The Promotion of Self-Regulation as a Means of Enhancing School Readiness and Early Achievement in Children at Risk for School Failure

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Abstract

This article reviews the literature on self-regulation and the development of school readiness and academic competence in early childhood. It focuses on relations between the development of cognitive aspects of regulation—referred to as executive functions and defined as abilities used to regulate information and to organize thinking in goal-directed activities—and the development of reactivity and regulation in stimulus-driven emotion, attention, and physiological stress response systems. It examines a bidirectional model of cognition–emotion interaction in the development of self-regulation in which top-down executive control of thought and behavior develops in reciprocal and interactive relation to bottom-up influences of emotion and stress reactivity. The bidirectional model is examined within the context of innovative preschool interventions designed to promote school readiness by promoting the development of self-regulation.

Keywords

executive functions; emotion regulation; self-regulation; school readiness

Many studies have demonstrated the role of self-regulation in academic achievement with children in preschool and the early elementary grades. Some of these studies measure self-regulation in terms of aspects of temperament and attention such as effortful control (Valiente, Lemery-Chalfant, Swanson, & Reiser, 2008), while others have examined self-regulation in terms of social-emotional well-being and positive social relationships with teachers and peers (Denham, 2006; Mashburn & Pianta, 2006). Still others have measured self-regulation in terms of the ability to persist and to delay gratification (Mischel, Shoda, & Rodriguez, 1989), while yet again others have examined executive functions (EF) and the ability to organize information and engage in rule-based and goal-directed tasks (Blair & Razza, 2007; McClelland et al., 2007).

The findings of numerous studies make it clear that self-regulation meaningfully predicts academic achievement. What is less clear, however, is how the various emotional, attentional, and cognitive aspects of self-regulation measured in studies of school readiness are interrelated yet also distinct. To address this question of the unity as opposed to diversity

of self-regulation abilities in young children, we focus primarily on two constructs—EF and emotion regulation—and present a developmental model that examines relations between them. We then examine how the model is relevant to innovative curricula to promote school readiness and academic achievement.

EF AND ACHIEVEMENT

To some extent, EF describes aspects of cognition that are synonymous with the volitional control of thinking in purposeful goal-directed activities. Specifically, EF includes three components: the ability to hold information in working memory, the ability to resist interference and distraction from extraneous or prepotent response tendencies and associations, and the ability to shift the focus of attention (or shift what is referred to as "cognitive set"). As such, EF abilities describe thinking skills that are important for learning and have been shown to account for unique variance in measures of academic competence. For example, Bull and Scerif (2001) demonstrated that measures of the shifting and working memory aspects of EF were uniquely associated with math achievement at the end of first grade. Similarly, Espy et al. (2004) demonstrated that a developmentally appropriate battery of nine tasks measuring all three components of EF were associated with math ability in preschoolers. Similarly, our research and studies by others suggest that measures of EF are both concurrently and longitudinally predictive of children's math and literacy ability in preschool and kindergarten (Blair & Razza, 2007; McClelland et al., 2007; Welsh, Nix, Blair, Bierman, & Nelson, 2010).

Skeptics might suggest that EF is simply a stage-salient correlate or marker of underlying general cognitive ability. However, many of the studies mentioned above found that EF measured in preschool and in kindergarten was uniquely associated with well-established indicators of academic ability, over and above measures of general cognitive ability. Importantly, most associations between EF and achievement have been observed when controlling for intelligence or for pretest achievement measures. In many instances, measures of EF substantially attenuate variance in outcomes associated with measures of intelligence and pretest academic ability. This is not to say that EF is necessarily more important for achievement than general ability but that both general ability (or what is referred to as "crystallized intelligence") and EF (a manifestation of fluid intelligence) are distinct and complementary influences on developing academic achievement (Blair, 2006).

EMOTION REGULATION AND ACHIEVEMENT

The relation of self-regulation to academic achievement is visible in studies measuring EF as well as in research on emotion regulation (Raver, 2002; Raver, Garner, & Smith-Donald, 2007). Emotion regulation is the intra- and interpersonal modulation of an activated emotion through a variety of cognitive and behavioral strategies (Cole, Martin, & Dennis, 2004). Children who can appropriately regulate positive and negative emotions have high levels of achievement in early elementary math and reading (Howse, Calkins, Anastopoulos, Keane, & Shelton, 2003; Trentacosta & Izard, 2007). Moreover, relations between emotion regulation (as measured by parental report on the Emotion Regulation scale of the Emotion Regulation Checklist) and performance on standardized math and early literacy assessments

in kindergarten hold even after controlling for IQ (Graziano, Reavis, Keane, & Calkins, 2007). Children with higher emotional competence (as indexed by accuracy in identifying and modulating emotions and responding prosocially in emotionally volatile situations) are more engaged in the classroom, and teachers perceive them as more academically and socially competent than children experiencing difficulty with emotion regulation (Denham, 2006).

Children's emotional self-regulation also affects early achievement by facilitating positive interactions with teachers and peers that promote school engagement, school liking, and early learning and achievement (Hamre & Pianta, 2001; Ladd, Birch, & Buhs, 1999). Children experiencing difficulty with emotion regulation are more likely to experience peer rejection, declining enjoyment and engagement in school, and poor academic outcomes (Hamre & Pianta, 2005; Ladd, Herald, & Kochel, 2006). Overall, emotion regulation is a key aspect of self-regulation related to children's school readiness and achievement.

SELF-REGULATION AND ACADEMIC ACHIEVEMENT: A DEVELOPMENTAL MODEL

As our brief literature review suggests, both EF and emotion regulation are meaningful correlates of school readiness and early school achievement. We suggest, however, that rather than thinking of EF and emotion regulation as separate influences on school readiness, it is most productive to think of cognitive and emotional aspects of self-regulation as functioning in a reciprocal, interrelated balance (Lewis & Todd, 2007). To address this point, we have proposed a developmental model of self-regulation that focuses on bidirectional relations between the development of emotion regulation and the development of EF ability (Blair & Dennis, 2010; Blair & Ursache, 2011). In this model, we define self-regulation as the primarily volitional management of arousal or activity in attention, emotion, and stress response systems in ways that facilitate the use of EF abilities in the service of goal-directed actions. The model indicates that for some children, experiences at home and at school foster levels of emotional reactivity, attention control, and stress responding that are conducive to EF abilities, and that increase the likelihood that individuals will use them. In contrast, for other children, particularly children growing up in poverty, early childhood experiences are more likely to lead to levels of arousal in emotion, attention, and stress response systems that do not foster optimal EF and that may lead to more reactive and less reflective responses to stimulation (Blair, 2010; Blair & Raver, in press).

The conception of self-regulation as a bidirectional system linking emotion with cognition is relevant to research on the role of self-regulation in early childhood education and academic achievement. In our model, EF is the top-down or volitional component of self-regulation, important for fostering motivation (defined as moderate levels of emotional and physiological arousal that accompany interest and engagement) and the effortful processing of information in a complex learning task. This volitional component, however, is reciprocally related to and dependent on bottom-up, less volitional, and more automatic regulation of responses to the environment through attention, emotion, and stress response

systems (Blair, 2002; Blair & Dennis, 2010). In school, children become more adept at regulating boredom or frustration by relying on strategies, classroom rules, and routines that help them reallocate their attention and regulate emotion and stress. This habitual management enables the activation and use of EF abilities that in turn further facilitate the management of attention, emotion, and stress, producing a positive feedback loop. In contrast, when children experience disengagement or emotional arousal, whether positive or negative, that exceed their capacity to regulate emotion, then bottom-up, stimulus-driven control of emotion, attention, and stress arousal can predominate and override EF abilities. In the bidirectional model of self-regulation, a balance is achieved when bottom-up processes of attention, emotion, and stress reactivity are managed within levels that facilitate rather than derail EF abilities. As such, the bidirectional model of self-regulation development is best understood within the framework of the classic Yerkes–Dodson inverted-U relation between arousal and complex learning, in which very high and very low levels of arousal lead to deficits in learning whereas moderate levels lead to more optimal learning (D. Diamond, Campbell, Park, Halonen, & Zoladz, 2007; Yerkes & Dodson, 1908).

In its focus on the integration of emotion and cognition, the bidirectional model of self-regulation development is similar to at least two other models examining self-regulation processes. The first is Calkins and Marcovitch's (2010) model, in which advances in emotion regulation set the stage for the development of cognitive control processes. The second is Cunningham and Zelazo's iterative reprocessing (IR) model. In the IR model, slower reflective executive processes through which individuals develop higher order, stable cognitive schema or representations (referred to in the IR model as "attitudes") are distinguished from more rapid, positively versus negatively valenced and automatic responses that may be less stable and more stimulus-driven (termed "evaluations"; Cunningham, Zelazo, Packer, & Van Bavel, 2007). The bidirectional model is similar to these models in its focus on automatic and volitional processing of information; it is distinct, however, in its focus on the probabilistic and contextually driven interaction of more automatic arousal processes (attention, emotion, and stress and their neuroendocrine and physiological sequelae) and volitional EF processes. Of course, habitual modes of responding, either reflective or reactive, can become readily established, producing continuity and apparent stability in development (see Gottlieb, 1983), but a primary focus for the bidirectional model is developmental malleability and the potential for behavior change inherent in a contextually based approach.

THE PROMOTION OF SELF-REGULATION AS A MEANS OF PREVENTING SCHOOL FAILURE

The model of self-regulation as a bidirectional system has implications for programs designed to promote school readiness and achievement in young children at risk for school failure because of poverty. Although no single program has yet explicitly addressed the development of self-regulation as a bidirectional system, several have incorporated measurement of various aspects of self-regulation. Here we focus on three evaluations of innovative preschool curricula, the Research-Based Developmentally Informed (REDI) Head Start innovation (Bierman, Domitrovich, et al., 2008; Bierman, Nix, Greenberg, Blair, &

Domitrovich, 2008), the Chicago School Readiness Project (CSRP; Raver et al., 2009), and the experimental evaluation of the Tools of the Mind curriculum (Tools; Bodrova & Leong, 2007) reported by Barnett et al. (2008) and A. Diamond, Barnett, Thomas, and Munro (2007). After describing the programs, we use the bidirectional model to explore how they may have improved self-regulation in order to promote early school success. We argue that the programs not only fostered children's learning but also may have enhanced the classroom environment, reducing classroom stress while improving students' ability to pay attention and to monitor their own learning. We suggest that through mechanisms relating to improved classroom environments, these programs increased the chances that children's arousal levels were optimal for supporting EF abilities. We conclude by reviewing the program evaluations, focusing specifically on improvements in EF and academic achievement.

Head Start REDI, Tools, and CSRP

Program Descriptions—The Head Start REDI program (Bierman, Domitrovich, et al., 2008) included enhanced language and emergent literacy instruction as well as the preschool version of the PATHS (Promoting Alternative Thinking Strategies) curriculum, which emphasizes children's social-emotional skills (Domitrovich, Cortes, & Greenberg, 2007; Riggs, Greenberg, Kusche, & Pentz, 2006). The CSRP targeted school readiness in low-income preschoolers by increasing emotional and behavioral self-regulatory skills (Raver et al., 2009; Raver et al., 2011). Its focus on teacher training and coaching by a mental health consultant was designed to improve the emotional climate of the classroom, lower children's level of conflict with peers, and lower teacher stress (Raver et al., 2008; Raver et al., 2009; Zhai, Raver, & Li-Grining, in press), thereby creating a classroom environment where children would be better able to handle challenging situations. The Tools curriculum specifically promotes the development of EF as a means to enhance student learning and engagement (A. Diamond et al., 2007). It is the only one of the curricula that uses activities to directly target children's EF but also emphasizes collaborative scaffolded learning through sociodramatic play in ways that foster children's ability to take turns, to take others' perspectives, and to monitor themselves and their peers simultaneously.

One focus of each intervention was to create a predictable classroom structure in which children could engage in self-directed learning. For example, REDI was incorporated into the daily structure of the classroom so that routines remained predictable (Bierman, Nix, et al., 2008). CSRP targeted the formation of clear classroom structure and routines by training teachers to manage their classrooms more effectively and supportively (Raver et al., 2009). In Tools, children cooperatively planned scenarios and acted them out according to the rules they had chosen to govern the story and characters (Bodrova & Leong, 2007). This promotion of self-directed learning within a predictable structure likely fostered optimal levels of emotional arousal including engagement and attention that could support children's EF development.

Improved ability to use language and regulate emotion also probably mediated student behavioral improvements in REDI, CSRP, and Tools (Dickinson, McCabe, & Essex, 2006; Riggs et al., 2006). REDI taught children to use language to scaffold self-regulation.

Moreover, the inclusion of PATHS in REDI further promoted emotion regulation by teaching children to understand and express emotions, negotiate conflicts, build pro-social skills, and inhibit impulsive behavior (Domitrovich, Greenberg, Kusche, & Cortes, 1999). In CSRP, because teachers themselves learned to use clearer, less affectively negative directives and requests, children may have better regulated their emotions even when asked to correct their misbehavior. In Tools, children first experienced language (including private language) as a means of regulating their own and others' attention and emotions during cooperative activities. Thus, children probably maintained arousal levels that further supported EF and academic skills. By being well regulated themselves, they may have been less likely to cause conflict situations that would have made emotion regulation difficult for others.

Furthermore, in managing their classrooms, teachers also regulate their own attention, emotions, and cognition when providing regulatory support to their students (Cole et al., 2004; Raver, 2004). In REDI, when children became upset, teachers could employ the emotion regulation techniques from PATHS to help students regulate their behavior, thus reducing the likelihood that teachers themselves would become dysregulated when dealing with a dysregulated student. As part of their emphasis on teacher stress and emotion regulation at the classroom level, CSRP assigned mental health counselors to each classroom to help teachers identify and minimize work-related stressors. Teachers also learned new ways to structure cognitively engaging and emotionally supportive environments with the aim of making classrooms less chaotic, noisy, and emotionally distressing to children (Li-Grining et al., 2010). Similarly, in Tools, teachers learned strategies to make classrooms more engaging and specific techniques for scaffolding children's development of self-regulatory skills, which likely lessened the stress of deciding how to deal with dysregulated behavior and may have allowed teachers to respond in a more sensitive manner.

Relation to the Bidirectional Model—The structure of the interventions we described above can be understood through the bidirectional model of self-regulation. From a bottom-up perspective, when classroom structure is consistent throughout the school year, children can learn appropriate behaviors; become better able to use language to plan, monitor, and reflect on the social and learning challenges they encounter during the school day; and focus their attention on learning goals. Furthermore, when teachers regulate their own emotions, attention, and cognition in order to interact with students in more positive ways, they can make the classroom less stressful for themselves and their students. Thus, throughout the year, children become better at staying on task, inhibiting inappropriate behaviors, and taking turns. These positive social skills in turn probably reduce peer conflicts that are stressful for teachers and students.

Because frustrating conflicts are less likely to occur, children can maintain levels of arousal that support the continued development of EF and academic skills. Moreover, because children are engaged rather than being bored in the classroom, they may be less prone to using inappropriate strategies such as acting out to increase their own arousal. In keeping with the inverted-U, effective classroom management and an increase in both teachers' and students' positive engagement is one promising mechanism for the success of the programs we outlined above.

Program Effects on Self-Regulation and Academic Achievement—Evaluations of REDI, CSRP, and Tools have considered the extent to which distinct aspects of self-regulation might serve as a key mediating mechanism, whereby the intervention would lead to increases in children's EF skills, which would in turn lead to increased school readiness. REDI was hypothesized to enhance EF by promoting skills such as emotion regulation and self-awareness through the PATHS curriculum's social-emotional focus. CSRP provided the most direct test of the bidirectional model by hypothesizing that creating a low-stress, positive classroom climate would improve emotion and attention regulation and promote EF. Tools, as noted above, was expected to foster EF development through direct instruction, but also, in keeping with the bidirectional model, to alter classroom climates to better support EF and literacy skills. We review each intervention's findings below, addressing these hypotheses.

The evaluation of the REDI curriculum with 44 Head Start classrooms and 356 four-year-old children indicated that the program improved EF as measured by task orientation (the assessor's global rating of the child's self-regulation) and the dimensional change card sort task (Zelazo, 2006). These effects on EF partially mediated the intervention's effects on measures of emergent literacy skills including vocabulary, phonological sensitivity, and letter knowledge (Bierman, Nix, et al., 2008). Although REDI's targeting of social-emotional competence and classroom structure to improve EF and achievement is consistent with the bidirectional model, the multiple aspects of the program make it difficult to determine which ones may have led to improvements in EF. Improved classroom structure may have set the stage for EF, but it is also possible that the PATHS program's specific targeting of emotion regulation led to improved EF. Alternatively, emotion regulation and classroom structure likely reciprocally influenced each other, and targeting both may have been necessary for improvements in EF. Thus, Head Start REDI demonstrated that improving children's EF may be one mechanism by which interventions can enhance school readiness but provides limited information on which program components helped improve EF.

The CSRP provided a more explicit test of the hypothesis that creating a more emotionally positive, less stressful classroom climate may improve EF. A cluster randomized design was used to evaluate CSRP with 543 children enrolled in 35 Head Start classrooms in Chicago. Control classrooms received a teacher's aide to address the concern that improvement in CSRP classrooms could be due purely to the teacher having another adult (the mental health counselor) to help manage the classroom. At the end of 1 year of implementation, treatment group children scored significantly higher on a standardized battery of EF assessments and were rated by the assessor as showing less impulsivity and greater attention. These significant differences in measures of self-regulation mediated the program effects on academic outcomes including vocabulary, letter naming, and math skills (Raver et al., 2011). Thus, CSRP provides evidence for the bidirectional model in that it successfully demonstrated that targeting classroom climate can lead to improvements in children's self-regulation skills including EF and thus to higher performance on academic outcomes.

The evaluation of the Tools curriculum also focused on EF as a mechanism of its effects on school readiness. Using a randomized, controlled design (Barnett et al., 2008; A. Diamond

et al., 2007) 274 preschool children from low-income families were randomly assigned to 18 classrooms in which teachers were newly trained to use the Tools curriculum or the district's newly developed high-quality literacy curriculum. Program effects at the end of 2 years for some children and 1 year for others indicated that Tools may have improved classroom climate, as children had lower teacher-reported behavior problems, were in classrooms that had higher productivity (a measure of how well teachers manage routines and instruction), and had more sensitive teachers (Barnett et al., 2008). Moreover, Tools children performed significantly better than children in the literacy classrooms on EF tasks integrating working memory, inhibitory control, and attention-shifting abilities (A. Diamond et al., 2007). Effects of Tools on academic achievement were positive in direction but not statistically significant, probably reflecting the very limited statistical power of the evaluation ($n = 85$ treatment, $n = 120$ control at the conclusion of the study). Correlation analyses, however, indicated that academic achievement was strongly related to performance on EF tasks. Thus, although Tools improved EF and although performance on difficult EF tasks was significantly correlated with academic performance, findings to date in the limited evaluation of the program provide limited evidence of effects on academic performance.

CONCLUSION

These three programs—the Head Start REDI program, the CSRP, and Tools—targeted improvements in self-regulation to increase academic achievement. All three successfully increased children's self-regulation. Moreover, CSRP and REDI demonstrated that these improvements translated into academic-related gains. Although the specific techniques and targeted aspects of the classroom differed for each program, all three programs worked generally to improve school readiness through multiple self-regulatory mechanisms that recognized the role of classroom management, the context dependence of self-regulation, and the ways that emotional and cognitive forms of self-regulation are bidirectionally and reciprocally related. In short, a multidimensional model of self-regulation helps to understand how intervention programs such as REDI, CSRP, and Tools use bottom-up strategies to help children improve top-down processes of self-regulation.

When children use classroom supports to regulate emotion, attention, and stress, they are, on a neurological level, likely to be at more optimal levels of arousal that could facilitate EF and engagement in their learning activities. This focus on bottom-up support of EF, however, does not preclude the possibility of improving EF through direct instruction, as was probably the case with some activities in Tools. Furthermore, whether EF is improved through direct instruction or through classroom support, it is likely that this top-down self-regulation on an individual level then reciprocally improves bottom-up self-regulatory processes for the whole classroom, as stressful conflicts between students and between students and teachers may be avoided. Through this reciprocal pathway, classrooms that set the stage for students to practice self-regulation skills could thus have lasting positive impacts on children's school competence and achievement.

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