Journal of Experimental Child Psychology 146 (2016) 66–78

Contents lists available at ScienceDirect

Journal of Experimental Child Psychology

journal homepage: www.elsevier.com/locate/jecp

Executive functioning predicts reading, mathematics, and theory of mind during the elementary years

Rachelle H. Cantin, Emily K. Gnaedinger, Kristin C. Gallaway, Matthew S. Hesson-McInnis, Alycia M. Hund *

Illinois State University, Normal, IL 61790, USA

ARTICLE INFO

Article history:
Received 28 May 2015
Revised 17 November 2015
Available online 23 February 2016

Keywords:
Executive functioning
Reading
Mathematics
Theory of mind
Working memory
Inhibition
Flexibility
Middle childhood

ABSTRACT

The goal of this study was to specify how executive functioning components predict reading, mathematics, and theory of mind performance during the elementary years. A sample of 93 7- to 10-year-old children completed measures of working memory, inhibition, flexibility, reading, mathematics, and theory of mind. Path analysis revealed that all three executive functioning components (working memory, inhibition, and flexibility) mediated age differences in reading comprehension, whereas age predicted mathematics and theory of mind directly. In addition, reading mediated the influence of executive functioning components on mathematics and theory of mind, except that flexibility also predicted mathematics directly. These findings provide important details about the development of executive functioning, reading, mathematics, and theory of mind during the elementary years.

Introduction

Executive functioning is an umbrella term used to describe the cognitive processes responsible for purposeful, goal-directed behavior (Best & Miller, 2010; Carlson, Zelazo, & Faja, 2013; Müller & Kerns, 2015). Research and practice have provided evidence linking executive functioning with academic and social success, including theory of mind (e.g., Best, Miller, & Jones, 2009). To date, executive

* Corresponding author.
E-mail address: amhund@ilstu.edu (A.M. Hund).

http://dx.doi.org/10.1016/j.jecp.2016.01.014
0022-0965/

functioning and theory of mind research has disproportionately concentrated on the preschool years, demonstrating both robust individual differences and remarkable developmental gains during these early years (Carlson, 2005; Devine & Hughes, 2014; Garon, Bryson, & Smith, 2008; Hughes, 2011; Liu, Wellman, Tardif, & Sabbagh, 2008; Wellman, Cross, & Watson, 2001). Even so, there is a major gap in our understanding of executive functioning and theory of mind beyond 5 years of age, as well as the mechanisms by which executive functioning predicts academic and social success across domains and age groups (Best & Miller, 2010; Best et al., 2009; Zelazo & Carlson, 2013). The goal of this study was to specify how executive functioning components predict reading, mathematics, and theory of mind performance during the elementary years. These domains were chosen given their importance for success in school and life (e.g., Best et al., 2009; Miller, 2009).

Despite ongoing debate regarding the core features of executive functioning, there is widespread agreement that executive functioning includes three distinct, yet overlapping, components—working memory, inhibition, and flexibility—during adulthood (Miyake et al., 2000). Recently, developmental scientists have extended this work, demonstrating the utility of similar three-component models during middle childhood (Brocki & Brohlin, 2004; Huizinga, Dolan, & van der Molen, 2006; Lee, Bull, & Ho, 2013; Lehto, Juujärvi, Kooistra, & Pulkkinen, 2003; Rose, Feldman, & Jankowski, 2011). Ongoing research probes the utility of these models during the preschool years (Hughes, Ensor, Wilson, & Graham, 2010; Wiebe, Espy, & Charak, 2008; Wiebe et al., 2011; Willoughby, Wirth, & Blair, 2011), leading some scientists to conclude that executive functioning begins as a unitary construct that becomes more differentiated across childhood (Garon et al., 2008; Lee et al., 2013).

This project focused on working memory, inhibition, and flexibility as three distinct, yet related, executive functioning components. Working memory is the capacity to retain and manipulate information during a short period of time (Schneider & Bjorklund, 2003). Inhibition involves the capacity to delay prepotent responses, to interrupt ongoing responses when given feedback about performance, and to inhibit responding to sources of interference when engaged in tasks requiring self-regulation and goal-directed behavior (Barkley, 1999). Flexibility refers to the ability to switch fluidly between activities and adapt in the presence of new or changing information (Bock, Gallaway, & Hund, 2015). We know that all three components evince developmental gains extending to the elementary years (Anderson, 2002; Bock et al., 2015; Lee et al., 2013; Prencipe et al., 2011; Schneider & Bjorklund, 2003).

Reading comprehension involves constructing meaning from text. Comprehension depends on some degree of mastery of phonemic awareness, phonics, vocabulary, and fluency as readers seek to understand words, sentences, paragraphs, and entire text passages. We know that executive functioning predicts gains in literacy and reading during the preschool and elementary years (Altemeier, Abbott, & Berninger, 2008; Carretti, Borella, Cornoldi, & De Beni, 2009; Locascio, Mahone, Eason, & Cutting, 2010; Sesma, Mahone, Levine, Eason, & Cutting, 2009). Conversely, deficits in executive functioning are evident in children who struggle with reading (Cain, 2006; Cutting, Materek, Cole, Levine, & Mahone, 2009; Gioia, Isquith, Kenworthy, & Barton, 2002). For instance, working memory is positively related to reading (and math) performance during preschool and early elementary school (Bull, Espy, & Wiebe, 2008; Gathercole & Pickering, 2000; Lan, Legare, Ponitz, Li, & Morrison, 2011; Swanson, 1994; Swanson & Jerman, 2007; van der Sluis, de Jong, & van der Leij, 2007; Welsch, Nix, Blair, Bierman, & Nelson, 2010; Willoughby, Blair, Wirth, & Greenberg, 2012). It is likely that working memory supports reading success by allowing children to hold in mind the multitude of words, concepts, and themes necessary to comprehend texts.

Similarly, flexibility is related to reading comprehension during the elementary years (Cartwright, 2002; Cartwright, Marshall, Dandy, & Isaac, 2010; Colé, Duncan, & Blaye, 2014; Gaskins, 2008; van der Sluis et al., 2007; Yeniad, Malda, Mesman, van IJzendoorn, & Pieper, 2013). For example, Cartwright (2002) found that reading-specific flexibility contributed to reading comprehension even after controlling for age, domain-general shifting performance, decoding skill, and verbal ability. Moreover, Cartwright (2002, 2006) demonstrated that training of reading-specific flexibility skills resulted in gains in reading comprehension. Flexibility is important for reading because it allows readers to make use of multiple features, especially orthographic, phonological, and semantic information, that support successful comprehension (Cartwright, 2002; Colé et al., 2014). Although there is some research linking inhibition and reading comprehension (Altemeier et al., 2008; Borella, Carretti, & Pelegrina, 2010; Cain, 2006), more work is needed in this area. Perhaps inhibition is linked with reading comprehension