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# The link between preschoolers' executive function and theory of mind and the role of epistemic states

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### ABSTRACT

The aim of this study was to assess the specific relation between 3- to 6-year-olds' performance on a task measuring executive function (EF), the Dimensional Change Card Sort task (DCCS), and different developmental attainments in their theory of mind (ToM) by employing a battery of scaled ToM tasks that were comparable in task format and task demands. In addition, individual differences on the temperamental dimensions emotionality, activity, sociability, and shyness were assessed by parental rating. The main findings show that children's ( $N = 195$ ) performance on the DCCS related to their overall performance on the ToM scale but that this relation was specific to those ToM tasks that tap children's understanding of epistemic states such as knowledge access, diverse beliefs, and false beliefs regarding content and location. The relation between children's EF and overall ToM performance remained significant after controlling for age, sentence comprehension, child temperament, and parental education. Individual differences in child activity showed consistent negative relation to EF and ToM abilities. The findings point to a differential involvement of the various EF components in reasoning about different mental concepts.

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### Introduction

The view of people as mental agents whose actions are causally mediated by their internal states such as intentions, emotions, and beliefs is commonly construed as a theory of mind (ToM). A milestone in children's ToM development takes place at around 4 years of age, when children understand

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that beliefs about the world may be true or false and, therefore, may lead to successful or erroneous actions (Wellman, Cross, & Watson, 2001). A key ability in false belief reasoning is the ability to hold in mind two conflicting representations regarding the same situation (e.g., true belief vs. false belief) and to inhibit the prepotent response tendency exerted by one of the two (e.g., one's own true belief vs. another person's false belief). Around the same time during the preschool years, children also show a marked improvement in higher level cognitive processes, termed executive function (EF), that are involved in planning and controlling goal-directed behavior (Zelazo, Carter, Reznick, & Frye, 1997). This rather heterogeneous set of skills seems to group into three core components of EF: working memory, inhibitory control, and mental set shifting (see Garon, Bryson, & Smith, 2008, for a review).

In addition to sharing a similar developmental timetable with a marked improvement during the preschool period, empirical evidence of the past two decades points to an ontogenetic link between children's EF and ToM (e.g., Carlson, Mandell, & Williams, 2004; Flynn, 2007; Frye, Zelazo, & Palfai, 1995; Hala, Hug, & Henderson, 2003; Hughes & Ensor, 2005; Hughes & Ensor, 2007; Müller, Zelazo, & Imrisek, 2005; Perner, Lang, & Kloo, 2002). Typically, the correlations found between individual differences in EF performance and ToM tasks are robust and remain significant after controlling for covarying effects of child age and verbal ability. Moreover, the findings of a study comparing Chinese and U.S. preschoolers suggest that this link is culturally universal and not influenced by differences in socialization goals regarding children's ability for self-control (Sabbagh, Xu, Carlson, Moses, & Lee, 2006). Although Chinese children outperformed U.S. preschoolers on the EF tasks but not on the ToM tasks, the correlation between EF and ToM performance was robust in both cultural groups.

Various explanations have been put forward to account for this association between children's performance on EF and ToM tasks (see, e.g., Perner & Lang, 1999, for an overview). On the one hand, expression accounts (Hughes & Russell, 1993; Russell, Mauthner, Sharpe, & Tidswell, 1991) posit that successful performance on classical ToM tasks requires some level of executive skills to disengage from salient reality cues as well as from one's own representations of events to reflect on the mental states of self and others. On the other hand, emergence accounts (Carlson & Moses, 2001; Perner, 1998; Russell, 1996) argue for a functional dependency between EF and ToM in development but offer different proposals regarding developmental direction. For example, Perner (1998) hypothesized that some metarepresentational insight into the causal relation between actions and underlying mental states is fundamental for the development of self-monitoring and inhibitory control. By contrast, Russell (1996) assumed that a certain level of executive control on goal-directed actions is a prerequisite for children's growing ability to reflect on the mental states underlying these actions. A third account, the cognitive complexity and control (CCC) theory (Frye, 2000; Frye et al., 1995), explains the relation between EF and ToM by reference to developmental changes in children's domain-general ability to use hierarchically embedded rule systems for reasoning about complex problems. According to this view, EF tasks such as the Dimensional Change Card Sort task (DCCS) (Frye et al., 1995) and classic ToM tasks both are complex problem-solving tasks that require the use of a higher order if–if–then rule to integrate two lower order conflicting representations or rules. Finally, there is some evidence suggesting that the maturation of common brain structures underlying EF and ToM may account for the observed correlations (Ozonoff, Pennington, & Rogers, 1991).

Perner's (1998) position that insight into mental states fosters EF development is supported by evidence showing that children's performance on the DCCS related to their performance on false belief prediction tasks as well as false belief explanation tasks, in which the pull of the real is less salient (Perner et al., 2002). However, the longitudinal evidence available to date suggests that earlier EF skills predict later ToM abilities rather than the reverse (Carlson, Moses, & Breton, 2002; Carlson et al., 2004; Flynn, 2007; Flynn, O'Malley, & Wood, 2004; Hughes, 1998; Müller et al., 2005). Still, there is no conclusive evidence supporting either an expression or emergence executive account of ToM development, especially given that the test batteries commonly employed comprise a variety of tasks within each area (EF and ToM) that are not necessarily comparable in task formats and task demands.

The work of Carlson and Moses (2001) and Carlson et al. (2002) suggests that different components of EF skills show differential relations with children's ToM development. Specifically, EF tasks that recruit not only inhibitory control but also working memory required for flexible shifting between conflicting propositions regarding one and the same situation (termed conflict tasks) show stronger relations with children's ToM performance than do EF tasks that mainly recruit inhibitory control

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