



The role of executive function in linking fundamental motor skills and reading proficiency in socioeconomically disadvantaged kindergarteners



Mei Chang^a, Xiangli Gu^{b,*}

^a University of North Texas, 1155 Union Circle #311335, Denton, TX 76203-5017, United States

^b University of North Texas, 1155 Union Circle #310769, Denton, TX 76203, United States

ARTICLE INFO

Keywords:

Executive function
Motor skills
Reading achievement
Preschool children
SES

ABSTRACT

The study examined the association between fundamental motor skills (FMS), executive function (EF), and reading proficiency among 145 socioeconomically disadvantaged kindergarteners of diverse ethnicity. Regression analyses supported that EF and FMS were significantly associated with children's reading proficiency. Working memory and inhibition explained a substantial amount of variances in reading proficiency after controlling for the covariates. Structural equation modeling analysis suggested that the relation between FMS and reading proficiency was fully mediated by global EF ($\chi^2/df = 4.29/3$; CFI = 0.983; RMSEA = 0.055). Results of the bootstrap method also supported the statistical significant effect of FMS on reading proficiency through global EF, 95% CI [0.029, 0.325]. This study provides initial evidence suggesting that education environment (i.e., school, home and community), specifically school physical activity program, may be important for improving FMS and EF in children for the sake of promoting reading proficiency.

1. Introduction

Motor proficiency and cognitive mechanisms (e.g., executive function) have been recognized as important foundational skills for children's school readiness, which may influence their short- and long-term academic success (Cameron et al., 2012; Grissmer, Grimm, Aiyer, Murrah, & Steele, 2010; Willoughby, Magnus, Vernon-Feagans, & Blair, 2016). Executive function (EF) is broadly defined as collective cognitive abilities responsible for purposeful, goal-directed, problem-solving behaviors and flexible responses to environmental demands (Gioia & Isquith, 2004; Willoughby et al., 2016). Donnelly and Lambourne (2011) proposed a hypothesized model of factors associated with improved academic achievement, arguing that the multi-component cognitive construct, such as executive function, is the direct influential factor of academic achievement. It was established in national large scales studies that children who are able to organize, remember directions, pay attention and keep information in mind, and control their impulses to engage in goal-achieving activities have greater success in school (Duncan et al., 2007; Grissmer et al., 2010). Substantial evidence has also identified that children from a high-risk environment (i.e., low SES) are more likely to demonstrate cognitive development delays and school failures (Pienaar, Barhorst, & Twisk, 2014; Sadeh, Burns, & Sullivan, 2012; Willoughby et al., 2016).

In the context of developing pre-academic skills, EF is perceived as

the strongest predictor of school readiness (Blair & Razza, 2007). Successful completion of academic tasks expected of young children often require the support of EF components, such as working memory for following and remembering teachers' instructions, selective attention to key points of a lesson, and inhibitory control for staying on the correct task while restricting irrelevant interruptions (Blair & Razza, 2007). In fact, Lehto, Juujärvi, Kooistra, and Pulkkinen (2003) distinguished working memory, shifting/attentional flexibility, and inhibition as the three central components of EF for success with school readiness. Various cross-sectional studies, using performance-based measures and rating scales, have established a link between EF and academic achievement in both reading and mathematics among young children (Blair & Razza, 2007; Cameron et al., 2012; Pienaar et al., 2014). Longitudinal studies also provide evidence that early EF skills predict growth in academic achievement over time (Bull, Espy, & Wiebe, 2008; Fuhs, Nesbitt, Farran, & Dong, 2014; Kegel & Bus, 2014; Welsh, Nix, Blair, Bierman, & Nelson, 2010).

Apart from EF being an important predictor of pre-academic skills, early childhood professionals noted that delayed fundamental motor skills (FMS) development may also be an important determinant of school readiness (Cameron et al., 2012; Grissmer et al., 2010). FMS develop in early childhood and are categorized as locomotor skills (e.g., run, hop, jump, sliding) and object-control skills (e.g., throw, catch, kick, dribbling) (Gallahue & Ozmun, 2006; National Association for

* Corresponding author.

E-mail addresses: mchang@unt.edu (M. Chang), Xiangli.Gu@unt.edu (X. Gu).

Sport and Physical Education [NASPE], 2010). These FMS allow children to function effectively and independently in their daily activities and provide the foundation for cognitive, social, motor, and physical growth (Clark & Woodward, 2007; Logan, Robinson, Wilson, & Lucas, 2012). Children with insufficient FMS are likely to be cognitively unprepared for academic demands and noncommittal in achieving academic success (Cameron et al., 2012). As school administrators continue to advocate employing evidence-based practices to improve academic achievement, an increasing body of research has attempted to connect FMS with positive academic attainment (Cameron et al., 2012). Recent researchers, using performance-based measures, have also shown associations between problems with fundamental motor proficiency and reading difficulties in children (Fuhs et al., 2014; Getchell, Mackenzie, & Marmon, 2010).

Schools provide a unique avenue for nearly 56 million children in the United States to develop sufficient levels of FMS by involving various daily physical activities, especially during early childhood (NASPE, 2010). The national standards and grade-level outcomes for elementary schools focus on fostering the maturation of the FMS and developing the understanding of movement concepts (SHAPE America, 2014). Unfortunately, research has shown that many children do not have adequate FMS proficiency when they exit the elementary school (Erwin & Castelli, 2008). Using performance-based measures, Cameron et al. (2012) reported that changes in FMS contribute to changes in school readiness and later achievement, and that children with insufficient FMS development are likely to encounter difficulties with reading during their school years. Studies found that disadvantaged children displayed developmental delays in FMS, suggesting that these delays reflect a lack of environmental support regarding where they came from (Gu, 2016; Pienaar et al., 2014). Using rating scale, Cohen, Morgan, Plotnikoff, Callister, and Lubans (2014) also suggested a low socioeconomic status (SES) as an environmental risk factor for FMS development. Thus, the kindergarten year emerges as a critical year for young children's skill acquisition in FMS development.

Additionally, substantial evidence suggested positive association between language abilities and EF during early school years (Gooch, Thompson, Nash, Snowling, & Hulme, 2016; White, Alexander, & Greenfield, 2017; Wittke, Spaulding, & Schechtman, 2013). White et al. (2017) found EF was related to various components of language (e.g., vocabulary, syntax, language learning) contributing to reading process. Longitudinal studies suggested EF not only predicted vocabulary development in preschools (Weiland, Barata, & Yoshikawa, 2014) but also demonstrated a reciprocal and strong concurrent association with language skills during the preschool years (Gooch et al., 2016; Vissers, Koolen, Hermans, Scheper, & Knoors, 2015). EF was also found linked to language impairment; young children with language impairment tended to show persistent EF deficits (Vissers et al., 2015; Yang & Gray, 2017). The literatures demonstrate EF plays an important role in language development for reading process.

Donnelly and Lambourne (2011)'s conceptual model hypothesized that EF and its subcomponents were direct indicators for successful academic achievement. Most recently, Donnelly et al. (2016)'s substantial review indicated that EF and FMS as the underlying mechanisms contributing independently to reading proficiency, and that moderate to strong associations were found between EF and reading proficiency. Children who evidence automaticity in certain FMS (e.g., object control skills) may have greater processing capacity to learn through empowered EF-related neurocognitive function (e.g., memory, attention), which may enhance their academic performance in reading (Donnelly & Lambourne, 2011; Stipek & Valentino, 2015). However, no inclusive mechanism has been identified between FMS and EF (Hilton et al., 2014) and how they may interact together to influence children's reading proficiency, especially among kindergarteners with socioeconomically disadvantaged backgrounds.

Guided by Donnelly and Lambourne (2011)'s conceptual model, the main purpose of the study was to investigate the relationship between

FMS (object control and locomotor skills), global EF, and reading proficiency. The effect of global EF on the relationship between FMS and reading proficiency among socioeconomically disadvantaged kindergarteners was also tested. Specific questions guided this study were: (1) What inter-association exists among FMS, global EF, and reading proficiency during early childhood? and (2) Does global EF mediate the relationship between FMS and reading proficiency among this population? It was hypothesized that 1) there would be significant relationships among FMS, EF components, and reading proficiency; and 2) global EF would emerge as a mediator in the relationship between FMS and reading proficiency.

2. Method

2.1. Participants

Participants included 145 five-year-old ($M = 66.23$ months; $SD = 2.53$ months) SES disadvantaged kindergarteners enrolled in three public schools in the southern region. Among them, 34.5% ($n = 50$) were identified as bilingual, whose home language is not English. The language background (monolingual vs. bilingual) was then used as a proxy for the language variable in the dataset. "SES disadvantaged" was determined based on the Income Eligibility Guidelines (IEGs; Start & Assistance, 2012) to classify the eligibility for free or reduced-cost lunches. Approximately 93% ($n = 135$) of the participants received a free lunch and 7% ($n = 10$) received lunch for a reduced price. Of these, 51% ($n = 74$) were boys and 49% ($n = 71$) were girls. Ethnicity distributions were 50.3% Latino/Hispanic, 26.4% Caucasian, 21.4% African American, and 1.4% multiracial.

2.2. Study design and procedure

The study employed a correlational research design across 2013–2014 academic school year. During the fall semester, children's FMS—including hopping, sliding, throwing, and dribbling—were assessed by two well-trained research assistants. At the end of the fall semester, classroom teachers completed a rating inventory designed to assess executive functions for each of the participants. The executive function scale is a standardized rating inventory with specific instructions provided for teachers to complete the scale. At the beginning of the spring semester, children's reading proficiency was administered by the classroom teachers using a standardized reading test employed by the school district. The study was approved by the University Institutional Review Board and received permission from the school district. Prior to the data collection, parental consents were received and collected from classroom teachers. Teachers' consent forms were also received before they completed the executive function rating scale for the participating students.

2.3. Measures

2.3.1. Executive function

The Behavior Rating Inventory of Executive Function–Preschool Version (BRIEF-P; Gioia, Espy, & Isquith, 2003) is a norm-referenced, individually administered questionnaire for measuring EF. The BRIEF-P Teacher Version was administered to assess the student participants' levels of executive functions observed at school. The BRIEF-P is a 3-point Likert-type questionnaire that contains 63 items yielding five scales (Inhibit, Shift, Emotional Control, Working Memory, Plan/Organize), two indices, and one EF composite score. Teachers' ratings were computed as T scores ($M = 50$; $SD = 10$). Higher scale scores indicate lower executive function and higher risks for executive dysfunction. The BRIEF-P Teacher Version displays strong validity and high reliability with Cronbach's alphas ranging from 0.80 to 0.97 (Gioia et al., 2003). Cronbach's alpha coefficient for the sample in the current study is 0.94, suggesting that 94% of the variance in the scores is

Download English Version:

<https://daneshyari.com/en/article/6844568>

Download Persian Version:

<https://daneshyari.com/article/6844568>

[Daneshyari.com](https://daneshyari.com)