



Independent and compensatory contributions of executive functions and challenge preference for students' adaptive classroom behaviors



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ABSTRACT

This study examined the unique contributions and interplay of children's executive function (EF) skills and challenge preference for adaptive classroom behaviors. The sample included socioeconomically and ethnically diverse third, fourth, and fifth grade students ($N = 334$, $M = 9.30$ years). EFs were directly assessed using tablet tasks in the classroom setting, challenge preference was measured with self-report questionnaires, and teachers reported on students' classroom behaviors. Both EFs and challenge preference independently predicted students' task orientation, assertiveness, peer social skills, and frustration tolerance, whereas only EFs were linked to students' conduct problems. Further, challenge preference emerged as a significant moderator of the association between EFs and students' assertiveness. Specifically, EFs were more strongly associated with students' assertiveness among students with low challenge preference. Implications include structuring classrooms to promote challenge preference by focusing on effort and learning.

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1. Introduction

There is increasing interest in understanding how non-academic or so-called “soft” skills, such as persistence, motivation, and self-regulation, promote school success. Students' behavioral adaptation to the classroom is critical for their academic achievement. Skills such as staying focused and completing tasks independently, interacting well with peers, and participating in classroom discussions provide a foundation for positive learning experiences. A rich body of research has established the importance self-regulatory skills, known as executive function (EF) skills, for various academic outcomes and classroom behaviors (Best, Miller, & Jones, 2009; Blair & Diamond, 2008). Separately, researchers have examined how different aspects of children's intrinsic motivation contribute to academic attainment (Broussard, 2004; Lepper, Corpus, & Iyengar, 2005). For example, students who believe that intellectual abilities can be grown and improved are more likely to seek cognitive challenges and demonstrate academic resilience (Yeager & Dweck, 2012). Both EFs and motivational processes contribute to children's ability and desire to engage in the classroom context. While the effective execution of EFs in the real world is modulated by motivational processes (Somerville & Casey, 2010), the two constructs have not been studied together. Given that the greater levels of EFs and motivation have both been linked to adaptive behaviors in the classroom, it is important to know if these effects are overlapping, independent, or interactive. Bridging disparate lines of research, the present

study examines the unique and interactive effects of EFs and challenge preference, an aspect of intrinsic motivation, on children's adaptive classroom behaviors implicated in school success. Using an ethnically and socio-economically diverse sample, we extend prior research on these constructs to middle childhood.

1.1. The importance of adaptive classroom behaviors for school success

Adaptive classroom behaviors, which encompass students' abilities to attend to learning goals and complete tasks, positively interact with peers, and engage in classroom activities, enable students to gain the most from their time in the classroom. Most researchers employ teacher reports of adaptive classroom behaviors using questionnaires such as the Teacher-Child Rating Scale (Hightower et al., 1986), that are designed to assess students' adjustment to and positive engagement in the classroom setting. Adaptive classroom behaviors have been associated with longitudinal growth in math and reading skills over the elementary and middle school years (DiPerna, Lei, & Reid, 2007; Li-Grining, Votruba-Drzal, Maldonado-Carreño, & Haas, 2010; Oberle, Schonert-Reichl, Hertzman, & Zumbo, 2014), even after controlling for socio-demographic measures and the home learning environment (McClelland, Morrison, & Holmes, 2000; Stipek, Newton, & Chudgar, 2010). Given their importance for school success, many researchers over the past two decades have explored family-level and school-level correlates of students' adaptive classroom behaviors (de Bruyn, Deković, & Meijnen, 2003; Ladd, Birch, & Buhs, 1999; Mashburn et al., 2008). Less is known about how malleable individual-level factors predict adaptive behaviors in the classroom context. It is important to

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understand how competencies which can be improved by family-level and school-level factors are linked to positive adaptation in the classroom.

1.2. Executive functions and adaptive classroom behaviors

EFs are higher-order cognitive processes, under the broad umbrella of self-regulatory skills, that allow children to regulate their behavior, attention, and emotions (Diamond, 2013). Children's EFs have been linked to their school success via two distinct pathways (Allan, Hume, Allan, Farrington, & Lonigan, 2014; Fuhs, Nesbitt, Farran, & Dong, 2014; St Clair-Thompson & Gathercole, 2006). First, EFs are implicated in the direct acquisition of reading, mathematics, and problem-solving skills (Cartwright, 2012; Foy & Mann, 2013; Kolkman, Hoijtink, Kroesbergen, & Leseman, 2013; Kroesbergen, Van Luit, Van Lieshout, Van Loosbroek, & Van de Rijt, 2009). Second, EFs promote adaptive classroom behaviors, such as abilities to stay on task, follow rules, organize materials, control emotions, and participate in group activities (Fantuzzo, Perry, & McDermott, 2004; McClelland, Acock, & Morrison, 2006). Indeed, studies of kindergarteners revealed that higher EFs, as indexed by both teacher-ratings and direct assessments, were linked with better work habits, higher rates of self-directed learning, and decreased inattention and hyperactivity (Brock, Rimm-Kaufman, Nathanson, & Grimm, 2009; Neuenchwander, Röthlisberger, Cimeli, & Roebbers, 2012; Ponitz, McClelland, Matthews, & Morrison, 2009; Rimm-Kaufman, Curby, Grimm, Nathanson, & Brock, 2009). Further, recent studies showed that the effect of EFs on prekindergarten children's academic achievement, social competence, and aggression have been mediated by adaptive classroom behaviors (Nesbitt, Farran, & Fuhs, 2015; Sasser, Bierman, & Heinrichs, 2015).

Children's EFs have also been linked to social skills and appropriate conduct in the classroom. At school entry, performance on EF tasks was associated with social competence and decreased behavior problems, even after controlling for children's preschool EFs (Hughes & Ensor, 2008, 2011). Early EFs are shown to predict decreased behavior problems and increased social skills in the classroom setting years later (Ciairano, Visu-Petra, & Settanni, 2007; Eisenberg et al., 1997; Riggs, Blair, & Greenberg, 2004). Recent longitudinal research from early childhood through adolescence, suggests that there are reciprocal relations between social skills and EFs (Holmes, Kim-Spoon, & Deater-Deckard, 2015). Children's EFs support positive peer interactions, and play activities with peers provide children with opportunities to practice and grow their regulatory skills (Meldrum & Hay, 2012; Stenseng, Belsky, Skalicka, & Wichstrøm, 2015).

During middle childhood, children face increased attentional and cognitive demands and are asked to manage their behaviors in the classroom and on the playground without adult scaffolding. Children are expected to be self-directed as they listen and keep track of directions, collaborate on group activities, complete work independently, and play well with other children. Thus, EFs provide a foundation for successful adaptation in the classroom setting of upper-elementary school grades. Yet, links between EFs and adaptive classroom behaviors have been largely unexamined during this developmental period. Given that EFs are malleable to environmental influences, particularly the quality of early home and school environments (Lengua et al., 2014; Weiland & Yoshikawa, 2013) and also continue to develop into early adulthood (Casey, Giedd, & Thomas, 2000; Weintraub et al., 2013), it is important to understand how EFs contribute to successful adaptation to school. Finally, while EFs support students' adaptive classroom behaviors via self-regulation, students' adaptation in the classroom also depends on their motivation to engage and persist with challenges.

1.3. Motivation, challenge preference, and adaptive classroom behaviors

A recent shift in education research has focused on the importance of non-academic "soft" skills or character traits, such as motivation,

mindset, and perseverance, in predicting grades, test scores, educational attainment, and job retention (Duckworth & Gross, 2014; Duckworth, Peterson, Matthews, & Kelly, 2007; Eskreis-Winkler, Shulman, Beal, & Duckworth, 2014; Heckman & Kautz, 2012; Lepper et al., 2005). In contrast to many broad measures of non-academic skills, challenge preference captures children's inclination to choose more difficult learning opportunities over easier ones and persevere when activities become challenging. It is considered a component of intrinsic motivation in that it reflects the extent to which children are driven by curiosity, interest, and desire to master learning independently, rather than by external rewards and validation (Gillet, Vallerand, & Lafrenière, 2012; Harter, 1981; Lepper et al., 2005; Ryan & Deci, 2000).

Challenge preference has been measured directly using puzzle and persistence tasks (Day & Burns, 2011; Smiley & Dweck, 1994; D. J. Stipek & Ryan, 1997) and via self, parent, and teacher reports (Broussard, 2004; Turner & Johnson, 2003). Empirical research shows that children who are more likely to choose challenging puzzles over easier ones they had already solved, display "learning goals" rather than "performance goals" (Cain & Dweck, 1995; Smiley & Dweck, 1994). Children who hold "learning goals" are mastery-oriented and focus on the process of learning and improving, rather than achievement and social comparison. They also use better learning strategies by connecting and integrating new information with existing knowledge, that benefit academic achievement (Greene, Miller, Crowson, Duke, & Akey, 2004). In contrast, children who hold "performance goals" are concerned how they will be judged and often display patterns of helplessness in response to setbacks (Elliott & Dweck, 1988; Heyman & Dweck, 1992).

Extant research has linked a higher preference for challenge to better academic achievement (Broussard, 2004), even after controlling for prior achievement and IQ (Turner & Johnson, 2003). Although the association between challenge preference and adaptive classroom behaviors has not been studied, per se, studies employing a composite measure of intrinsic motivation, as indexed by multiple skills including persistence, curiosity, preference for challenge, and mastery-orientation, provide initial evidence that challenge preference may be linked to adaptive classroom behaviors. For example, students who are intrinsically motivated demonstrate more adaptive behaviors in the classroom, including increased engagement in schoolwork, use of learning strategies, and effort management (Appleton, Christenson, & Furlong, 2008; Pintrich & de Groot, 1990; Walker, Greene, & Mansell, 2006).

While this work gives us a broad understanding that intrinsic motivation is related to children's performance and behaviors in schools, it lacks specificity. Despite a growing interest in how non-academic skills contribute to children's school success, empirical evidence is lacking on how these distinct constructs *independently* contribute to learning and social behaviors in the classroom context. This line of research is particularly important because challenge preference is malleable to contextual factors, especially adult feedback. The framing of learning activities and the feedback children receive from teachers influences their willingness to pursue challenging options and persevere when tasks become challenging (Harter, 1978; Kamins & Dweck, 1999).

1.4. Executive functions and challenge preference: independent or interactive model?

Given the importance of both EFs and challenge preference for children's school success, we need to understand how these skills uniquely contribute to adaptive classroom behaviors. Although EFs and challenge preference are conceptually related constructs, their effects on classroom behaviors may be independent. EFs support children's ability to regulate their own attention and behavior, whereas challenge preference provides them with the motivation to engage in the classroom setting. Higher EFs may help children stay focused, wait turns, and not persevere on a failed problem-solving strategy or a negative experience with peers. On the other hand, challenge preference may

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