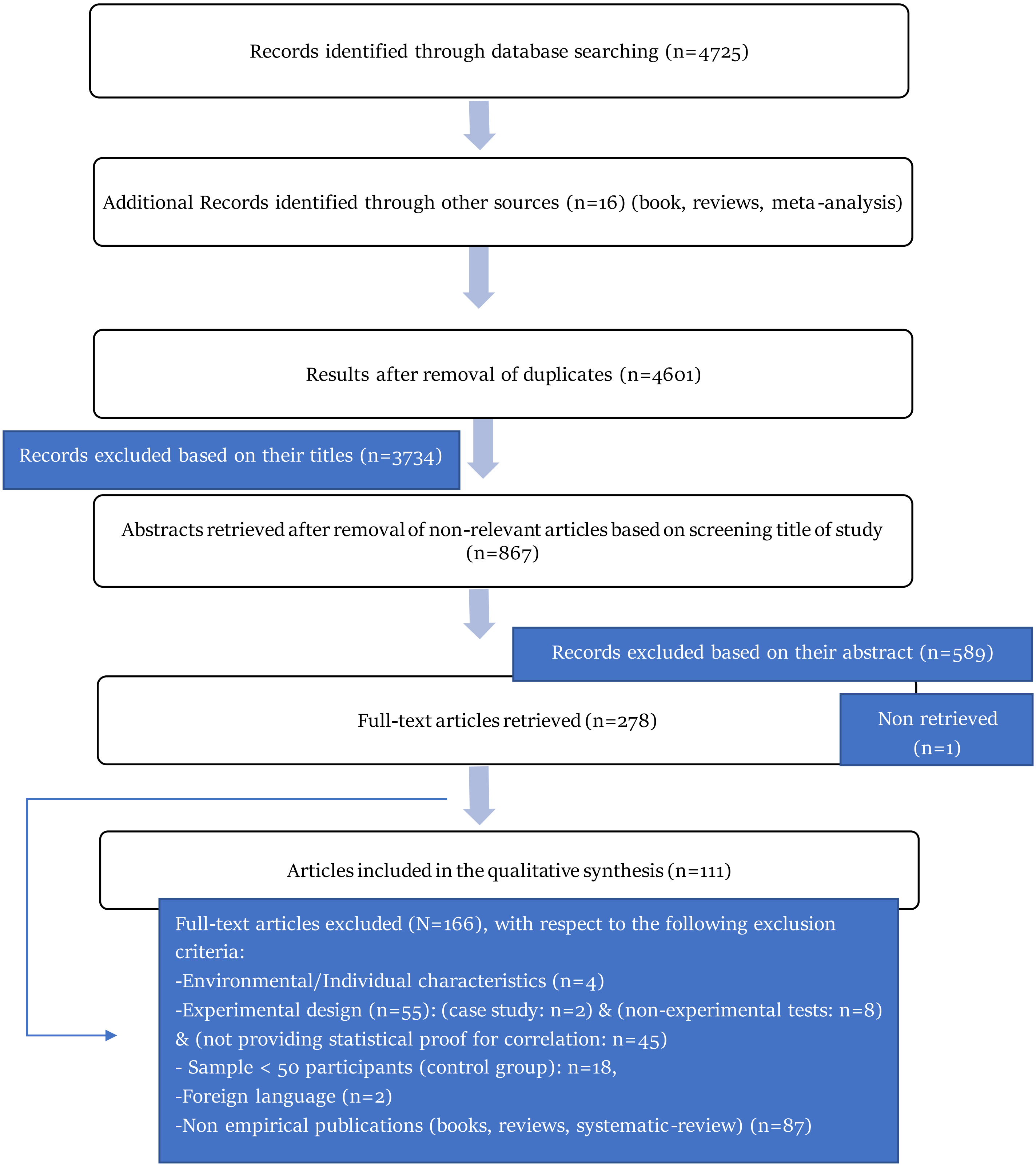

Figure 1. PRISMA flow chart describing the levels of screening and the process of selection of included studies

Results

Data classification

The analysis of 111 studies led to their primary organisation into three categories depending on their experimental design. *Cross-sectional* (n=87), *longitudinal* (n=18), and *training protocols* (n=6) are presented separately in Tables 2, 3, 4 and 5. Furthermore, given the prevalent number of studies focusing uniquely on False Belief (FB) understanding as a ToM measure, cross-sectional studies are presented into two groups: studies including exclusively FB tasks (Table 2) and studies assessing multiple aspects of ToM (e.g., attribution of desires, emotion recognition) (Table 3). In the FB category, experimenters mostly used stories presenting the unexpected location, the unexpected content or the difference between appearance and reality paradigms to evaluate children's false belief attribution. It should be noted that Wimmer and Perner's unexpected location test (1983), Flavell et al.'s (1983, 1986) appearance reality task, and the Smarties test by Gopnik & Astington (1988) were among the most frequently used FB tests (see, Table 2). When multiple facets of ToM skills were assessed, the batteries most commonly used were: Strange Stories (Happé et al., 1994), ToM Scale (Wellman & Liu, 2004), and NEPSY II Social Perception tasks (Korkman et al., 2007) (see, Table 3). When the experimental design did not include an already existing battery, several individual tasks were administered to assess attribution of desires, perception, pretence, knowledge awareness, deception and emotion recognition/attribution. It should be noted that FB understanding was evaluated almost in all the studies included in the review.

Given the differing developmental timelines of both the ToM and EF subdomains, the second primary criterion for the organization of the studies was the participants' chronological age. As a result, five broad age-range categories were formed: *infancy* (0 to 18 months), *toddlerhood* (18 to 36 months), *early childhood* (36 to 74 months), *middle childhood* (74-144 months), and *adolescence* (144-168 months) (Craig & Baucum, 2002). As seen in Table 2, the relationship between FB understanding and EFs is predominately assessed in early and middle childhood. On the contrary, studies using a variety of ToM tests recruited samples of a broader age range (Table 3). This difference in age groups is in line with the existing data showing that FB understanding develops by the age of 6 years. In addition, the complex nature of the tasks explicitly assessing ToM and EFs leads to limited studies on infants and toddlers. Finally, training programs were primarily applied in early and middle childhood (see Table 4).

In order to account for the dimensions of ToM and EFs that researchers evaluated in their study, we opted for coding the cognitive abilities addressed in each paper rather than the name of the tests used. FB tests were reported as *Unexpected Location* (UL), *Unexpected Content* (UC), and *Appearance-Reality* (AR) tests, according to the event that led the story's protagonist to have a FB. The rest of ToM measures were reported according to the type of mental state that was being attributed (*Deception* (DC), *Pretence* (PR), *Emotion Understanding* (EU), *Knowledge Access* (KA), *Social Stories / Faux pas* (SS), *Different Desires* (DD), *Intentions Understanding* (IU), *Perspective Taking* (PT)). This way of categorisation was not always feasible since some tests required the simultaneous attribution of different types of mental states (intentions, perspectives, beliefs). This is why they are referred to as *Mental State Attribution Tasks* (MSA).

We should note that ToM batteries, such as the ToM scale (Wellman & Liu, 2004), NEPSY-II ToM tasks (Korkman et al., 2007), and Strange Stories (Happé et al., 1994), are coded in Table 3 with their full name for convenience reasons. However, in the results section, they are analysed according to the various dimensions of ToM they assess. Classifying tests according to the skill assessed was more difficult for EFs measures. The multilevel cognitive demands of EFs tasks, and the frequent lack of information concerning the reasons for selecting each measure, complicated this effort. Unfortunately, many of the most well-known tasks of EF assessment, for example, the DCCS (Zelazo, 2006), were found to be used for the assessment of different EFs, depending on the experimental design of each study (SH in Cantin et al., 2016, IC in Kloo et al., 2010; Chu & Minai, 2018; Scullin & Bonner, 2006, assessment of reasoning in Müller et al., 2005). WM and IC were the two most frequently assessed EFs. For the evaluation of WM, the Digit Span task (mostly backward) (Davis & Pratt, 1995) and the Counting and Labelling tasks were among the most broadly used tests (Gordon & Olson, 1998). On the other hand, IC was either assessed with gratification / hot IC (ICH) tasks (Diamond, 2013), such as the Gift Delay (Kochanska et al., 1996) or the Snack Delay task (Kochanska et al., 2000) or with cool IC tasks (ICC), as Go/NoGo-like (Carlson et Moses, 2001) and Stroop-like tasks (e.g., Bear/Dragon: Reed et al., 1984; Day/Night: Gerstadt et al., 1994).

Relationship between FB and EFs

Only six of the studies included failed to confirm a relationship between EFs and FB despite the use of multiple tests for the assessment of EFs (Cardillo et al., 2021; Diaz & Farrar, 2018b; Meinhardt-Injac et al., 2020; Scullin & Bonner, 2006; Sudo & Matsui, 2021 -only for the monolingual sample; Talwar et al., 2017).

Conversely, a relationship between FB and EFs was evidenced in all the remaining studies assessing FB. More specifically, significant correlations have been found in children aged 3 – 9 years old between cool IC and performance in FB tasks, either as the only evaluated EF (e.g., Bellagamba et al., 2015; Dick et al., 2005; Lang & Perner, 2002; Poole et al., 2014) or as part of a broader EF battery (e.g., Grosse Wiesmann et al., 2017; McGlamery et al., 2007). Moreover, cool IC has also been found to predict FB score in children aged 3-12 (Cassetta et al., 2018; Kouklari et al., 2017; Powell & Carey, 2017; Wang et al., 2012). As for the relationship between hot IC with FB, three studies failed to find a link between the delay of gratification tasks and FB performance (Bellagamba et al., 2015; Carlson et al., 2002; Chasiotis et al., 2006). The remaining studies detected either a correlation (Grosse Wiesmann et al., 2017; Sabbagh, Moses et al., 2006) between hot IC and FB (3-5.5 years) or an effect of hot IC on FB performance (4-10 years) (Miller et al., 2018; Powell & Carey, 2017).

Working Memory has been identified as a significant predictor of children's ability to correctly attribute beliefs to others in the unexpected transfer or unexpected content tasks. The impact of WM on FB performance was the principal research question for many studies, which were either uniquely focused on this cognitive mechanism (Keenan, 1998) or compared its contribution in ToM to that of other EFs (Buac & Kaushanskaya, 2020-only for the monolingual sample; Kennedy et al., 2015; Longobardi et al., 2021; Mutter et al., 2006). In addition, performance in WM tasks was correlated to FB performance (ages 3-12 years) (Gordon et al., 2014; Hasselhorn et al., 2005; Talwar et Lee, 2008), a result which remained significant even when the participants' justifications of their responses in the mental states' attribution task were taken into account (Ford et al., 2012; Putko & Zlotogorska, 2014).

Finally, FB performance has been associated with other aspects of EFs, such as SH (ages 3-8 years) (Blair & Razza, 2007; Gordon et al., 2014; Guajardo et al., 2009; Kara & Selcuk, 2021; Oh & Lewis, 2008) and planning (PL) (Putko & Zlotogorska, 2014). Furthermore, children's scores (ages 8-11 years) in SH (Cassetta et al., 2018) and PL (ages 3-6 years) (Cole & Mitchell, 2000; Longobardi et al., 2021; Memisevic et al., 2018) have also been found to predict FB performance.

Attribution of desires and EFs

Attribution of desires is one of the fundamental aspects of ToM. The ability to understand that someone else does not necessarily share the same desires with us or that their actions do not always reflect their desires has been explored even in infancy. These are usually measured by tasks assessing the understanding and attribution of conflicting desires (e.g., Desire Appreciation Task or Conflicting Desires Task). Indeed, attribution of desires is found to be one of the ToM abilities with the earliest onset (Peterson & Wellman, 2019) and is considered less cognitively demanding than FB. Only two studies have assessed the association between attribution of desires and EFs by means of a dedicated task. In particular, a significant correlation has been found between a conflicting desires task and IC in preschoolers (ages 3-5 years) (Rakoczy, 2010). Also, performance in the DCCS task has been found to be a predictor of conflicting desires (ages 4-7 years) (Rostad & Pexman, 2014).

Attribution of intentions and EFs

Attribution of intentions, however, despite being central to human perspective-taking and interpersonal relations (Maselli & Altrocchi, 1969), has not been widely addressed in the EFs-ToM literature. Attribution of intentions is usually assessed with picture sequencing tasks. Only one study has addressed the effect of cool and hot IC on attribution of intentions in toddlers and has found positive results (Carlson et al., 2004).

Knowledge Access - Perspective Taking and EFs

Explaining a person's behaviour by evaluating their possible knowledge of a particular situation is essential to understanding and responding to their social behaviours. Knowledge access has been mainly assessed in pre-schoolers, for example, through the "Hiding Games" task, and is found to be predicted by their performance in tasks assessing cool IC (Chu & Minai, 2018).

Highly linked with knowledge access, perspective-taking is an additional key function for social understanding. More specifically, when trying to explain the behaviour of others, one should acknowledge that each person perceives the world differently and that these different perceptions (auditory, visual, etc.) lead one to act in particular ways. The ability to acknowledge and adopt someone else's perception of the world activates complex mental functions, such as the visualisation and the mental rotation of visual stimuli, in the case of visual perception. This ability is taken to express complex cognitive mechanisms and is found to be predicted by SH performance (ages 6-10 years) (Miller et al., 2018). However, according to Carlson, Mandell and Williams (2004) age seems to play an important role in this relationship. In the second wave of their longitudinal study, IC (hot and cool) was correlated to visual perspective taking in 39 months, whereas no relationship was found when the same participants were 24 months old.

Pretence and Deception and EFs

Pretend play has always presented a great interest for researchers of ToM development. Pretence seems to share some underlying skills with mental state understanding. According to Lillard (1993), pretence is a mental state that requires not only a mental representation of an object but also the capacity to inhibit reality to adopt an alternative representation. The findings of the present review revealed that pretence was correlated to cool and hot IC, WM and SH (ages 2-3 years) (Carlson, Mandell et al., 2004; Hughes & Ensor, 2006). Importantly, two studies found it could both predict and be predicted by IC, SH and PL (ages 2-6 years) (Hughes & Ensor, 2005; McAlister & Peterson, 2006).

Similarly, deception constitutes another ability highly related to mental state understanding. The ability to infer the other person's mental representation is considered a prerequisite for deception, even when this knowledge remains implicit. For example, in their study, Chandler and his colleagues (1998) revealed that 2 to 3 years old children erased a puppet's footprints, willing to keep the location of their treasure secret. The performance in deceptive tasks, even of different levels of complexity, has been correlated to IC, WM, and SH (Guajardo et al., 2009; Hoyo et al., 2019; Hughes & Ensor, 2006) (sample age range: 3-9 years old). Furthermore, an effect of IC on deception in preschoolers (3-5 years old) (Chasiotis et al., 2006), but also a bidirectional effect between IC, SH and deception (Hughes & Ensor, 2005) was reported in toddlers (2-3 years old).

Understanding of emotions and EFs

Understanding another person's emotional state is commonly found in the ToM literature as part of the affective ToM (Dennis et al., 2013). Some of the basic forms of relevant ToM tasks require understanding mixed, discrepant, or hidden emotions, inferring their causes, and estimating typical vs atypical emotional reactions. Emotion understanding (EU) was found to be correlated with WM in middle childhood (ages 6-11 years) (Morra et al., 2011) and SH (ages 5-9 years old) (Hoyo et al., 2019). Additionally, exploring the relationship between EU and IC in similar age groups (5-8 years old), Hudson and Jacques (2014) found only the recognition of discrepant emotions to be related to IC. Importantly, a series of studies in a wide age range of participants (3.5-18 years old) has confirmed an effect of IC, ICH, SH, WM or PL (Draperi et al., 2022; Gabriel et al., 2019; Kouklari et al. 2017; Longobardi, 2021; Vetter et al., 2013) on emotion understanding. Emotion understanding will be further discussed in the context of ToM scales presentation in the next section.

ToM Scales and EFs

Children's performance on ToM scales and its relationship with executive functioning is presented separately due to the complex nature of these assessment tools. Wellman and Liu's *ToM scale* (2004) is considered one of the most complete batteries, offering a multilevel assessment of ToM (current version assesses knowledge access, different desires, different beliefs, contents false belief, explicit false belief, belief emotion, hidden emotion; Peterson & Wellman, 2019). Used in different cultural contexts and various age groups, the ToM Scale has contributed to a more comprehensive study of ToM development. IC (cool and hot), SH, PL, and WM are the main EFs that have been correlated either to the total score of the ToM Scale tasks (ages 3-12) (Baker et al., 2021; Fujita et al., 2022; Karpinski & Scullin, 2009; Melinder et al., 2006; Nathanson & Fries, 2014; Wade et al., 2014) or to particular subtests (Doenyas et al., 2018; FB, EU and knowledge access subscales). Moreover, WM (ages 3-11 years) (Burnel et al., 2020; Duh et al., 2016; Shahaeian et al., 2015), IC (sample's age range: 4-5) (Duh et al., 2016; Shahaeian et al., 2015), and SH (ages 4-5 years) (Shahaeian et al., 2015) were found to predict the ToM Scale's total score. Finally, Henning and colleagues (2011) were able to confirm the effect of the DCCS score on the ToM Scale's total score, but they could not confirm the inverse effect (ages 3-6 years).

The *Strange Stories test* (Happé et al., 1994), initially created for assessing autistic children, includes 24 social stories. The main purpose of this test is to examine a person's ability to understand non-literal communication concepts, such as irony, white lies, sarcasm, and humour (Beaudoin et al., 2020). It should be noted that the Strange Stories task was used only for assessing older children (approximately 6-17 years old). Significant correlations were detected between the Strange Stories total score and WM, IC cool and hot, and SH (ages 6-12 years) (Austin et al., 2014; Bock et al., 2015; Wilson et al., 2021). Performance in the Strange Stories task was also found to be predicted by IC and SH in adolescence (ages 13-18 years) (Gabriel et al., 2019) and also by WM (ages 6-18 years old) (Cantin et al., 2016; Gabriel et al., 2019). Im-Bolter and colleagues (2016) have shown that according to the participant's age, the contribution of EFs may differ. More specifically, 7-12 years old children's scores in Strange Stories were found to be positively predicted by WM, SH, and IC, while adolescents' performance by SH and IC.

Finally, the NEPSY-II test, and more specifically, its Social Perception subscale, assesses the following skills: facial affect recognition, comprehension of others' perspectives, intentions and beliefs. Social perception subtests of NEPSY-II were used in a small number of studies as a measure of mental states' understanding in different social contexts. WM, IC and PL were found to be correlated to the children's (3-16 years-old) performance in the NEPSY-II ToM subtests (Brock et al., 2019; Huyder et al., 2017), although Huyder et al. (2017) failed to find a correlation with PL for the 9-12 years group. Finally, a significant effect of WM and the EF scale of NEPSI-II was found on the NEPSY-II ToM subtests (ages 3-6 years) (Rosenqvist et al., 2014).

Training and longitudinal studies

Training programs and longitudinal studies do not only provide evidence about the relationship between EF and ToM. A deeper analysis of their results could offer a much deeper insight into the nature of this relationship and provide evidence of potential causalities. This section will further assess the developmental interconnection between ToM and EFs based on the results of both training programs and longitudinal studies.

Despite their limited number, the training programs present inconclusive results on the predictive role of EFs in ToM performance. Of the six reported studies (Table 4), one focused on training both EFs and ToM skills (Kloo & Perner, 2003). By including two different experimental groups, each exposed to either EFs or ToM tasks, Kloo and Perner revealed a bidirectional developmental link between EFs and ToM. Three of the remaining training studies, exclusively focusing on ToM training, identified pre-training EFs as a significant predictor of post-training ToM performance (Gao et al., 2020; Lecce & Bianco, 2018; Qu et al., 2015). Finally, two training programs did not confirm the effect of EFs on ToM (Arslan et al., 2018; Lecce et al., 2014). In particular, Arslan and her colleagues (2018) noted that the difficulty of pre-training EFs assessment tasks could explain the negative findings since the performance in an easy pre-training WM test was unrelated to post-training FB performance. In the study of Lecce and colleagues (2014), participation in the training program has improved participants' performance in both EF and ToM post-training tasks. However, the observed gains in EFs performance were unrelated to post-training ToM.

Longitudinal studies included different ages from 18 months to 10 years, with intervals varying from 4 months to 4 years and differed in the EFs and the aspects of ToM they assessed. These studies offer some insight into the EF-ToM interconnected developmental trajectories, although their results are not very clear. Eleven studies found an effect of one or more EFs on some aspect of ToM at a subsequent time point (Austin et al., 2014;

Table 2

The relationship between False Belief Understanding and Executive Functions

	Age Group[1]	Authors[2]	N	Age (in month)[3]	Country	ToM[4]	EF[5]	Relationship[6]
FALSE BELIEF	EC	Kara & Selcuc, 2021	115	**33-95**	Turkey	UC & UL (1st and 2nd order), AR	ICC, WM, SH	ToM↔EF
		Sudo & Matsui, 2021	50	62-66	Japan	UL	ICC	ICC + other variables↦UL (bilinguals) **N.S.** (monolinguals)
		Dicataldo & Roch, 2020	111	44-75	Italy	UC	WM, ICC, SH	WM↔UC
		Diaz & Farrar, 2018b	65	40-65	USA	UL, UC, AR	ICC, SH	**N.S**
		Memisevic et al., 2018	116	36-72	Bosnia Herzegovina	UL	ICC, SH	SH + other variables ↦UL
		O'Toole et al., 2017	106	**46-80**	UK	UL, UC	ICC, ICH, PL, WM	ICC & PL & WM↔ToM
		Talwar et al., 2017	160	47-71	Canada	UL	WM, ICC, SH	**N.S.**
		Powell & Carey, 2017 (1)	70	60-71	USA	UL	ICH	ICH↦UL
		Powell & Carey, 2017 (2)	102	48-71	USA	UL (prediction, justification)	ICC	ICC↦ToM (even when EF demands were lower)
		Grosse Wiesmann et al., 2017	57	36-48	Germany	UL & UC (explicit), UL (implicit)	SH, ICC, ICH	SH & ICC & ICH↔FB (explicit)
		Bellagamba et al., 2015	101	35-49	Italy	UC	ICC, ICH	ICC↔UC
		Kennedy et al., 2015	192	**53-107**	USA	FB	WM, ICC	WM & ICC + other variables ↦ FB
		Putko & Zlotogorska, 2014	59	36-48	Portugal	UL (prediction, justification)	ICC, WM	WM + other variables ↦ UL (justification)
		Gordon et al., 2014	107	**48-144**	Canada	UL (1st and 2nd order)	BRIEF	PL & SH & WM↔ToM
		Poole et al., 2014	61	**48-108**	USA	UC, UL	ICC	ICC↔UC & UL
		Ford et al., 2012 (1)	59	48-72	Australia	UC, UL	ICC, WM	WM & ICC (not all tests)↔ToM
		Ford et al., 2012 (2)	50	49-67	Australia	FBlv, FB	ICC, WM	ICC↔FB & FBlv
		Wang et al., 2012	192	36-48	China	UC, UL	ICC	ICC + other variables ↦ToM
		Talwar & Lee, 2008	150	**36-96**	USA	UL, UC (1st and 2nd order)	WM, ICC	WM & ICC↔ToM
		Oh & Lewis, 2008	138	36-62	Korea, UK	UL, UC	ICC, WM, SH	ICC & SH↔FB (KR)/ ICC & SH ↔ FB(UK)
		Müller et al., 2007	99	36-65	Canada	UL, UC	WM	WM + other variables ↦ UL
		Blair & Razza, 2007	170	**45-83**	USA	UL, UC	ICC, SH	ICC & SH↔FBU
		Lewis et al., 2006	67	36-65	China	UC, UL	ICC, SH, WM	ICC↔UC & UL
		Mutter et al., 2006	72	32-64	USA	UC	ICC, WM	WM+ other variables↦ToM > ICC+other variables↦ToM
		Sabbagh, Moses et al.,2006	60	37-58	Canada	UL, ULlv, UC, UClv	ICC, ICH	ICC↔UL & UL & UClv/ ICH↔UL
		Scullin & Bonner, 2006	62	36-60	USA	UC	ICC	**N.S.**
		Hasselhorn et al., 2005	126	38-69	Germany	FB (1st, and 2nd order)	WM	WM↔FB 1st (<4 yo)
		Müller et al., 2005	69	37-65	Canada	UC, UClv	DCCS	DCCS + other variables ↦UC
		Dick et al., 2005	107	36-60	USA	UL, AR	ICC	ICC↔UL
		Andrews et al., 2003 (1)	60	36-60	Australia	AR, UC, UL	ICC	ICC + other variables ↦AR & UC & UL
		Andrews et al., 2003 (2)	60	36-60	Australia	AR, UC, UL	ICC	ICC + other variables ↦AR & UC & UL
		Kloo & Perner, 2003	60	35-48	Austria	UL	DCCS	DCCS↔UL (only with 1 of 2 stories)
		Carlson et al., 2002	47	40-66	USA	UL, UC, AR	ICH, ICC, WM	ICC + other variables ↦UL & UC
		Lang & Perner, 2002	57	37-61	Austria	UL	ICC	ICC↔UL
		Cole & Mitchell, 2000 (1)	121	36-48	UK	UL, UC	ICC, PL	ICC & PL + other variables ↦ UL & UC
		Cole & Mitchell, 2000 (2)	71	47-68	UK	UL, UC	ICC, PL	ICC & PL ↦ UL & UC
		Keenan, 1998	60	48-62	New Zealand	UL	WM	WM↦UL
		Gordon & Olson, 1998	72	36-76	Canada	UC, AR	DT	DT↔ToM
	MC	Buac & Kaushanskaya, 2020	115	84-144	USA	UL (1st and 2nd order)	ICC, SH, WM	WM + other variables↦UL (monolinguals) SH + other variables ↦ UL (bilinguals)
		Cassetta et al., 2018	168	96-132	Canada	FB (2nd order) & FBe	ICC, SH, WM	EF + other variables ↦ FB & FBe
		McGlamery et al., 2007	66	**69-80**	USA	UC, UL (2nd order)	ICC, SH, WM, PL	EF↔ToM

[1] TD = Toddlerhood, EC= Early Childhood, MC = Middle Childhood

[2] Numbers (1) and (2) next to the authors refer to the different experiments reported in the same paper.

[3] Ages typed in bold extend beyond the limits of the age group.

[4] ToM (lv=low verbal): DC=Deception, PR=Pretence, FB=False Belief, UL=Unexpected Location, MSA=Mental State Attribution EU=Emotion Understanding, KA=Knowledge Access, AR=Appearance-Reality, TK=Think-Know (differentiation), UC=Unexpected Content, IU=Intentions understanding, PT= Perspective taking, SS=Social Stories, DD=Different Desires

[5] EFs: WM=Working Memory, ICC=Inhibitory Control Cool, SH=shifting/switching/mental flexibility, ICH=Inhibitory Control Hot, DT=Dual Task, PL=planning, CST=card shorting test, PCA=physical causality

[6] Symbols referring to the relationship between EFs and ToM: ↔ = variable X is related to variable Y (correlation), ↦ = variable X predicts variable Y (regression), ⇆ = variable X predicts variable Y, but variable Y also predicts variable X (regression)

Table 3

The relationship between ToM scales and Executive Functions

Age Group[1]	Authors [2]	N	Age (in months)[3]	Country	ToM [4]	EF [5]	Relationship [6]
TD	Wade et al., 2014	468	**2-45**	Canada	ToM Scale	ICC, SH, WM	EF↔ToM
	Hughes & Ensor, 2006	127	24-36	USA	DC, PR, FB	WM, ICC, SH	EF↔ToM
	Hughes & Ensor, 2005	140	24-36	UK	UL, PR, DC	ICC, SH	EF⇆ToM
EC	Draperi et al., 2022	112	42-78	France	FB, EU	ICC, ICH	ICH (mediating role) ↦ EU
	Fujita et al., 2022	236	48-84	Japan & UK	ToM Scale	ICC, WM, SH	ToM↔EF (both cultures)
	Sabbagh, Xu et al., 2006	109	36-59	China	UC, UL, AR, DC	ICC	EF↔ToM (despite better performance in EF)
	Duh et al., 2016	922	36-60	China	ToM Scale	ICC, WM	ICC & WM ↦ ToM
	Chasiotis et al., 2006	314	36-60	Germany, Costa Rica, Cameroon	UL, DC	ICC, ICH	ICC + other variables ↦ ToM
	Longobardi et al., 2021	144	35-71	Italy	UL, EU	BRIEF-P	WM + other vatiables ↦UL PL + other variables ↦ EU (marginally)
	Baker et al., 2021	121	37-78	USA	ToM Scale	ICC	ToM↔ICC
	Wilson et al., 2021	126	**60-144**	Australia	Strange stories	WM, ICC, ICH	ToM↔EF (hot and cool)
	Austin et al., 2020	1657	**72-132**	Germany	MSA	ICC, SH, WM	EF↔ToM, (only when age not controlled)
	Burnel et al., 2020	126	**38-141**	France	ToM Scale, FBlv	ICC, SH, WM	WM + other variables ↦ToM Scale SH + other variables ↦ FBlv
	Hoyo et al., 2019	86	**60-108**	Spain	DC, UL (1st, 2nd order), EU	WM, SH, ICC	SH↔EU (8-9 yo) ICC↔DC & UL (5-6 yo)
	Tsuji & Mitchell, 2019	160	36-72	Japan	UL, IU	SH, ICC	WM & SH & ICC + other variables ↦ ToM
	Brock et al., 2019	140	**52-192**	USA	NEPSY II	WM, ICC	WM & ICC↔ NEPSY II
	Miller et al., 2018	81	81-120	USA	PT, SS	SH, WM, ICH	SH + other variables ↦ PT ICH & SH + other variables ↦ SS
	Chu & Minai, 2018	354	36-75	USA	KA	ICC	ICC + other variables ↦ KA
	Lagattuta et al., 2018	211	**48-120**	USA	MSA	ICC, WM	WM & ICC + other variables ↦ MSA
	Wilson et al., 2018	126	**60-132**	Australia	SS	ICC, ICH, WM, SH	EF (hot & cool) ↔ SS
	Huyder et al., 2017	248	**60-144**	Canada	NEPSY II	PL, ICC, WM	PL & WM ↔ NEPSY-II (younger participants) WM ↔ NEPSY-II (older participants)
	Aslan et al., 2016	89	**53-120**	Turkey	UL (2nd order)	WM	WM + other variables ↦ UL (only for younger participants)
	Shahaeian et al., 2015	140	48-60	Iran	ToM Scale, UL	ICC, WM, SH	EF + other variables ↦ ToM
	Hudson & Jacques, 2014	107	**60-96**	Canada	EU	ICC	ICC↔EU (only for hidden emotions)
	Lagattuta et al., 2014	195	**48-132**	USA	ToM probability task	ICC, WM	ICC & WM + other variables ↦ ToM probability task
	Nathanson & Fries, 2014	107	38-74	USA	ToM Scale	PL, ICC, WM	EF↔ToM
	Peskin et al., 2014	96	**60-95**	Canada	FB (2nd order), SS, KA	IC, WM	WM↔FB(2nd order)
	Rostad & Pexman, 2014	80	48-84	Canada	DD, UL (1st-2nd order)	DCCS	DCCS + other variables ↦ DD
	Rosenqvist et al., 2014	370	36-72	Finland	NEPSY II (EU)	NEPSY-II EF, WM	EF + other variables ↦ EU
	Fizke et al., 2014 (2)	62	42-59	Germany	UL (reality known/unknown)	ICC, WM	WM + other variables ↦ UL (reality unknown) ICC + other variables ↦ UL (reality known)
	Morra et al., 2011	130	**61-134**	Italy	EU	WM	WM↔EU
	Henning et al., 2011	195	38-72	Germany	ToM Scale	DCCS	DCCS + other variables ↦ ToM ToM + other variables ↦ DCCS(not found)
	Rakoczy, 2010 (1)	80	37-61	Germany	DD, UL, UC	ICC	ICC↔DD & UL & UC
	Rakoczy, 2010 (2)	54	61-55	Germany	FB, DD	ICC, WM	ICC↔FB & DD
	Guajardo et al., 2009	92	36-71	USA	UL, UC, DC	SH, WM	SH↔ToM
	Karpinski & Scullin, 2009	80	36-60	USA	ToM Scale	PL, ICC, WM	EF↔ToM
	McAlister & Peterson, 2006	124	39-69	Australia	UL, UC, AR, PR	ICC, SH, PL	EF ⇆ ToM+ other variables in two models
	Melinder et al., 2006	115	36-72	Norway	ToM Scale	ICC	ICC↔ToM
	Perner et al., 2002 (1)	56	37-74	Austria	UL (prediction)	ICC	ICC↔UL
	Perner et al., 2002 (2)	73	33-68	Austria	UL (prediction & explanation)	ICC	ICC↔UL (prediction & justification)
	Carlson & Moses, 2001	107	39-59	USA	UL, UC, DC, AR, FB control	ICC, ICH	ICC + other variables ↦ ToM (except deception)
	Keenan et al., 1998	60	48-60	New Zealand	UL	WM	WM + other variabls ↦ UL
MC	Cardillo et al., 2021	70	**96-216**	Italy	EU, NEPSY-II	WM	**N.S.**
	Holl et al., 2021	1501	108-136	Germany	EU, IU	ICC, SH, WM	EF ↔ ToM
	Kouklari et al., 2017	69 (TD)	84-144	Greece	UL, MSA/EU	ICC, PL, WM, ICH	Cool EFs + other variables ↦ FB Cool and Hot EFs + other variables ↦ MSA/EU
	Cantin et al., 2016	87	84-120	USA	SS	ICC, WM, SH	ICC & WM / ICC & SH↦ToM
	Im-Bolter et al., 2016	444	84-144	Canada	SS	ICC, WM, SH	ICC & WM & SH + other variables ↦ ToM (kids) ICC & SH + other variables ↦ ToM (adolescents),
	Wang et al., 2016	334	108-192	UK/Hong Kong	MSA, SS	ICC, SH, WM	EF + other variables ↦ ToM (Hong Kong)
	Bock et al., 2015	104	84-144	USA	SS, UL 2nd order	WM, SH, ICC	SH + other variables ↦ SS
AD	Meinhardt-Injac et al., 2020	267	132-300	Germany	EU, SS	IC	**N.S.**
	Gabriel et al., 2019	643	156-216	Austria	SS, EU	SH, WM	WM + other variables ↦ SS SH & WM + other variables ↦ EU (13-14 years old)
	Vetter et al., 2013	139	144-264	Germany	EU	ICC, SH, WM	EF + other variables ↦ EU

1 TD = Toddlerhood, EC= Early Childhood, MC = Middle Childhood, AD = Adolescence

2 Numbers (1) and (2) next to the authors refer to different experiments reported in the same paper.

3 Ages typed in bold extend beyond the limits of the age group.

4 ToM (lv=low verbal): DC=Deception, PR=Pretence, FB=False Belief, UL=Unexpected Location, MSA=Mental State Attribution EU=Emotion Understanding, KA=Knowledge Access, AR=Appearance-Reality, TK=Think-Know (differentiation), UC=Unexpected Content, IU=Intentions understanding, PT= Perspective taking, SS=Social Stories, DD=Different Desires,

5 EFs: WM=Working Memory, ICC=Inhibitory Control Cool, SH=shifting/switching/mental flexibility, ICH=Inhibitory Control Hot, DT=Dual Task, PL=planning, CST=card shorting test, PCA=physical causality

6 Symbols referring to the relationship between EFs and ToM: ↔ = variable X is related to variable Y (correlation), ↦ = variable X predicts variable Y (regression), ⇆ = variable X predicts variable Y, but variable Y also predicts variable X (regression)

Table 4
Training program protocols

Age Group [1]	Authors	Sample[2]	Age (in months)	Training program	Duration	Results
EC	Arslan et al., 2018	N=106, EG=72, ACG=34	60-72	1) 3 conditions for EG training (3 FB tasks): (a) feedback (correct/wrong) with explanation (FB justified) (b) feedback without explanation (c) no feedback 2) active control	30-45min/session, 2 training sessions, 1/week	WM could not predict ToM performance. The task used for the assessment of ToM was criticized as too simple
	Kloo & Perner, 2003	N=44, EG1=14, EG2=15, ACG=15	36-55	a) EG1: trained in DCCS task b) EG2: trained in FB tasks c)ACG=relative clause tests, and number-conservation tasks	15 min/session, 2 training sessions, 1/week	Both DCCS and FB groups significantly improved in both EF and ToM tasks. CG no results.
	Qu et al., 2015	71 divided into 3 conditions	50-74	3 training programs: a) Free play b) Sociodramatic Play c) Sociodramatic Play & ToM	45min/session, 4 training sessions, 1/week	Children's pretest EF positively predicted the training effect of Sociodramatic Play on children's ToM. Post-EF performance was only related to pre-EF scores.
MC	Gao et al., 2020	N=96, EG=49, ACG=47	108-120	1) 4 ToM tasks (Misunderstanding, persuasion, double deception, white lies) for EG training 2) similar stories but without including mental state attribution for ACG	40-60min/session, 4 training sessions, 1/week	ToM performance was improved. EF performance did not change. Pre-test EF skills predicted ToM improvement.
	Lecce & Bianco, 2018	N=86, 46 EG, 40 ACG	108-132	1) EG: trained in attributing mental state 2) ACG: physical condition stories (no attribution of mental states)	50 min/session, 4 training sessions, 1/week	ToM skills were improved. WM skills were not improved. Pre-test WM predicted ToM improvement.
	Lecce et al., 2014	N=46 (EF) EG=25, ACG=21	M=115	1) EG: trained in attributing mental state (use of appropriate verbs and synonyms) 2) ACG: physical condition stories (no attribution of mental states)	45-50 min/session, 4 training sessions, 1/week	Performance in both ToM and EFs tasks during post-training assessment was improved in the EG. The gains in ToM were not related to EFs gains.

[1] TD = Toddlerhood, EC= Early Childhood, MC = Middle Childhood
[2] EG=experimental group, ACG=active control group

Table 5
Longitudinal experimental protocols

Age Group [1]	Title	Sample	Age range (months)[2]	Country	Experimental Design	ToM[3]	EF[4]	Relationship[5]
TOD	Kloo et al., 2020	54	**18-70**	Germany	7 time points of evaluation, between 18-70 months y.o.	UC, UL (1st and 2nd order) (implicit/explicit)	ICC, ICH	Implicit FB and late EF ↦ later explicit ToM
	Müller et al., 2012	82	20-31	Canada	1 assessment/year, 3 times (1h/ses)	DD, EU, PR, UL, UC, PT, DB	ICC, WM, PL	Time 2 ICC + other variables ↦ time 3 ToM (not the opposite)
EC	Shahaeina et al., 2023	142	**24-78**	Israel	1 assessment/8 months 3 times (45min/ses)	UL, UC, EU	WM, ICC	Time 1 EF + other variables ↦ time 2 ToM Time 2 EF & Time 2 ToM + other variables ↦ Time 3 EF Time 2 EF & Time 2 ToM + other variables ↦ Time 3 ToM
	Huang et al., 2022	90	37-64	USA	1 assessment/4 months, 2 time points (15 min/ses)	ToM Scale	WM, ICC, ICH	Time 2 EF + other variables ↦ Time 2 ToM Time 1 ToM (Hidden Emotions) + other variables ↦ Time 2 ICC
	Brock et al., 2018	354 (T1) 298 (T2)	53-74	USA	1 assessment/ year, 2 times	NEPSY II, EU	WM, ICC	ICC + other variables ↦ Time 2 ToM
	Doenyas et al., 2018	150	36-60	Turkey	1 assessment/year, 1 time (1h/ses)	ToM Scale	ICC	Time 1 EF + other variables ↦ time 2 ToM
	Devine et al., 2016	137	60-84	UK	1 assessment/4 years, 2 times	UL, UC, SS, EU, MSA	SH, ICC, WM	Time 1 EF + other variables ↔ Time 1 ToM Time 2 EF + other variables ↔ Time 2 ToM
	Diaz & Farrar, 2018a	78	35-66.8	USA	1 assessment/year, 2 times (40 min/ses)	UL, UC, AR	ICC, SH, STM	Metalinguistic awareness but **not** EF ↦ Time 2 FB
	Marcovitch et al., 2015	226	36-60	USA	1 assessment/ year, 3 times (2h/ses)	UL, UC, PT, FB (2nd ord)	ICC, SH	Earlier EF+ other variables ↦ later ToM performance (not the opposite)
	McAlister & Peterson, 2013	124	39-80	Australia	2 assessments, 9-15 months interval, 2ses/time,	UC, AR, PR, HE, EU, UL	PL, ICC, WM	Time 1 ToM + other variables ↦ Time 2 EF (not the opposite)
	Jahromi & Stifter, 2008	178	53-65	Canada	1 asssessment/year, 1 session/time	UL, FB (2nd order), DD	ICC	Time 1 EF + other variables ↦ Time 2 ToM
	Razza & Blair, 2008	72	42-72	USA	1 assessment/year, 2 times, (45min/ses)	UC, UL, AR	ICC, SH	EF time 1 ↦ FBU time 2 but only as a mediator between Time 1 FBU and Time 2 FBU causal relationship
	Hughes & Ensor, 2007	122	24-48	USA	1 assessment/year, 3 times (2h/ses)	UL, UC, DC, PR, FBlv	ICC, WM, SH	Time 1 EF + other variables ↦ Time 2 ToM Time 1 EF + other variables ↦ Time 3 TOM Time 1 ToM + other variables ↦ Time 3 EF
	Schneider et al., 2005	176	36-46	Germany	1 assessment/6 months, 3 times, 3 ses/time	UL, UC, AR	ICC, WM	Time 2 EF + other variables ↦ Time 3 ToM
	Carlson et al., 2004	81	24-39	USA	1 assessment/15 months, 2 times (45min/time)	IU, PT, DD, PR, AR, UC	ICH, ICC	Time 1 EF + other variables ↦ Time 2 ToM
	Hughes, 1998	50	39-55	USA	1 assessment/year, 2 times	Time 1: UL, UC Time 2: UL, UC, FB (2nd order), KA	ICC, WM, PL	Time 1 EF + other variables ↦ Time 2 ToM (not the opposite)
MC	Lecce et al., 2017	113	114-128	Italy	1 assessment/year, 3 times	SS, DD, DB, KA (film)	ICC, WM	Time 1 WM + other variables ↦ Time 2 TOM Time 2 WM + other variables ↦ Time 3 ToM Time 1 IC + other variables ↦ Time 2 TOM
	Austin et al., 2014	3276	72-132	Germany	1 assessment/year, 2 times (50min/ses)	FB 2nd order, SS, MSA, ToM scale	ICC, SH, WM	WM ⇆ ToM

[1] TD = Toddlerhood, EC= Early Childhood, MC = Middle Childhood, AD = Adolescence
[2] Ages typed in bold extend beyond the limits of the age group.
[3] ToM (lv=low verbal): DC=Deception, PR=Pretence, FB=False Belief, UL=Unexpected Location, MSA=Mental State Attribution EU=Emotion Understanding, KA=Knowledge Access, AR=Appearance-Reality, TK=Think-Know (differentiation), UC=Unexpected Content, IU=Intentions understanding, PT= Perspective taking, SS=Social Stories, DD=Different Desires, HE=Hidden Emotion
[4] EFs: WM=Working Memory, ICC=Inhibitory Control Cool, SH=shifting/switching/mental flexibility, ICH=Inhibitory Control Hot, DT=Dual Task, PL=planning, CST=card shorting test, PCA=physical causality, STM=Short Term Memory
[5] Symbols referring to the relationship between EFs and ToM: ↔ = variable X is related to variable Y (correlation), ↦ = variable X predicts variable Y (regression), ⇆ = variable X predicts variable Y, but variable Y also predicts variable X (regression).

Brock et al., 2018; Carlson et al., 2004; Doenyas et al., 2018; Huang et al., 2022; Hughes & Ensor, 2007; Hughes et al. 1998; Lecce et al., 2017; Marcovitch et al., 2015; Müller at al., 2012; Shahaeina et al. 2023). Three of these studies also explored the inverse effect of a ToM measure on later EFs but failed to confirm it (Hughes et al., 1998; Marcovitch et al., 2015; Müller et al., 2012). Another three of these studies succeeded in finding a bidirectional effect of some EF measure on later ToM and of some aspect of ToM on later EFs (Austin et al., 2014; Huang et al., 2022; Hughes & Ensor, 2007). One more study (McAlister & Peterson, 2013) only found a ToM-EF effect, while two studies only revealed a mediating role of EFs in the effect between two successive measurements of ToM (Kloo et al. 2020; Razza & Blair, 2008). Finally, two studies failed to confirm any effect of EFs on some aspect of ToM at a later time (Diaz & Farrar, 2018; McAlister & Peterson, 2013) (for more details, see Table 5).

Cognitive demands of ToM tasks and EFs

One of the most common criticisms against EFs and ToM developmental interconnection concerns whether this relationship can solely be attributed to the demands of ToM tasks or whether there is a real developmental or causal link between the two. As already noted, expression theory (Moses, 2003) suggests that the association between performance in EFs and ToM may be affected by the nature of ToM tasks.

Indeed, changes in the executive demands of an unexpected location task (e.g., eliminating the need for reality suppression) by decreasing inhibitory load revealed an increase in children's ToM performance (Fizke et al., 2014; Wang et al., 2012). However, manipulating the verbal demands of ToM tasks (using photographs, signs, or drawings) does not always lead to an enhanced ToM performance. Müller et al. (2005) found a significant correlation between performance in DCCS and an FB task low in verbal demands. However, when a partial correlation controlled for the participants' verbal ability and age, this correlation was no longer significant. Similarly, among the three EFs (IC, WM, SH) assessed by Burnel et al. (2020), only WM and SH were significantly correlated to a ToM task low in verbal demands after controlling for age. Ford et al. (2012) administrated five IC tasks and found a marginal correlation between only one of the IC tasks and a ToM task low in verbal demands. Finally, Sabbagh, Moses et al. (2006) explored the relationship between IC and WM with two low verbal FB tasks, one with photographs and the other with signs. Their results revealed a significant correlation of EFs only with the sign version of the ToM task.

Discussion

Only 9 of the 111 studies included in the present systematic review failed to find any kind of relationship between EF and ToM (Arslan et al., 2018; Cardillo et al., 2021; Diaz & Farrar, 2018a; Diaz & Farrar, 2018b; Lecce et al., 2014; Meinhardt-Injac et al., 2020; Scullin & Bonner, 2006; Sudo & Matsui, 2021 -only for the monolingual sample; Talwar et al., 2017). Every aspect of Cognitive and Affective ToM has been linked with at least one of the principal EFs (inhibition, updating, and shifting). The importance of IC in the attribution of FB has been reported and explained in many studies. According to existing data, to perform correctly in ToM prediction and justification tasks, one needs to inhibit and disengage from a salient real-world situation and focus on an abstract mental representation. Therefore, IC is taken to be a prerequisite for FB attribution (Wellman, 2001). Inhibition was also shown to be a crucial factor for the attribution of desires, emotions, knowledge, perspective-taking and deception (e.g., Andrews et al., 2003; Chasiotis et al., 2006; Chu & Minai, 2018; Fizke et al., 2014). However, the relationship between IC and ToM seems to depend on the nature of the task used for measuring EFs. For instance, studies measuring IC through more than one IC task yielded divergent results for each task's relationship with ToM (e.g., Huang et al., 2022; Ford et al., 2012). As Rey-Mermet et al. (2018) explain, different inhibitory control tasks "do not measure a common underlying construct, but the highly task-specific ability to resolve the interference arising in that task" (p.32) and, thus, relate to FB understanding to different extents (Devine & Hughes, 2014).

The effect of WM on ToM tasks performance has also been addressed by several studies. Simultaneously dealing with two different and controversial realities seems to rely heavily on WM capacity. The vast majority of studies found either a correlation or an effect of WM on one or more ToM tasks. WM has been found to be an important factor for the attribution of beliefs, emotions, and for deception, as well as for the mentalistic understanding of non-literal communication (e.g., Austin et al., 2014; Buac & Kaushanskaya, 2020; Hoyo et al., 2019; Longobardi et al., 2021).

Finally, SH has been found to be linked with the attribution of beliefs, emotions, desires, perspectives, and knowledge (e.g., Bock et al., 2015; Gabriel et al., 2019; Grosse Wiesmann et al., 2017; Miller et al., 2018). The need to shift between different representations seems to be necessary for the correct attribution of a mental state (Bock et al., 2015). SH is related to ToM performance in various developmental phases. However, Gabriel et al. (2019) suggest that it is not until children have reached a certain level of ToM functioning that it becomes the principal executive function for more complicated ToM skills, usually emerging in adolescence. Given the limited number of relevant studies in this age group, this assumption should be further assessed.

Russell et al. (1991) were among the first theorists to propose that self-control is a prerequisite for ToM development. He suggested that endogenous changes in executive control are important for ToM development. Data from longitudinal studies offer insight into the predictive effect of EFs on ToM development. The majority of studies reported positive results on this effect (e.g., Austin et al., 2014; Brock et al., 2018; Huang et al., 2022; Shahgeina et al., 2023), but some studies failed to confirm it (Diaz & Farrar, 2018; McAlister & Peterson, 2013). The training studies also present inconclusive results on the predictive role of EFs on ToM performance. Among the handful of studies available, most studies revealed a positive effect of EFs on ToM (e.g., Gao et al., 2020; Kloo & Perner, 2003; Lecce & Bianco, 2018); however, here again, there have been studies with negative results (Arslan et al., 2018; Lecce et al., 2014).

These contradictory findings could be attributed to the significant heterogeneity among the studies concerning the participants' ages, age-range explored, testing intervals, aspects of EFs and ToM assessed, as well as other contextual factors taken simultaneously into account (e.g., demographic, sociocultural or cognitive factors). Additionally, on several occasions during this review, the concrete tasks used were reported to affect the resulting association between EFs and ToM. This was particularly evident in studies administering simultaneously to the same participants more than one IC task, or more than one EF task, or more than one FB task; results of these tasks, measuring in theory the same construct, were found to differ or even be contradictory (e.g., Burnel et al., 2020; Ford et al., 2012; Kloo & Perner, 2003). Therefore, we assume that another very important factor accounting, at least in part, for the inconclusive findings reported earlier can be the nature and demands of the wide variety of tasks (some of them standardized but many of them research-specific) used to assess either EFs or ToM.

As for the inverse effect of the contribution of ToM in the refinement of the EFs, it appears not to be supported by sufficient data. Despite theories suggesting that an improved understanding of one's mind could potentially lead to greater self-control (Perner, 1991), the number of studies exploring the bidirectional developmental relationship between EFs and ToM is very limited. Results have shown that ToM performance at a particular time point could predict subsequent EFs (Austin et al., 2014; Huang et al., 2022; Hughes & Ensor, 2007; McAlister & Peterson, 2013), although negative results are also present in the literature (e.g., Marcovitch et al., 2015; Müller et al., 2012; Hughes, 1998). Furthermore, among the training protocols focusing on mental state attribution practice, only one resulted in post-training improvement in executive functioning (Kloo & Perner, 2003). However, given the restricted number of heterogeneous studies included in the review, no safe conclusions can be drawn.

Overall, the majority of longitudinal and training studies appear to support the "emergence" account (Moses, 2003), suggesting that EFs contribute to the development of ToM concepts. At the same time, possible effects of decreasing the cognitive demands in FB tasks (e.g., less need for reality suppression, non-verbal tasks) suggest that the "expression" theory remains a noteworthy approach. While reviewing existing literature, adopting a synthetic point of view seems important. An effect of the cognitive demands of ToM tasks does not necessarily translate to a lack of a more direct link between these cognitive functions. This point of view is supported by some studies that found a significant relationship between EFs and ToM even when using ToM tasks low in cognitive or linguistic demands (e.g., Burnel et al., 2020; Müller et al., 2005; Sabbagh, Moses et al., 2006). One could assume that the nature and the demands of a task may mediate an existing relationship of EFs with ToM or even a direct effect of EFs on ToM development. However, the lack of longitudinal studies designed to address this particular hypothesis prevents us from reaching more specific conclusions.

Conclusion

During the last decades, an important number of theorists have tried to explain the link between EFs and ToM (Perner et al., 2002). Researchers have approached this topic by focusing on different parameters, like brain region connections, the cognitive profile of children with neurodevelopmental disorders or of typically developing children (Carruthers & Smith, 1996; Ozonoff et al.,1991) from multiple perspectives and in a variety of ways. Undoubtedly, not only the complex nature of ToM and EFs as theoretical constructs but also the varying nature and cognitive demands of the tasks that are currently used for their assessment obscure the picture of this relationship. In addition, the differing age ranges covered in each study is another important factor that may explain many contradictory results and hinder the generation of a unified account of what one expects to be a complex and dynamic developmental relationship.

Finally, several contextual factors have been reported to mediate the ToM-EFs relationship; cultural context (e.g., Chasiotis et al., 2006; Wang et al., 2016), socio-economic status (e.g., Dicataldo & Roch, 2020; Kara & Selcuk, 2021), bilingualism (e.g., Diaz & Farrar, 2018; Sudo & Matsui, 2021), or the "siblings' effect" (McAlister & Peterson, 2006) should be further assessed and carefully controlled for in experimental designs.

Overall, this review highlights the need for researchers to adopt clear conceptual definitions and rigorous methodological tools, providing details about the concrete aspects of ToM and EFs they aim to address and making careful and informed choices of the tools they will use accordingly. Contradictory as it may seem, acquiring many very clear partial pieces of the ToM-EFs relationship puzzle could enable us to see the entire picture one day. Importantly, given the asynchronous development of each and every one of these pieces, the implementation of many long-term longitudinal studies, assessing as many aspects of ToM and EFs as possible while controlling for the cognitive demands of the tasks, is deemed necessary so that we can reach a theoretical explanation (vs description) of the dynamic interactions among these complex theoretical constructs.

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References

Andrews, G., Halford, G. S., Bunch, K. M., Bowden, D., & Jones, T. (2003). Theory of mind and relational complexity. *Child Development*, *74*, 1476-1499. https://doi.org/10.1111/1467-8624.00618

Arranz, E., Artamendi, J., Olabarrieta, F., & Martín, J. (2002). Family context and theory of mind development. *Early Child Development and Care*, *172*(1), 9-22. https://doi.org/10.1080 /03004430210880

Arslan, B., Hohenberger, A., & Verbrugge, R. (2017). Syntactic recursion facilitates and working memory predicts recursive theory of mind. *PloS one*, *12*(1), Article e0169510. https://doi.org/10.1371/journal.pone.0169510

Arslan, B., Verbrugge, R., Taatgen, N., & Hollebrandse, B. (2018). Accelerating the development of second-order false belief reasoning: A training study with different feedback methods. *Child development*, *91*(1), 249-270. https://doi.org/10.1111/cdev.13186

Austin, G., Bondü, R., & Elsner, B. (2020). Executive Function, Theory of Mind, and Conduct-Problem Symptoms in Middle Childhood. *Frontiers in psychology*, *11*, 539. https://doi.org/10.3389/fpsyg.2020.00539

Austin, G., Groppe, K., & Elsner, B. (2014). The reciprocal relationship between executive function and theory of mind in middle childhood: A 1-year longitudinal perspective. *Frontiers in Psychology*, *5*, Article e655. https://doi.org/10.3389/fpsyg.2014.00655

Baker, E. R., D'Esterre, A. P., & Weaver, J. P. (2021). Executive function and Theory of Mind in explaining young children's moral reasoning: A Test of the Hierarchical Competing Systems Model. *Cognitive Development*, *58*, 101035.

Baron-Cohen, S., O'riordan, M., Stone, V., Jones, R., & Plaisted, K. (1999). Recognition of faux pas by normally developing children and children with Asperger syndrome or high-functioning autism. *Journal of autism and developmental disorders, 29*(5), 407-418. https://doi.org/ 10.1023/A: 1023035012436

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

Bellagamba, F., Addessi, E., Focaroli, V., Pecora, G., Maggiorelli, V., Pace, B., & Paglieri, F. (2015). False belief understanding and "cool" inhibitory control in 3-and 4-years-old Italian children. *Frontiers in Psychology*, *6*, Article e872. https://doi.org/10.3389/fpsyg.2015.00872

Blair, C., & Razza, R., P. (2007). Relating effortful control, executive function, and false belief understanding to emerging math and literacy ability in kindergarten. *Child Development*, *78*, 647-663. https://doi.org/10.1111/j.1467-8624.2007.01019.x

Bock, A. M., Gallaway, K. C., & Hund, A. M. (2015). Specifying Links Between Executive Functioning and Theory of Mind during Middle Childhood: Cognitive Flexibility Predicts Social Understanding. *Journal of Cognition and Development*, *16*(3), 509-521. https://doi.org/10.1080 /15248372.2014.888350

Brock, L. L., Kim, H., Gutshall, C. C., & Grissmer, D. W. (2018). The development of theory of mind: predictors and moderators of improvement in kindergarten. *Early Child Development and Care*, *189*(12), 1914-1924. https://doi.org/10.1080/03004430.2017.1423481

Brock, L. L., Kim, H., Kelly, C. L., Mashburn, A. J., & Grissmer, D. W. (2019). Theory of mind, directly and indirectly, facilitates kindergarten adjustment via verbal ability, executive function, and emotion knowledge. *Psychology in the Schools*, *56*(2), 176-193. https://doi.org/ 10.1002/pits.22216

Brüne, M., & Brüne-Cohrs, U. (2006). Theory of mind-evolution, ontogeny, brain mechanisms and psychopathology. *Neuroscience & Biobehavioral Reviews*, *30*(4), 437-455. https://doi.org/10.1016/j.neubiorev.2005.08.001

Brysbaert, M. (2021). Power considerations in bilingualism research: Time to step up our game. *Bilingualism: Language and Cognition*, *24*(5), 813-818. https://doi.org/10.1017/S1366728920000437

Buac, M., & Kaushanskaya, M. (2020). Predictors of Theory of Mind performance in bilingual and monolingual children. *International Journal of Bilingualism*, *24*(2), 339-359. https://doi.org/10.1177/ 1367006919826866

Bunch, K. M., & Andrews, G. (2012). Development of relational processing in hot and cool tasks. *Developmental Neuropsychology*, *37*(2), 134-152. https://doi.org/10.1080/87565641.2011.63 2457

Burnel, M., Durrleman, S., Reboul, A., Carré, A., Baciu, M., & Perrone-Bertolotti, M. (2020). Theory-of-mind during childhood: Investigating syntactic and executive contributions. *Social Development*, *12*(8), 743. https://doi.org/10.1111/sode.12471

Cantin, R. H., Gnaedinger, E. K., Gallaway, K. C., Hesson-McInnis, M. S., & Hund, A. M. (2016). Executive functioning predicts reading, mathematics, and theory of mind during the elementary years. *Journal of Experimental Child Psychology*, *146*, 66-78. https://doi.org/10.10 16/j.jecp.2016.01.014

Cardillo, R., Mammarella, I. C., Demurie, E., Giofre, D., & Roeyers, H. (2021). Pragmatic language in children and adolescents with autism spectrum disorder: Do theory of mind and executive functions have a mediating role?. *Autism Research*, *14*(5), 932-945.

Carlson, S. M., Mandell, D. J., & Williams, L. (2004). Executive function and theory of mind: Stability and prediction from ages 2 to 3. *Developmental Psychology*, *40*(6), 1105-1122. https://doi. org/10.1037/0012-1649.40.6.1105

Carlson, S. M., & Moses, L. J. (2001). Individual Differences in Inhibitory Control and Children's Theory of Mind. *Child Development*, *72*(4), 1032-1053. https://doi.org/10.1111/1467-8624.00333

Carlson, S. M., Moses, L. J., & Breton, C. (2002). How Specific is the Relation between Executive Function and Theory of Mind? Contributions of Inhibitory Control and Working Memory. *Infant and Child Development*, *11*(2), 73-92. https://doi.org/10.1002/icd.298

Carlson, S. M., Moses, L. J., & Claxton, L. J. (2004). Individual differences in executive functioning and theory of mind: An investigation of inhibitory control and planning ability. *Journal of Experimental Child Psychology*, *87*(4), 299-319. https://doi.org/10.1016/j.jecp.2004.01.002

Carlson, S. M., White, R. E., & Davis-Unger, A. C. (2014). Evidence for a relation between executive function and pretense representation in preschool children. *Cognitive development*, *29*, 1-16. https://doi.org/10.1016/j.cogdev.2013.09.001

Carruthers, P., & Smith, P. K. (Eds.). (1996). *Theories of theories of mind*. Cambridge university press.

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://doi.org/10.13110/merrpalmquar1982.64.4.0514

Chandler, M., Fritz, A. S., & Hala, S. (1989). Small-scale deceit: Deception as a marker of two-, three-, and four-year-olds' early theories of mind. *Child development*, 1263-1277. https://doi.org/10.2307/1130919

Chasiotis, A., Kiessling, F., Campos, D., & Hofer, J. (2006). Theory of mind and inhibitory control in three cultures: Conflict inhibition predicts false belief understanding in Germany, Costa Rica and Cameroon. *International Journal of Behavioral Development*, *30*(3), 249-260. https://doi.org/ 10.1177/0165025406066759

Chaytor, N., & Schmitter-Edgecombe, M. (2003). The ecological validity of neuropsychological tests: A review of the literature on everyday cognitive skills. *Neuropsychology review*, *13*, 181-197. https://doi.org/10.1023/B:NERV.0000009483.91468.fb

Chu, C. Y., & Minai, U. (2018). Children's Demonstrative Comprehension and the Role of Non-linguistic Cognitive Abilities: A Cross-Linguistic Study. *Journal of Psycholinguistic Research*, *47*(6), 1343-1368. https://doi.org/10.1007/s10936-018-9565-8

Cole, K., & Mitchell, P. (2000). Siblings in the development of executive control and a theory of mind. *British Journal of Developmental Psychology*, *18*(2), 279-295. https://doi.org/10.1348 /026151000165698

Colvert, E., Rutter, M., Kreppner, J., Beckett, C., Castle, J., Groothues, C., Hawkins, A., Stevens, S., & Sonuga-Barke, E. J. (2008). Do theory of mind and executive function deficits underlie the adverse outcomes associated with profound early deprivation?: Findings from the English and Romanian adoptees study. *Journal of abnormal child psychology*, 36, 1057-1068. https://doi.org/10.1007/s10802-008-9232-x

Craig, G. J., & Baucum, D. (2002). *Human development*. Pearson Educación.

Crone, E. A. (2009). Executive functions in adolescence: inferences from brain and behavior. *Developmental science*, *12*(6), 825-830.https://doi.org/10.1111/j.1467-7687.2009.00918.x

Dahlgren, S., Almén, H., & Dahlgren Sandberg, A. (2017). Theory of mind and executive functions in young bilingual children. *The Journal of genetic psychology*, *178*(5), 303-307. https://doi.org/10.1080/00221325.2017.1361376

Davis, H. L., & Pratt, C. (1995). The development of children's theory of mind: The working memory explanation. *Australian Journal of Psychology*, *47*(1), 25-31. https://doi.org/10.1080/00049539508258765

Demetriou, A., Spanoudis, G., Makris, N., Golino, H., & Kazi, S. (2021). Developmental reconstruction of cognitive ability: Interactions between executive, cognizance, and reasoning processes in childhood. *Cognitive Development*, *60*, 101124.

Dennis, M., Simic, N., Bigler, E. D., Abildskov, T., Agostino, A., Taylor, H. G., Rubin, K., Vannatta, K., Gerhardt, C. A., Stancin, T. & Yeates, K. O. (2013). Cognitive, affective, and conative theory of mind (ToM) in children with traumatic brain injury. *Developmental cognitive neuroscience*, *5*, 25-39.

Devine, R. T., & Hughes, C. (2014). Relations between false belief understanding and executive function in early childhood: A meta-analysis. *Child development*, *85*(5), 1777-1794. https://doi.org/10.1111/cdev.12237

Devine, R. T., White, N., Ensor, R., & Hughes, C. (2016). Theory of mind in middle childhood: Longitudinal associations with executive function and social competence. *Developmental Psychology*, *52*(5), 758-771. https://doi.org/10.1037/dev0000105

Diamond, A. (2006). The early development of executive functions. *Lifespan cognition: Mechanisms of change*, *210*, 70-95. https://doi.org/10.1093/acprof:oso/9780195169539.003.0006

Diamond, A. (2013). Executive functions. *Annual review of psychology*, *64*, 135.

Diaz, V., & Farrar, M. J. (2018a). The missing explanation of the false-belief advantage in bilingual children: a longitudinal study. *Developmental science*, *21*(4), Article e12594. https://doi.org/ 10.1111/desc.12594

Diaz, V., & Farrar, M. J. (2018b). Do bilingual and monolingual preschoolers acquire false belief understanding similarly? The role of executive functioning and language. *First Language*, *38*(4), 382-398. https://doi.org/10.1177/0142723717752741

Dicataldo, R., & Roch, M. (2020). Are the effects of variation in quantity of daily bilingual exposure and socioeconomic status on language and cognitive abilities independent in preschool children? *International Journal of Environmental Research and Public Health*, *17*(12), 1-23. https://doi.org/ 10.3390/ijerph17124570

Dick, A. S., Overton, W. F., & Kovacs, S. L. (2005). The development of symbolic coordination: Representation of imagined objects, executive function, and theory of mind. *Journal of Cognition and Development, 6*(1), 133-161. https://doi.org/10.1207/s15327647jcd0601_8

Doenyas, C., Yavuz, H. M., & Selcuk, B. (2018). Not just a sum of its parts: How tasks of the theory of mind scale relate to executive function across time. *Journal of Experimental Child Psychology*, *166*, 485-501. https://doi.org/10.1016/j.jecp.2017.09.014

Draperi, M., Aïte, A., Cassotti, M., Le Stanc, L., Houdé, O., & Borst, G. (2022). Development of cool and hot theory of mind and cool and hot inhibitory control abilities from 3.5 to 6.5 years of age. *Plos one*, *17*(1), Article e0262251.

Duh, S., Paik, J. H., Miller, P. H., Gluck, S. C., Li, H., & Himelfarb, I. (2016). Theory of mind and executive function in chinese preschool children. *Developmental Psychology*, *52*(4), 582-591. https://doi.org/10.1037/a0040068

Etel, E.Yagmurlu, B. (2014). Social competence, theory of mind, and executive function in institution-reared Turkish children. *Internation Journal of Behavioral Development*, *39*(6), 519-529. https://doi.org/10.1177%2F0165025414556095

Farrar, M. J., & Ashwell, S. (2012). Phonological awareness, executive functioning, and theory of mind. *Cognitive Development*, *27*(1), 77-89. https://doi.org/10.1016/j.cogdev.2011.08.002

Fizke, E., Barthel, D., Peters, T., & Rakoczy, H. (2014). Executive function plays a role in coordinating different perspectives, particularly when one's own perspective is involved. *Cognition*, *130*(3), 315-334. https://doi.org/10.1016/j.cognition.2013.11.017

Flavell, J. H. (2004). Theory-of-mind development: Retrospect and prospect. *Merrill-Palmer Quarterly, 50*(3), 274–290.https://doi.org/10.1353/mpq.2004.0018

Flavell, J. H., Flavell, E. R., & Green, F. L. (1983). Development of the appearance-reality distinction. *Cognitive psychology*, *15*(1), 95-120. https://doi.org/10.1016/0010-0285(83)90005-1

Flavell, J. H., Green, F. L., Flavell, E. R., Watson, M. W., & Campione, J. C. (1986). Development of knowledge about the appearance-reality distinction. *Monographs of the society for research in child development*, i-87. https://doi.org/10.2307/1165866

Ford, R. M., Driscoll, T., Shum, D., & Macaulay, C. E. (2012). Executive and theory-of-mind contributions to event-based prospective memory in children: Exploring the self-projection hypothesis. *Journal of Experimental Child Psychology*, *111*(3), 468-489. https://doi.org/ 10.1016/j.jecp.2011.10.006

Fujita, N., Devine, R. T., & Hughes, C. (2022). Theory of mind and executive function in early childhood: A cross-cultural investigation. *Cognitive Development*, *61*, 101150.

Gabriel, E. T., Oberger, R., Schmoeger, M., Deckert, M., Vockh, S., Auff, E. & Willinger, U. (2019). Cognitive and affective Theory of Mind in adolescence: developmental aspects and associated neuropsychological variables. *Psychological Research*. https://doi.org/10.1007/s00426-019-01263-6

Gao, Q., Huang, Q., Zhang, Q., & Chen, W. (2020). Does executive function influence the development of theory of mind in elementary students? *Current Psychology*, *39*(2), 389-396. https:// doi.org/10.1007/s12144-018-0107-1

Gathercole, S. E., Pickering, S. J., Ambridge, B., & Wearing, H. (2004). The structure of working memory from 4 to 15 years of age. *Developmental psychology*, *40*(2), 177. https://doi.org/ 10.1037/0012-1649.40.2.177

German, T. C., & Cohen, A. S. (2012). A cue-based approach to 'theory of mind': Re-examining the notion of automaticity. *British Journal of Developmental Psychology*, *30*(1), 45-58. https://doi.org/10.1111/j.2044-835X.2011.02055.x

Gerstadt, C. L., Hong, Y. J., & Diamond, A. (1994). The relationship between cognition and action:Performance of 3.5–7 years old on Stroop-like day–night test. *Cognition*, *53*, 129–153 *(4) (PDF) Inhibitory and working memory demands of the day–night task in children*. Available from: https://www.researchgate.net/publication/227695287_Inhibitory_and_working_memory_demands_of_the_day-night_task_in_children

Goldstein, S., Naglieri, J. A., Princiotta, D. & Otero, T. M. (2014). Introduction: A History of Executive Functioning as a Theoretical and Clinical Construct. In S. Goldstein & J. A. Naglieri, *Handbook of Executive Functioning* (p. 3-12). Springer.

Gopnik, A., & Astington, J. W. (1988). Children's understanding of representational change and its relation to the understanding of false belief and the appearance-reality distinction. *Child development*, *59*(1), 26-37. https://doi.org/10.2307/1130386

Gordon, A. C. L. & Olson, D. R. (1998). The relation between acquisation of a theory of mind and the capacity to hold on mind. *Journal of Experimental Child Psychology*, *68*(1), 70-83. https://doi.org/10.1006/jecp.1997.2423

Gordon, H. M., Lyon, T. D., & Lee, K. (2014). Social and Cognitive Factors Associated With Children's Secret-Keeping for a Parent. *Child Development*, *85*(6), 2374-2388. https://doi.org/ 10.1111/cdev.12301

Goukon, A., Kikuchi, T., Noguchi, K., Ohuchi, T., Hirano, M., & Hosokawa, T. (2006). Developmental order driving the relationship between executive functions and theory of mind: A case study. *Psychological reports*, *98*(3), 662-670. https://doi.org/10.2466/pr0.98.3.662-670

Grosse Wiesmann, C., Friederici, A. D., Singer, T., & Steinbeis, N. (2017). Implicit and explicit false belief development in preschool children. *Developmental Science*, *20*(5). https://doi.org /10.1111/desc.12445

Guajardo, N. R., Parker, J., & Turley-Ames, K. (2009). Associations among false belief understanding, counterfactual reasoning, and executive function. *British Journal of Developmental Psychology*, *27*, 681-702. https://doi.org/10.1348/026151008X357886

Happé, F. G. (1994). An advanced test of theory of mind: Understanding of story characters' thoughts and feelings by able autistic, mentally handicapped, and normal children and adults. *Journal of autism and Developmental disorders*, *24*(2), 129-154. https://doi.org/10.1007/BF02172093

Hasselhorn, M., Mähler, C., & Grube, D. (2005). Theory of mind, working memory, and verbal ability in preschool children: The proposal of a relay race model of the developmental dependencies. In W. Schneider, R. Schumann-Hengsteler, & B. Sodian (Eds.), *Young children's cognitive development: Interrelationships among executive functioning, working memory, verbal ability, and theory of mind* (pp. 219–237). Lawrence Erlbaum Associates Publishers.

Henning, A., Spinath, F. M., & Aschersleben, G. (2011). The link between preschoolers' executive function and theory of mind and the role of epistemic states. *Journal of Experimental Child Psychology*, *108*(3), 513-531. https://doi.org/10.1016/j.jecp.2010.10.006

Holl, A., Vetter, N.C., & Elsner, B. (2021). Disentangling the relations of theory of mind, executive function and conduct problems. *Journal of Applied Developmental Psychology, 72*, 101233. https://doi.org/10.1016/j.appdev.2020.101233

Hoyo, Á., Rueda, M. R., & Rodríguez-Bailón, R. (2019). Children's Individual Differences in Executive Function and Theory of Mind in Relation to Prejudice Toward Social Minorities. *Frontiers in Psychology, 10*, Article e2293 https://doi.org/10.3389/fpsyg.2019.02293

Hudson, A., & Jacques, S. (2014). Put on a happy face! Inhibitory control and socioemotional knowledge predict emotion regulation in 5- to 7-year-olds. *Journal of Experimental Child Psychology*, *123*(1), 36-52. https://doi.org/10.1016/j.jecp.2014.01.012

Huang, R., Baker, E. R., Battista, C., & Liu, Q. (2022). Executive function and theory of mind in children living in poverty: A short-term longitudinal study. *Journal of Cognition and Development*, 23(5), 751-775. https://doi.org/10.1080/15248372.2022.2110873

Hughes, C. (1998). Executive function in preschoolers: Links with theory of mind and verbal ability. British *Journal of Developmental Psychology*, *16*(2), 233-253. https://doi.org/10.1111/j.2044-835X. 1998.tb00921.x

Hughes, C., Dunn, J., & White, A. (1998). Trick or treat?: Uneven understanding of mind and emotion and executive dysfunction in “hard-to-manage” preschoolers. *The Journal of Child Psychology and Psychiatry and Allied Disciplines*, *39*(7), 981-994.

Hughes, C., Ensor, R. (2006). Behavioural problems in 2-year-olds: Links with individual differences in theory of mind, executive function and harsh parenting. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, *47*(5), 488-497. https://doi.org/10.1111/j.1469-7610.2005.01519.x

Hughes, C., & Ensor, R. (2005). Executive function and theory of mind in 2 year olds: A family affair? *Developmental Neuropsychology*, *28*(2), 645-668. https://doi.org/10.1207/s15326942dn 2802 5

Hughes, C., & Ensor, R. (2007). Executive Function and Theory of Mind: Predictive Relations From Ages 2 to 4. *Developmental Psychology*, *43*(6), 1447-1459. https://doi.org/10.1037/0012-1649.4 3.6.1447

Hughes, C., & Russell, J. (1993). Autistic children's difficulty with mental disengagement from an object: Its implications for theories of autism. *Developmental psychology, 29*(3), 498. https://doi.org/10.1037/0012-1649.29.3.498

Hughes, C., Dunn, J. and White, A. (1998) Trick or Treat?: Uneven Understanding of Mind and Emotion and Executive Dysfunction in 'Hard-to-Manage' Preschoolers. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, *39*, 981-994. https://doi.org/10.1111/1469-7610.00401

Huyder, V., Nilsen, E. S., & Bacso, S. A. (2017). The relationship between children's executive functioning, theory of mind, and verbal skills with their own and others' behaviour in a cooperative context: Changes in relations from early to middle school-age. *Infant and Child Development*, *26*(6), Article e2027. https://doi.org/10.1002/icd.2027

Im-Bolter, N., Agostino, A., & Owens-Jaffray, K. (2016). Theory of mind in middle childhood and early adolescence: Different from before? *Journal of Experimental Child Psychology*, *149*, 98-115. https://doi.org/10.1016/j.jecp.2015.12.006

Jahromi, L. B., & Stifter, C. A. (2008). Individual differences in preschoolers' self-regulation and theory of mind Merrill-Palmer Quarterly, *54*(1), 125-150. https://doi.org/10.1353/mpq.2008.0007

Kara, B., & Selcuk, B. (2021). The Role of Socioeconomic Adversity and Armed Conflict in Executive Function, Theory of Mind and Empathy in Children. *Child Psychiatry & Human Development*, 1-13.

Karakelle, S., & Ertugrul, Z. (2012). Zihin kurami ile çalişma belleği, dil becerisi ve yönetici i̇ şlevler arasindaki bağlantilar küçük (36-48 ay) ve büyük (53-72 ay) çocuklarda farklilik gösterebilir mi? [Do Developmental Relationships between Theory of Mind, Language, Working Memory, and Executive Functions Show Differences across Early (36-48 months) and Late (53-72 Months) Age Groups?], *Turk Psikoloji Dergisi*, *27*(70), 1-25.

Karpinski, A. C., & Scullin, M. H. (2009). Suggestibility under pressure: Theory of mind, executive function, and suggestibility in preschoolers. *Journal of Applied Developmental Psychology*, *30*(6), 749-763. https://doi.org/10.1016/j.appdev.2009.05.004

Kemp, J., Després, O., Sellal, F., & Dufour, A. (2012). Theory of Mind in normal ageing and neurodegenerative pathologies. *Ageing research reviews*, *11*(2), 199-219. https://doi.org/ 10.1016/j.arr.2011.12.001

Keenan, T. (1998). Memory span as a predictor of false belief understanding. *New Zeeland Journal of Psychology*, *27*, 36-43.

Keenan, T., Olson, D. R., & Marini, Z. (1998). Working memory and children's developing understanding of mind. *Australian Journal of Psychology*, *50*(2), 76-82. https://doi.org/10.1080 /00049539808257537

Kennedy, K., Lagattuta, K. H, & Sayfran, L. (2015). Simblings compositions, executive function and children's thinking about mental diversity. *Journal of Experimental Child Psychology*, *132*, 121-139. https://doi.org/10.1016/j.jecp.2014.11.007

Kenny, L., Cribb, S. J., & Pellicano, E. (2019). Childhood executive function predicts later autistic features and adaptive behavior in young autistic people: A 12-year prospective study. *Journal of abnormal child psychology*, *47*, 1089-1099. https://doi.org/10.1007/s10802-018-0493-8

Kerr, A., & Zelazo, P. D. (2004). Development of "hot" executive function: The children's gambling task. *Brain and cognition*, *55*(1), 148-157. https://doi.org/10.1016/S0278-2626(03)00275-6

Klindt, D., Devaine, M., & Daunizeau, J. (2017). Does the way we read others' mind change over the lifespan? Insights from a massive web poll of cognitive skills from childhood to late adulthood. *Cortex*, *86*, 205-215. https://doi.org/10.1016/j.cortex.2016.09.009

Kloo, D., Kristen-Antonow, S., & Sodian, B. (2020). Progressing from an implicit to an explicit false belief understanding: A matter of executive control? *International Journal of Behavioral Development*, *44*(2), 107-115. https://doi.org/10.1177/0165025419850901

Kloo, D. & Perner, J. (2003). Training transfer between card sorting and false belief understanding: Helping children apply conflicting descriptions. *Child Development*, *74*(6), 1823-1839. https://doi.org/ 10.1046/j.1467- #8624.2003.00640.x

Kochanska, G., Murray, K. T., & Harlan, E. T. (2000). Effortful control in early childhood: continuity and change, antecedents, and implications for social development. *Developmental psychology*, *36*(2), 220.

Kochanska, G., Murray, K., Jacques, T. Y., Koenig, A. L., & Vandegeest, K. A. (1996). Inhibitory control in young children and its role in emerging internalization. *Child development*, *67*(2), 490-507.

Kouklari, E. C., Thompson, T., Monks, C. P., & Tsermentseli, S. (2017). Hot and cool executive function and its relation to theory of mind in children with and without autism spectrum disorder. *Journal of Cognition and Development*, *18*(4), 399-418. https://doi.org/10.1080/15248372.2017.1339708

Korkman, M., Kirk, U., & Kemp, S. (2007). *NEPSY II: Clinical and interpretive manual*. Harcourt Assessment, PsychCorp.

Lagattuta, K. H., Sayfan, L., & Harvey, C. (2014). Beliefs About Thought Probability: Evidence for Persistent Errors in Mindreading and Links to Executive Control. *Child Development*, *85*(2), 659-674. https://doi.org/10.1111/cdev.12154

Lagattuta, K. H., Tashjian, S. M., & Kramer, H. J. (2018). Does the past shape anticipation for the future? Contributions of age and executive function to advanced theory of mind. Zeitschrift fur Psychologie / *Journal of Psychology*, *226*(2), 122-133. https://doi.org/10.1027/2151-2604/a 000328

Lang, B., & Perner, J. (2002). Understanding of intention and false belief and the development of self-control. *British Journal of Developmental Psychology*, *20*(1), 67-76. https://doi.org/10.1348 /026151002166325

Lecce, S., & Bianco, F. (2018). Working memory predicts changes in children's theory of mind during middle childhood: A training study. *Cognitive Development*, *47*, 71-81. https://doi.org/10.1016/j.cogdev.2018.04.002

Lecce, S., Bianco, F., Devine, R. T., & Hughes, C. (2017). Relations between theory of mind and executive function in middle childhood: A short-term longitudinal study. *Journal of Experimental Child Psychology*, *163*, 69-86. https://doi.org/10.1016/j.jecp.2017.06.011

Lecce, S., Bianco, F., Devine, R. T., Hughes, C., & Banerjee, R. (2014). Promoting theory of mind during middle childhood: a training program. *Journal of Experimental Child Psychology*, *126*, 52-67. https://doi.org/10.1016/j.jecp.2014.03.002

Leslie, A. M., & Polizzi, P. (1998). Inhibitory processing in the false belief task: Two conjectures. *Developmental Science*, *1*(2), 247–253. https://doi.org/10.1111/1467-7687.00038

Lewis, C., Huang, Z., & Rooksby, M. (2006). Chinese preschoolers' false belief understanding: IS social knowledge underpinned by parental styles, social interactions or executive functions? *Psychologia*, *49*(4), 252-266. https://doi.org/10.2117/psysoc.2006.252

Lillard, A. S. (1993). Pretend play skills and the child's theory of mind. *Child development*, *64*(2), 348-371. https://doi.org/10.2307/1131255

Liu, B., Huang, Z., Xu, G., Jin, Y., Chen, Y., Li, X., Wang, O., Song, S., & Jing, J. (2016). Altruistic sharing behavior in children: Role of theory of mind and inhibitory control. *Journal of experimental child psychology*, *141*, 222-228. https://doi.org/10.1016/j.jecp.2015.09.010

Longobardi, E., Spataro, P., Morelli, M., & Laghi, F. (2021). Executive function ratings in educational settings: concurrent relations with cognitive and affective theory of mind. *Early Child Development and Care*, 1-13.

Luria, A. R. (1959). The directive function of speech in development and dissolution. *Word*, *15*(2), 341-352. https://doi.org/10.1080/00437956.1959.11659703

Marcovitch, S., O'Brien, M., Calkins, S. D., Leerkes, E. M., Weaver, J. M., & Levine, D. W. (2015). A longitudinal assessment of the relation between executive function and theory of mind at 3, 4, and 5 years. *Cognitive Development*, *33*, 40-55. https://doi.org/10.1016/j.cogdev.2014.07.001

Markiewicz, K. (2009). Disorder of executive function in autistic children. *The New Educational Review*, *17*(1), 361-366.

Maselli, M. D., & Altrocchi, J. (1969). Attribution of intent. *Psychological Bulletin, 71*(6), 445–454. https://doi.org/10.1037/h0027348

Matthews, D., Biney, H., & Abbot-Smith, K. (2018). Individual differences in children's pragmatic ability: a review of associations with formal language, social cognition, and executive functions. *Language Learning and Development*, *14*(3), 186-223. https://doi.org/10.1080/15475441 .2018.1455584

McAlister, A., & Peterson, C. C. (2006). Mental playmates: Siblings, executive functioning and theory of mind. British *Journal of Developmental Psychology*, *24*(4), 733-751. https://doi.org /10.1348/026151005X70094

McAlister, A. R., & Peterson, C. C. (2013). Siblings, theory of mind, and executive functioning in children aged 3-6 years: New longitudinal evidence. *Child Development*, *84*(4), 1442-1458. https://doi.org/10.1111/cdev.12043

McGlamery, M. E., Ball, S. E., Henley, T. B., & Besozzi, M. (2007). Theory of mind, attention, and executive function in kindergarten boys. *Emotional and Behavioural Difficulties*, *12*(1), 29-47. https://doi.org/10.1080/13632750601135899

Meinhardt-Injac, B., Daum, M. M., & Meinhardt, G. (2020). Theory of mind development from adolescence to adulthood: Testing the two-component model. *British Journal of Developmental Psychology*, *38*(2), 289-303. https://doi.org/10.1111/bjdp.12320

Melinder, A., Endestad, T., & Magnussen, S. (2006). Relations between episodic memory, suggestibility, theory of mind, and cognitive inhibition in the preschool child. *Scandinavian Journal of Psychology*, *47*(6), 485-495. https://doi.org/10.1111/j.1467-9450.2006.00542.x

Memisevic, H., Biscevic, I., & Pasalic, A. (2018). Exploring the link between a theory of mind and executive functions in preschool children. *Acta Neuropsychologica*, *16*(1), 17-26. https://doi.org/10.5604/01.3001.0011.6503

Miller, S. E., Reavis, R. E., & Avila, B. N. (2018). Associations between theory of mind, executive function, and friendship quality in middle childhood. *Merrill-Palmer Quarterly*, *64*(3), 397-426. https://doi.org/10.13110/merrpalmquar1982.64.3.0397

Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex "frontal lobe" tasks: A latent variable analysis. *Cognitive psychology*, *41*(1), 49-100. https://doi.org /10.1006/cogp.1999.0734

Morra, S., Parrella, I., Camba, R. (2011). The role of working memory in the development of emotion comprehension. *British Journal of Developmental Psychology, 29*, 744-764. https://doi.org/ 10.1348/2044-835X.002006

Moses, L. J. (2003). Executive Accounts of Theory of Mind Development. *Child Development*, *72*(3), 688-690. https://doi.org/10.1111/1467-8624.00306

Müller, U., Miller, M. R., Michalczyk, K., & Karapinka, A. (2007). False belief understanding: The influence of person, grammatical mood, counterfactual reasoning and working memory. British *Journal of Developmental Psychology*, *25*(4), 615-632. https://doi.org/10.1348/026151007X1 82962

Müller, U., Liebermann-Finestone, D. P., Carpendale, J. I., Hammond, S. I., & Bibok, M. B. (2012). Knowing minds, controlling actions: The developmental relations between theory of mind and executive function from 2 to 4 years of age. *Journal of Experimental Child Psychology*, *111*(2), 331-348. https://doi.org/10.1016/j.jecp.2011.08.014

Müller, U., Zelazo, P. D., & Imrisek, S. (2005). Executive function and children's understanding of false belief: How specific is the relation?. *Cognitive Development*, *20*(2), 173-189. https://doi.org/10.1016/j.cogdev.2004.12.004

Mutter, B., Alcorn, M. B., & Welsh, M. (2006). Theory of mind and executive function: Working-memory capacity and inhibitory control as predictors of false belief task performance. *Perceptual and Motor Skills*, *102*(3), 819-835. https://doi.org/10.2466/pms.102.3.819-835

Nathanson, A. I., & Fries, P. T. (2014). Television Exposure, Sleep Time, and Neuropsychological Function Among Preschoolers. *Media Psychology*, *17*(3), 237-261. https://doi.org/10.1080 /15213269.2014.915197

Oh, S. & Lewis, C. (2008). Koreans Preschoolers' Advanced Inhibitory Control and Its Relations to Other Executive Skills and Mental State Understanding. *Child Development*, *79*(1), 80-99 https://doi.org/10.1111/j.1467-8624.2007.01112.x

O'Toole, S. E., Monks, C. P., & Tsermentseli, S. (2017). Executive function and theory of mind as predictors of aggressive and prosocial behavior and peer acceptance in early childhood. *Social Development*, *26*(4), 907-920. https://doi.org/10.1111/sode.12231

Ozonoff, S., Pennington, B. F., & Rogers, S. J. (1991). Executive function deficits in high-functioning autistic individuals: relationship to theory of mind. *Journal of child Psychology and Psychiatry*, *32*(7), 1081-1105. https://doi.org/10.1111/j.1469-7610.1991.tb00351.x

Perner, J. (1991). *Understanding the representational mind.* The MIT Press.

Perner, J., & Lang, B. (1999). Development of theory of mind and executive control. *Trends in cognitive sciences*, *3*(9), 337-344. https://doi.org/10.1016/S1364-6613(99)01362-5

Perner, J., & Lang, B. (2000). Theory of mind and executive function: Is there a developmental relationship? In S. Baron-Cohen, H. Tager-Flusberg, & D. J. Cohen (Eds.), *Understanding other minds: Perspectives from developmental cognitive neuroscience* (p. 150–181). Oxford University Press.

Perner, J., Lang, B., & Kloo, D. (2002). Theory of mind and self-control: More than a common problem of inhibition. *Child Development*, *73*(3), 752-767. https://doi.org/10.1111/1467-8624.00436

Peterson, C. C., & Wellman, H. M. (2019). Longitudinal theory of mind (ToM) development from preschool to adolescence with and without ToM delay. *Child development, 90*(6), 1917-1934. https://doi.org/10.1111/cdev.13064

Peskin, J., Prusky, C., & Comay, J. (2014). Keeping the reader's mind in mind: Development of perspective-taking in children's dictations. *Journal of Applied Developmental Psychology*, *35*(1), 35-43. https://doi.org/10.1016/j.appdev.2013.11.001

Poole, D. A., Dickinson, J. J., Brubacher, S. P., Liberty, A. E., & Kaake, A. M. (2014). Deficient cognitive control fuels children's exuberant false allegations. *Journal of Experimental Child Psychology*, *118*(1), 101-109. https://doi.org/10.1016/j.jecp.2013.08.013

Powell, L. J., & Carey, S. (2017). Executive function depletion in children and its impact on theory of mind. *Cognition*, *164*, 150-162. https://doi.org/10.1016/j.cognition.2017.03.022

Putko, A., & Złotogórska, A. (2014). Predictions of actions and their justifications in false-belief tasks: The role of executive function. *Polish Psychological Bulletin*, *45*(4), 500-510. https://doi.org/10.2478/ppb-2014-0060

Qu, L., Shen, P., Chee, Y. Y., & Chen, L. (2015). Teachers' Theory-of-mind Coaching and Children's Executive Function Predict the Training Effect of Sociodramatic Play on Children's Theory of Mind. *Social Development*, *24*(4), 716-733. https://doi.org/10.1111/sode.12116

Rakoczy, H. (2010). Executive function and the development of belief-desire psychology. *Developmental Science*, *13*(4), 648-661. https://doi.org/10.1111/j.1467-7687.2009.00922.x

Razza, R. A., & Blair, C. (2008). Associations among false-belief understanding, executive function, and social competence: A longitudinal analysis. *Journal of Applied Developmental Psychology*, *30*(3), 332-343. https://doi.org/10.1016/j.appdev.2008.12.020

Reed, M. A., Pien, D. L., & Rothbart, M. K. (1984). Inhibitory self-control in preschool children.*Merrill-Palmer Quarterly*, *30*(2), 131–147.

Rey-Mermet, A., Gade, M., & Oberauer, K. (2018). Should we stop thinking about inhibition? Searching for individual and age differences in inhibition ability. *Journal of experimental psychology. Learning, memory, and cognition*, *44*(4), 501–526. https://doi.org/10.1037/xlm0000450

Romine, C. B., & Reynolds, C. R. (2005). A model of the development of frontal lobe functioning: Findings from a meta-analysis. *Applied neuropsychology*, *12*(4), 190-201. https://doi.org/ 10.1207/s15324826an1204_2

Rosenqvist, J., Lahti-Nuuttila, P., Laasonen, M., & Korkman, M. (2014). Preschoolers recognition of emotional expressions: Relationships with other neurocognitive capacities. *Child Neuropsychology*, *20*(3), 281-302. https://doi.org/10.1080/09297049.2013.778235

Rostad, K., & Pexman, P. M. (2014). Developing appreciation for ambivalence: The understanding of concurrent conflicting desires in 4- to 7-year-old children. *Canadian Journal of Experimental Psychology*, *68*(2), 122-132. https://doi.org/10.1037/cep0000016

Russell, J., Mauthner, N., Sharpe, S., & Tidswell, T. (1991). The 'windows task'as a measure of strategic deception in preschoolers and autistic subjects. *British journal of developmental psychology*, *9*(2), 331-349. https://doi.org/10.1111/j.2044-835X.1991.tb00881

Sabbagh, M. A., Moses, L. J., & Shiverick, S. (2006). Executive functioning and preschoolers' understanding of false beliefs, false photographs, and false signs. *Child Development*, *77*(4), 1034-1049. https://doi.org/10.1111/j.1467-8624.2006.00917.x

Sabbagh, M. A., Xu, F., Carlson, S. M., Moses, L. J., & Lee, K. (2006). The development of executive functioning and theory of mind: A comparison of Chinese and U.S. preschoolers. *Psychological Science*, *17*(1), 74-81. https://doi.org/10.1111/j.1467-9280.2005.01667.x

Schneider, W., Lockl, K., & Fernandez, O. (2005). Interrelationships among theory of mind, executive control, language development, and working memory in young children: A longitudinal analysis. In W. Schneider, R. Schumann-Hengsteler, & B. Sodian (Eds.), *Young children's cognitive development: Interrelationships among executive functioning, working memory, verbal ability, and theory of mind* (pp. 259–284). Lawrence Erlbaum Associates Publishers. https://doi.org/ 10.4324/9781410612007

Scullin, M. H., & Bonner, K. (2006). Theory of mind, inhibitory control, and preschool-age children's suggestibility in different interviewing contexts. *Journal of Experimental Child Psychology*, *93*(2), 120-138. https://doi.org/10.1016/j.jecp.2005.09.005

Selcuk, B., Yucel. M. (2017). The role of institutionalization in theory of mind. In V. Slaughter, M. de Rosnay, *Theory of mind development in context* (pp 89-105). Routledge.

Shahaeian, A., Haynes, M., & Frick, P. J. (2023). The role of language in the association between theory of mind and executive functioning in early childhood: New longitudinal evidence. *Early Childhood Research Quarterly*, *62*, 251-258. https://doi.org/10.1016/j.ecresq.2022.09.003

Shahaeian, A., Henry, J. D., Razmjoee, M., Teymoori, A., & Wang, C. (2015). Towards a better understanding of the relationship between executive control and theory of mind: An intra-cultural comparison of three diverse samples. *Developmental Science*, *18*(5), 671-685. https://doi.org /10.1111/desc.12243

Sudo, M., & Matsui, T. (2021). School Readiness in Language-Minority Dual Language Learners in Japan: Language, Executive Function, and Theory of Mind. *The Journal of Genetic Psychology*, *182*(6), 375-390. https://doi.org/10.1080/00221325.2021.1930994

Tager-Flusberg, H., & Joseph, R. M. (2005). Theory of mind, language, and executive functions in autism: A longitudinal perspective. In W. Schneider, R. Schumann-Hengsteler, & B. Sodian (Eds.), *Young children's cognitive development: Interrelationships among executive functioning, working memory, verbal ability, and theory of mind* (pp. 239–257). Lawrence Erlbaum Associates Publishers.

Talwar, V., Crossman, A., & Wyman, J. (2017). The role of executive functioning and theory of mind in children's lies for another and for themselves. *Early Childhood Research Quarterly*, *41*, 126-135. https://doi.org/10.1016/j.ecresq.2017.07.003

Talwar, V., & Lee, K. (2008). Social and cognitive correlates of children's lying behavior. *Child Development*, *79*(4), 866-881. https://doi.org/10.1111/j.1467-8624.2008.01164.x

Thommen, É., Bulgarelli, D., Cattelan, C., Fulvio, A.D., Foudon, N., Molina, P., Rossini-Drecq, E., Rudelli, N., & Salomone, E. (2016). L'évolution de la cognition sociale chez les enfants avec un trouble du spectre de l'autisme : approche longitudinale et comparative. *ANAE*, *28*(144), 527-537.

Tsuji, H., & Mitchell, P. (2019). Modelling the executive components involved in processing false belief and mechanical/intentional sequences. *British Journal of Developmental Psychology*, *37*(2), 184-198. https://doi.org/10.1111/bjdp.12266

Venkadasalam, V. P., Jenkins, J. M., Ganea, P. A., & Wade, M. (2022). Linking early maternal input during shared reading to later theory of mind through receptive language and executive function: A within-and between-family design. *Journal of Experimental Child Psychology*, *223*, 105469.

Vetter, N. C., Altgassen, M., Phillips, L., Mahy, C. E. V., & Kliegel, M. (2013). Development of affective theory of mind across adolescence: Disentangling the role of executive functions. *Developmental Neuropsychology*, *38*(2), 114-125. https://doi.org/10.1080/87565641.2012 .733786

Wade, M., Browne, D. T., Madigan, S., Plamondon, A., & Jenkins, J. M. (2014). Normal birth weight variation and children's neuropsychological functioning: Links between language, executive functioning, and theory of mind. *Journal of the International Neuropsychological Society*, *20*(9), 909-919. https://doi.org/10.1017/S1355617714000745

Wang, Y., Hong, S., Pei, M., Wang, X., & Su, Y. (2022). Emotion matters in early polite lies: Preschoolers' polite lie-telling in relation to cognitive and emotion-related abilities. *Social Development*, *31*(2), 406-422.

Wang, B., Low, J., Jing, Z., & Qinghua, Q. (2012). Chinese preschoolers' implicit and explicit false-belief understanding. *British Journal of Developmental Psychology*, *30*, 123-140. https://doi.org/ 10.1111/j.2044-835X.2011.02052.x

Wang, Z., Devine, R. T., Wong, K. K., & Hughes, C. (2016). Theory of mind and executive function during middle childhood across cultures. *Journal of Experimental Child Psychology*, *149*, 6-22. https://doi.org/10.1016/j.jecp.2015.09.028

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

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

Wilson, J., Andrews, G., Hogan, C., Wang, S., & Shum, D. H. K. (2018). Executive function in middle childhood and the relationship with theory of mind. *Developmental Neuropsychology*, *43*(3), 163-182. https://doi.org/10.1080/87565641.2018.1440296

Wilson, J., Hogan, C., Wang, S., Andrews, G., & Shum, D. H. (2021). Relations between executive functions, theory of mind, and functional outcomes in middle childhood. *Developmental Neuropsychology*, *46*(7), 518-536.

Wimmer, H., & Perner, J. (1983). Beliefs about beliefs: Representation and constraining function of wrong beliefs in young children's understanding of deception. *Cognition, 13*(1), 103-128. https://doi.org/10.1016/0010-0277(83)90004-5

Yott, J., & Poulin-Dubois, D. (2016). Are infants' theory-of-mind abilities well integrated? Implicit understanding of intentions, desires, and beliefs. *Journal of Cognition and Development*, *17*(5), 683-698.

Yu, Y. T., Li, H. J., Tsai, C. H., Lin, C. H., Lai, S. S., & Chen, K. L. (2021). Cool executive function and verbal comprehension mediate the relation of hot executive function and theory of mind in children with autism spectrum disorder. *Autism Research*, *14*(5), 921-931. https://doi.org/10.1002/aur.2412

Zelazo, P. D. (2006). The Dimensional Change Card Sort (DCCS): A method of assessing executive function in children. *Nature protocols*, *1*(1), 297-301. https://doi.org/10.1038/nprot.2006.46

Zelazo, P. D., Müller, U., Frye, D., Marcovitch, S., Argitis, G., Boseovski, J., Chiang, J. K., Hongwanishkul, D., Schuster, B. V., & Sutherland, A. (2003). The development of executive function in early childhood. *Monographs of the Society for Research in Child Development*, *68*(3), vii–137. https://doi.org/10.1111/j.0037-976x.2003.00260.x

Zelazo, P. D., Qu, L., & Müller, U. (2005). Hot and cool aspects of executive function: Relations in early development. In W. Schneider & R. Schumann-Hengsteler & B. Sodian (Eds.), *Young children's cognitive development: Interrelationships among executive functioning, working memory, verbal ability, and theory of mind* (pp. 71-93). Erlbaum.

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ΒΙΒΛΙΟΓΡΑΦΙΚΗ ΑΝΑΣΚΟΠΗΣΗ | REVIEW PAPER

Η σχέση μεταξύ Θεωρίας του Νου και Εκτελεστικών Λειτουργιών σε τυπικά αναπτυσσόμενα παιδιά: Μια συστηματική ανασκόπηση

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ΛΕΞΕΙΣ-ΚΛΕΙΔΙΑ

Θεωρία του Νου (ΘτΝ),
Κατανόηση νοητικών αναπαραστάσεων,
Εκτελεστικές λειτουργίες,
Γνωστική ανάπτυξη,
Παιδική ηλικία,
Τυπική ανάπτυξη

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ΠΕΡΙΛΗΨΗ

Η ανάπτυξη της Θεωρίας του Νου (ΘτΝ) αποτελεί κεντρικό θέμα στη μελέτη της γνωστικής ανάπτυξης. Τις τελευταίες δεκαετίες, ερευνητές που εκπροσωπούν διαφορετικές θεωρητικές προσεγγίσεις προσπάθησαν να διερευνήσουν την ανάδυση και την ανάπτυξη της κατανόησης νοητικών αναπαραστάσεων και τη δυνητική συμβολή άλλων σύνθετων γνωστικών μηχανισμών σε αυτή την αναπτυξιακή διεργασία. Η σχέση μεταξύ της ΘτΝ και των εκτελεστικών λειτουργιών (ΕΛ) έχει αξιολογηθεί στο πλαίσιο διαφόρων πειραματικών σχεδίων. Παρά τον σημαντικό αριθμό των διαθέσιμων μελετών και την ποικιλία των θεωριών που έχουν προταθεί, δεν υπάρχει ακόμη συναίνεση σχετικά με την επακριβή φύση της σχέσης αυτής. Ο κύριος στόχος της παρούσας ανασκόπησης είναι η συστηματική καταγραφή των σχετικών ερευνητικών αποτελεσμάτων που αφορούν σε παιδιά τυπικής ανάπτυξης. Επιδιώκεται να διαχωριστούν οι παράγοντες που μπορούν ενδεχομένως να εξηγήσουν τα αντιφατικά ευρήματα που αναφέρονται στη βιβλιογραφία. Τα αποτελέσματα της ανασκόπησης στηρίζουν σε γενικές γραμμές τη σχέση ΘτΝ-ΕΛ και αναδεικνύουν τον σημαντικό ρόλο των ΕΛ στην ανάπτυξη της ΘτΝ. Η φύση αυτής της σχέσης επισκιάζεται, ωστόσο, από την ποικιλομορφία των προσεγγίσεων, των εννοιολογικών διατυπώσεων, των μεθόδων και των ηλικιών που περιλαμβάνονται στις μελέτες. Συνεπώς, προτείνεται ότι για την οικοδόμηση μιας ενοποιημένης εικόνας των αναπτυξιακών σχέσεων μεταξύ αυτών των δύο πολυδιάστατων θεωρητικών κατασκευών, είναι απαραίτητη η εκλέπτυνση των εννοιολογικών τους ορισμών και των μεθοδολογικών προσεγγίσεων.