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## Cognitive Development



# The contribution of executive function and social understanding to preschoolers' letter and math skills



Michael R. Miller<sup>a,\*</sup>, Ulrich Müller<sup>a</sup>, Gerald F. Giesbrecht<sup>a,1</sup>,  
Jeremy I. Carpendale<sup>b</sup>, Kimberly A. Kerns<sup>a</sup>

<sup>a</sup> Department of Psychology, University of Victoria, PO Box 3050 STN CSC, Victoria, British Columbia V8W 3P5, Canada

<sup>b</sup> Department of Psychology, Simon Fraser University, RCB 5246, 8888 University Drive, Burnaby, British Columbia V5A 1S6, Canada

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### ABSTRACT

The influence of executive function and social understanding on letter and math skills was examined in 129 3–5-year-olds. Tasks were administered to measure working memory, inhibition, social understanding, letter and math skills, and vocabulary. Using latent variable analyses, multiple models were compared in order to examine the influence of executive function and social understanding on participants' emerging academic skills. In the best-fitting model, working memory contributed to letter and math skills, over and above inhibition, social understanding, age, and vocabulary. Inhibition and social understanding did not uniquely contribute to letter and math skills, but significant relations were found among working memory, inhibition, and social understanding. Findings are discussed with respect to improving ways to examine the complex relations among preschoolers' executive function, social understanding, and school readiness skills.

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\* Corresponding author. Present address: Department of Psychology and Human Development, Vanderbilt University, Peabody College #552, 230 Appleton Place, Nashville, TN 37203-5721, United States. Tel.: +1 615 343 7051; fax: +1 615 343 9494.

E-mail addresses: [m.miller@vanderbilt.edu](mailto:m.miller@vanderbilt.edu) (M.R. Miller), [umueller@uvic.ca](mailto:umueller@uvic.ca) (U. Müller), [ggiesbre@ucalgary.ca](mailto:ggiesbre@ucalgary.ca) (G.F. Giesbrecht), [jcarpend@sfu.ca](mailto:jcarpend@sfu.ca) (J.I. Carpendale), [kkerns@uvic.ca](mailto:kkerns@uvic.ca) (K.A. Kerns).

<sup>1</sup> Current address: Department of Paediatrics, Alberta Children's Hospital, 2888 Shaganappi Trail NW, Calgary, Alberta T2N 4Z6, Canada.

## 1. Introduction

Preschoolers' rudimentary academic skills, such as knowledge of letters and numbers, may be important for later school achievement because they create a strong motivational basis for future learning and facilitate the acquisition of further academic skills (Duncan et al., 2007; Pagani, Fitzpatrick, Archambault, & Janosz, 2010; Romano, Babchishin, Pagani, & Kohen, 2010). Empirical evidence for this claim comes from a growing body of research showing that early academic skills predict later school achievement (Lemelin et al., 2007; for a meta-analysis, see La Paro & Pianta, 2000). The majority of these studies have focused on young children's early literacy and math skills, often assessed in terms of identifying letters, words, numbers, counting, and shapes. For example, Duncan et al. (2007) analyzed six longitudinal data sets and found that preschoolers' math skills, such as their knowledge of numbers, were the most powerful predictors of later learning (average  $\beta = .34$ ), followed by preliteracy skills, such as letter knowledge (average  $\beta = .17$ ).

In addition to specific academic skills, recent research on school readiness and achievement has highlighted the importance of more domain-general cognitive skills (Blair, 2002; Bodrova & Leong, 2006). Executive function (EF) and, to a lesser extent, social understanding (SU) have received attention (Astington & Pelletier, 2005; Blair & Razza, 2007; Meltzer, 2007; Monette, Bigras, & Guay, 2011; Müller, Liebermann, Frye, & Zelazo, 2008; Welsh, Nix, Blair, Bierman, & Nelson, 2010). EF refers to an interrelated set of higher cognitive processes used in the control of action and thought (Garon, Bryson, & Smith, 2008; Zelazo & Müller, 2010), whereas SU (also referred to as social cognition or theory of mind) refers to the attribution of mental states to self and others that can be used to explain and to predict behavior (Astington, 1993; Carpendale & Lewis, 2006). Research suggests that a functional relation exists between EF and SU because (a) both undergo dramatic developmental changes during the preschool years, (b) both have neural underpinnings in the frontal lobes, and (c) impairments in both are implicated in various developmental disorders (Sabbagh, Bowman, Evraire, & Ito, 2008; Zelazo & Müller, 2010). Moreover, significant correlations between EF and SU tasks have been found both in typically (Moses & Tahiroglu, 2010) and in atypically (Pelicano, 2010) developing children, even after controlling for age, verbal ability, and IQ.

Whereas the relation between EF and SU in young children is well supported, the influence of each on children's school readiness is inconsistent across studies, especially in terms of their relative contribution to academic performance. Therefore, the goal of the present study was to examine the combined and unique influence of EF and SU on preschoolers' school readiness skills, specifically letter and math skills. We also sought to better explain variance in preschoolers' academic skills by using a latent variable approach.

### 1.1. Executive function and school readiness

Factor analytic studies suggest that EF in school-age children includes component processes of inhibition, working memory/updating, and shifting/flexibility (Garon et al., 2008; Huizinga, Dolan, & van der Molen, 2006; Lehto, Juujärvi, Kooistra, & Pulkkinen, 2003). In these studies, inhibition refers to the ability to suppress prepotent responses, working memory to the ability to monitor and revise information, and shifting to the ability to switch between multiple tasks (Miyake et al., 2000). In preschoolers, these component processes may remain relatively undifferentiated (Zelazo & Müller, 2010). Recent latent variable studies involving a variety of EF tasks have tended to support a unitary EF factor structure in preschoolers (Hughes, Ensor, Wilson, & Graham, 2010; Wiebe, Espy, & Charak, 2008; Wiebe et al., 2011; Willoughby, Blair, Wirth, & Greenberg, 2010, 2012; Willoughby, Wirth, & Blair, 2012). However, in most of these studies, a two-factor EF structure consisting of working memory and inhibition still fit the data well, but was rejected in favor of a unitary structure on grounds of parsimony. Moreover, other latent variable studies have found that a two-component EF structure with working memory and inhibition as latent factors fit the data better than a unitary EF structure both in typically (Miller, Giesbrecht, Müller, McInerney, & Kerns, 2012) and atypically developing preschoolers (Schoemaker et al., 2012). Therefore, while the structure of EF remains open to investigation, the importance of working memory and inhibition processes is well recognized in preschoolers' EF development (Garon et al., 2008).

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