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Self-Regulation and Social School Readiness in Preschoolers: An Analysis of Performance-Based Measures of Effortful Control and Executive Function

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Abstract

This study explored a causal model of the association between two focal self-regulation constructs (executive functioning and effortful control) and social school readiness in preschoolers. The population comprised all preschool children and their mothers who resided in Tehran (2018-2019). With the help of their mothers, 342 children with a mean age of five years completed the Cambridge Neuropsychological Test Automated Battery (CANTAB, 1994), the Children's Behavior Questionnaire (Very Short Form)–(CBQ-VSF, 2006), the Child Behavior Checklist (CBCL, 2001), and the Social School Readiness Scale (1982). The data were analyzed using structural equation modeling (SEM) in AMOS 22. Findings evidenced that effortful control and socio-emotional competence significantly affected social school readiness ($p<0.01$). Moreover, the results indicated that executive functioning affected social school readiness, mediated by effortful control in the alternative model ($p<0.01$). The findings expand the existing early childhood research by specifying the link between two major aspects of self-regulation and social-emotional school readiness. An integrative approach considering the behavioral and neuropsychological measurements of self-regulation would help elucidate the predictors of social school readiness in early childhood.

Keywords: Effortful Control, Executive Functioning, Preschoolers, Self-Regulation, Social School Readiness

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Introduction

Social school readiness, assessed in children aged 3-5 years, refers to a child's ability to successfully begin or make a smooth transition into formal schooling. Self-regulation, as a core developmental capacity for social school readiness and future learning and achievement outcomes, has been investigated in many studies (e.g., Blair & Raver, 2015; Kim-Spoon et al., 2017;

Meuwissen & Carlson, 2019; Robson et al., 2020). Children's ability to self-regulate has developmental implications that will lead to successful achievement of short- and long-term goals (Griffin et al., 2016). Liew et al. (2018) stated that self-regulation is the ability to either inhibit or activate responses through neurocognitive and behavioral processes to attain a goal, which is a core component underlying children's social school readiness. Given the importance of this construct, there is a need for valid and reliable methods of assessing self-regulation skills in children to identify attentional, emotional, and behavioral difficulties in this domain.

According to Nigg (2017), many studies consider the self-regulation construct in early childhood to be a combination of effortful control (EC) and executive functioning (EF). While these constructs are distinct by definition, they overlap, which makes their measurement controversial and challenging. Thus, it is important to integrate EC and EF to obtain a deeper understanding of their unique and shared contributions to the broader construct of self-regulation.

Thus, the main purpose of the present study was to examine the relationships between performance-based measures of EC and EF as two major facets of self-regulation in young children.

Definition of Effortful Control and Executive Function

Blair (2016) defined self-regulation as a broad concept referring to behaviors exhibited in complex real-life situations, such as planning ahead, persevering through frustration, and using multiple strategies, based on EF. According to Carver and Scheier (1998), self-regulation is related to the dynamic process of identifying a state or goal and then acting to realize it while monitoring progress. this situation can be remedied by integrating different models of self-regulation coming from disparate researches.

EF can be classified into discrete subskills (planning, working memory/updating, self-monitoring, problem-solving, generativity/fluency, mental flexibility, and the inhibition of impulsive responses) in adults and children (Fisk & Sharp, 2004; Garon et al., 2008; Pennington & Ozonoff, 1996). EFs gradually develop from infancy (Diamond & Goldman-Rakic, 1989) through early childhood and adolescence, and may still continue improving in young adulthood (Anderson, 2002; Garon et al., 2008; Huizinga et al., 2006). EF is a fundamental cognitive skill that determines successful goal-directed behavior and is associated with educational success (St Clair-Thompson & Gathercole, 2006).

Executive dysfunction, on the other hand, refers to deficits in the inhibition of well-learned patterns of behavior and deriving novel ways to solve problems. People who have executive dysfunction are entrapped in repetitive cycles of well-learned behavior (perseveration) and do not possess the flexibility to accommodate and re-accommodate their behavior to novel situations (Al-Hmouz & Abu-Hamour, 2017). However, the exact nature of executive dysfunctions still remains unclear (Coenen et al., 2022).

Cognitive control is a prominent part of the influential multicomponent model of working memory (Baddeley, 2007) and involves focusing, dividing, and switching attention. However, it has been postulated that cognitive control may be the same as general intelligence (Conway et al., 2003; Engelhardt et al., 2016; Jewsbury et al., 2016). Moreover, executive abilities are increasingly regarded as being at least partly 'fractionated', or divided, (e.g., Lehto, 1996) into separate subcomponents that are loosely related to one another (Garon et al., 2008; Huizinga et al., 2006; Molen, 2006). Executive control is not exercised during routine tasks (Shallice & Vallar, 1990), but, it is used during demanding tasks involving novelty.

Kim-Spoon et al. (2019) offered the most popular definition of EF as the ability to flexibly adjust one's behavior in the context of dynamically changing goals and task demands. EF is associated with the prefrontal cortex and comprises a set of general-purpose control mechanisms that regulate goal-directed behavior (Best & Miller, 2010). Different models have been used to conceptualize EF as a unitary construct with multiple components (e.g., Wiebe et al., 2011) or as a multifaceted construct (e.g., Miyake et al., 2000). Miyake et al. (2000), in their original framework, identified three foundational dimensions: updating (the constant monitoring and rapid addition/deletion of information in working memory), inhibition (the purposeful overriding of default responses), and cognitive flexibility (the ability to switch between tasks or mental sets). Previous research (e.g., Miyake & Friedman, 2012) has indicated that people show similarities and differences in these dimensions.

In contrast, EC, a core temperament factor most directly relevant to self-regulation, refers to the efficiency of executive attention, including the ability to suppress a dominant response and to activate a subdominant response (Rueda, 2012), and is related to EF (Allan & Lonigan, 2011). EC as a dispositional representation of top-down control is associated with frontal lobe functioning (Nigg, 2017). Researchers investigating self-regulation in children tend to focus on the construct of EC, including inhibitory control, effortful attention, conflict resolution, and the ability to identify and correct errors and plan actions (Kochanska et al., 2000).

Relationship between Executive Function and Effortful Control

As stated earlier, EF and EC come from different traditions, but there is considerable conceptual and empirical overlap between them (Kalin & Roebers, 2021; Schmidt et al., 2022). For example, neurologically, both constructs involve the frontal lobe, specifically the prefrontal cortex (Hrabok & Kerns, 2010), and refer to the ability to inhibit a salient response in favor of a less salient or subdominant response. The two constructs seem to be associated (Philbrook et al., 2022; Rea-Sandin et al., 2022), and both focus on top-down goal-oriented processes, such as attentional planning (Eisenberg & Zhou, 2016).

According to Lin et al. (2019), in the literature, the differences between these terms depend on the researchers' discipline and the measures used to assess self-regulation. However, many researchers are often not careful in explicitly selecting and using measurements or assessment tasks (Zhou et al., 2012), and the distinction between the two constructs is not obvious.

Self-Regulation and Social School Readiness

Upon entering school, children are expected to make academic achievement, and this achievement is associated with better socioeconomic and health outcomes (Williams et al., 2019). Furthermore, early school success affects later academic success as a predictive factor (Lonigan, 2006; National Research Council, 2001). Many researchers have utilized one or more assessment instruments to measure children's readiness for school. Ellwein et al. (1991) classified these instruments as being achievement-focused and assessing number concepts, color naming, and general information. Past research has shown many of these types of screening tests to have low predictive validity for school success (e.g., Joy, 2016). Currently, since academic screenings continue to be performed at the beginning of kindergarten, researchers have shown that teachers stress the importance of social readiness when discussing the potential for success in school (Erhart, 2013; Sabol & Pianta, 2012).

Pianta and La Paro (2003) stated that early school success addresses potential difficulties that children may demonstrate early in their schooling, including difficulty with problem-solving, independence, and following rules. In this vein, readiness in children, teachers, schools, parents, and the community is crucial for successful transitions (McWayne et al., 2004). Readiness is a measure of the fit between the classroom expectations and the child's abilities and needs, rather than a set of acquired skills and experiential knowledge. Therefore, to better predict school success, a broadened view of readiness must be incorporated. The present study proposed a model of social readiness as a competency related to learning and demonstrating appropriate social skills (e.g., following rules), interacting with others in a supportive way, and becoming motivated toward goals, as these behaviors are considered key indicators of social school readiness in children.

Clarke-Stewart and Parke (2014) stated that socio-emotional competence involves an individual's ability to express, receive, and manage emotions that will help to form and maintain relationships and interactions. As a key behavioral factor, socio-emotional competence comprises core aspects, including emotional expressiveness, understanding of emotions, regulation of emotions and behavior, social problem-solving, and social relationship skills that are critical to children's adjustment (Ahmad et al., 2019). In the present study, socio-emotional competence refers to children's social and emotional competences that were assessed separately.

Given the conceptual and empirical overlap between EF and EC as the two main components of self-regulation, it is important to examine whether and how performance-based measures of these components relate to one another. Many researchers have applied different tasks and have validated them interchangeably. Thus, the similarities between these performance-based tasks were identified, and the inter-correlations among the performance-based EC and EF tasks were evaluated. Further, the researchers assessed the functional significance of self-regulation by examining its associations with behavioral outcomes among children. Using these methods, the researchers observed the direct and indirect effects of the variables and investigated whether there are any mediating effects. The proposed model is summarized in Figure 1. Accordingly, the present study put forward nine hypotheses:

H_1: EF will be a significant predictor of social competence in preschoolers.

H_2: EC will be a significant predictor of social competence in preschoolers.

H_3: EF will be a significant predictor of emotional competence in preschoolers.

H_4: EC will be a significant predictor of emotional competence in preschoolers.

H_5: Social competence will be a significant predictor of social school readiness in preschoolers.

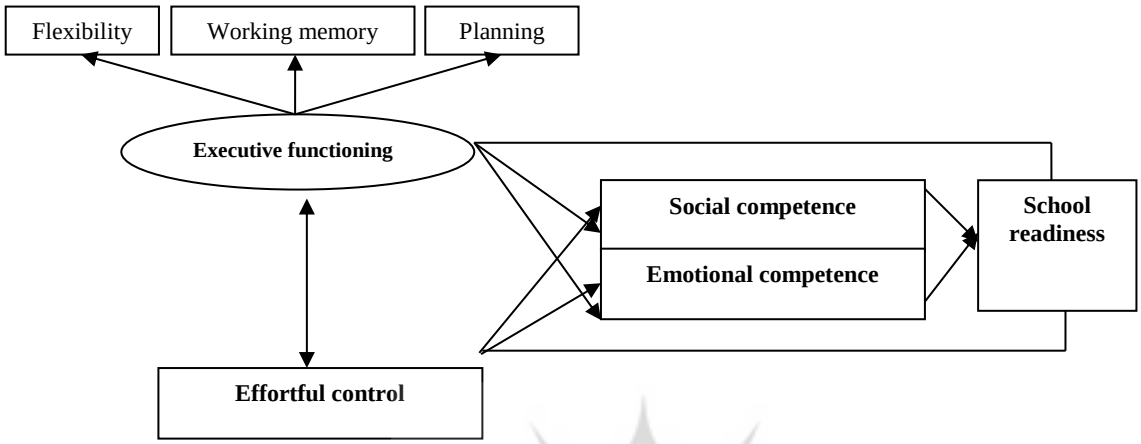
H_6: Emotional competence will be a significant predictor of social school readiness in preschoolers.

H_7: The relationship between EF and social school readiness will be mediated by social and emotional competences in preschoolers.

$H_{8:}$ The relationship between EC and social school readiness will be mediated by social and emotional competences in preschoolers.

$H_{9:}$ The relationship between EF and social school readiness will be mediated by EC and social and emotional competences in preschoolers.

Figure 1
The Proposed Model of the Present Research



Method

Design

This quantitative study explored a causal model of the association between two focal self-regulation constructs (ED and EC) and social school readiness in preschoolers in 2018-2019.

Participants

The population comprised all preschool children (aged four to six years) and their mothers who resided in Tehran. According to SPSS sample power, the participants were 342 children (154 girls and 188 boys) and their mothers, selected from 10 preschool centers in Tehran by the cluster random sampling method. The children aged 4 (26%), 5 (32%), and 6 (42%) years. The mothers were, on average, 39 years old, and 86% of them had an undergraduate academic degree or higher.

Instruments

Executive functioning

The Cambridge Neuropsychological Test Automated Battery (CANTAB) is a computerized assessment that covers flexibility, working memory, and planning. Normative data are available from the time the participants are four years old, so this test is suitable for young children (Robbins et al., 1994). Of the 23 tests in the CANTAB, most (21) are nonverbal, both in terms of test presentation and participant response; therefore, this assessment is valuable for participants with limited verbal abilities and may be more 'culture-free' than other tests. The construct and discriminant validity of the CANTAB has been demonstrated in child populations in many studies for more than 15 years using clinical and non-clinical samples (e.g., Henry & Bettenay, 2010).

Effortful control

The mothers' reports on the Children's Behavior Questionnaire Short Form (CBQ; Putnam & Rothbart, 2006) were used to assess EC in children. EC, as the third broad factor in the very short form of the CBQ (36 items, three broad scales), has been compared to conscientiousness/constraint and contains high positive loadings for inhibitory control, attentional control, low-intensity pleasure, and perceptual sensitivity scales (Rothbart et al., 2001). Putnam and Rothbart (2006) stated that the CBQ short form demonstrated both satisfactory internal consistency and criterion validity and exhibited longitudinal stability and cross-informant agreement, comparable to those of the standard CBQ. Najarpourian et al. (2017) validated the very short form of CBQ for the Iranian population and concluded that it is an appropriate tool to measure temperament in 3-7-year-old children.

Socio-emotional competence

Socio-emotional competence, as a key indicator of behavioral problems, was assessed using the mothers' reports on the Child Behavior Checklist (CBCL; Achenbach et al., 2001). The CBCL consists of 140 items assessing behavioral or emotional problems in children aged 6-18 years old. The main information providers for the CBCL are parents or other

individuals who know the child well. These individuals rate problem behaviors and competencies. Twenty items related to the child's social competency, as rated by parents, address the child's participation in sports, hobbies, games, activities, organizations, jobs, chores, friendships, social interactions during play, independent work, and school functioning. The second section consists of 120 items related to behavioral or emotional problems exhibited during the past six months, as rated on a three-point scale. The main areas of this construct are aggression, hyperactivity, bullying, conduct problems, defiance, and violence. The following behavioral and emotional problems are also measured: aggressive behavior, anxiousness/depression, attention problems, delinquent rule-breaking behavior, social problems, somatic complaints, thought problems, withdrawal, externalization, internalization, and overall problems. Minaei (2007) supported the requirement of Achenbach's model in the Iranian population and stated that CBCL could be used to assess children's emotional and behavioral problems based on acceptable goodness-of-fit indices in confirmatory factor analysis.

Social school readiness

Social school readiness, i.e., whether children fit in in school, was measured by three 4-point items (1 = strongly disagree to 4 = strongly agree) corresponding to the Social Attention subscale of the BASE (Behavioral Academic Self Esteem-A Rating Scale) (Coopersmith & Gilberts, 1982). The items were adapted to be assessed through parental reports. The social attention factor measures how well the student 'fits' into a school environment (Coopersmith & Gilberts, 1982). For the present study, the items included to measure this variable assessed how well the children cooperated with others, their positive view of the school, and their ability to talk and listen at appropriate times. Research is just beginning to evaluate the optimal dimensions of this variable. Thus, these variables were chosen because they have been used to evaluate 'fit' in previous studies (Joy, 2016). The alpha coefficient showing the reliability of the scale was .82 in the current study.

Procedure

The data were analyzed using both descriptive statistics and path analysis. Descriptive statistics such as the means and standard deviations, correlation coefficients, and Kaiser-Meyer-Olkin (KMO) values were used to investigate the children's characteristics, the relationships between the variables, and the scores' normal distribution, respectively. Pearson product-moment correlation coefficients were used to determine the relationships between the variables. After determining the relationships among the variables by correlation analyses, path analysis was performed to test the predictive role of self-regulation, including EC and EF, in behavioral outcomes (social competence and emotional competence). The proposed and alternative structural equation models based on the hypotheses were analyzed in Amos 22.

The conceptual model presented in Figure 1 was analyzed using path analysis in Amos 22. Path analysis procedures are advantageous in that they enable researchers to test and compare competing *a priori* models. Similarly, the decomposition of effects provides clarity into the direct and indirect relationships between variables**.** In terms of the goodness-of-fit index values, we used the following: (i) chi-squared statistics (χ^2) and degrees of freedom (*df*), (ii) the comparative fit index (CFI) (CFI value $\geq$ .90), and (iii) the root-mean-square error of approximation (RMSEA) (RMSEA value $\leq$ .080).

Data collection and Ethical Considerations

Complying with the acceptable practice in Iran, we first visited the Education Department of Tehran and obtained a permit for conducting the research, which acts in lieu of IRB approval. Then, we performed the sampling with the permission and cooperation of the preschool centers. Ethical considerations based on the Declaration of Helsinki were adhered to throughout the study. The mothers provided informed consent to participation, to which the children also verbally assented.

Findings

Table 1 presents the correlations between the variables, means, and standard deviations.

Table 1

Descriptive Statistics and Bivariate Correlations for Research Variables

	Variables	M	SD	1	2	3	4	5	KMO
1	Executive functioning	14.26	1.02	___					.345 *p > 0.05*
2	Effortful control	27.86	12.43	.36*	___				.248 *p > 0.05*
3	Social competence	31.24	1.26	.80*	.42*	___			.117 *p > 0.05*
4	Emotional competence	41.25	4.16	.63*	.51*	.35*	___		.158 *p > 0.05*
5	Social school readiness	51.23	11.47	.31*	.91*	.32*	.97*	___	.183 *p > 0.05*

Note: * ***p < 0.05***

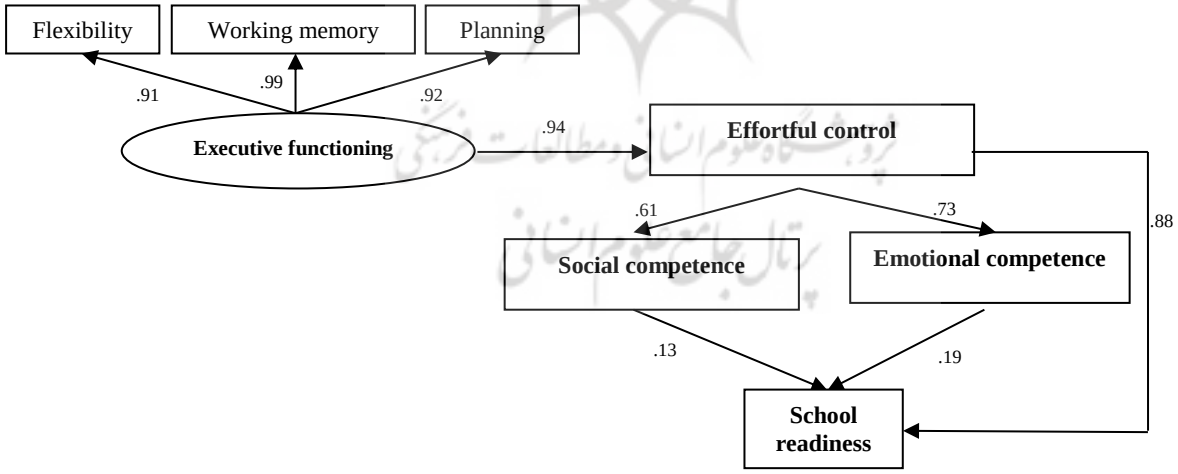
Structural equation modeling (SEM) was adopted to test the hypotheses, and the fit indices are presented in Table 2. When the fit indices for the conceptual model were analyzed, it was found that the model did not properly fit the data. This analysis also demonstrated that the paths between EF and social and emotional competences were not significant, so Hypotheses 1 and 3 were rejected. A new model was created by considering these modifications and after omitting two paths. The nonsignificant paths were excluded from the model, and a new additional pathway (from EF to EC) was added; thus, instead of the original conceptual model, an alternative model was created and tested (Figure 2).

Table 2
The Fit Indices of the Proposed and Alternative Models

		χ^2	df	χ^2 /df	CFI	NFI	TLI	GFI	RMSEA
1	Conceptual model	326.086	10	36.209	.90	.90	.72	.81	.09
2	Alternative model	362.091	12	30.174	.90	.90	.77	.82	.064

The results of the SEM analysis indicated the better fit indices of the alternative model (Table 2). The fit indices of the alternative model (χ^2 = 362.091 ($p< 0.001$), χ^2/df=30.174, RMSEA=.064, CFI=.90, GFI=.82, NFI=.90) were accepted as they met the criteria for an acceptable fit. Garver and Mentzer (1999) suggested that the values of CFI and RMSEA could indicate acceptable fit indices. Therefore, the fit indices that are most often used are CFI (with >.90 showing a good fit to the data), RMSEA (with <.08 indicating a good fit to the data), and an additional χ^2/df statistic, which could be employed for the model (the χ^2/df ratio should be < 3) (Hoe, 2008). Thus, herein, the model demonstrated an acceptable fit to all the data as CFI, RMSEA, and the χ^2/df rate had acceptable values. Standardized path coefficients (direct, indirect, and total effects) were calculated for all the variables in the alternative model, and the results of the analysis are given in Table 3. The path coefficients of the alternative model are also displayed in Figure 2.

Figure 2
Path Standardized Coefficients of the Alternative Model



As shown in Figure 2, there was a significant positive correlation between EF and EC. The standardized path coefficient from EF to EC was found to be .94 (Hypothesis 1 was accepted). Significant positive correlations were also found between EC and social competence (.61) and emotional competence (.73) (Hypothesis 3 was accepted). Additionally, the standardized path coefficients for both EC and social school readiness were found to be .88. Moreover, social competence and emotional competence were significantly positively correlated with social school readiness in preschoolers (Hypothesis 6 was accepted). Table 3 presents the standardized direct, indirect, and total effects coefficients for variables found in the alternative model.

The results indicated that EF has a direct effect on EC. According to Table 3, EF also has indirect effects on social competence (β=.57) and emotional competence (β=.69). EC is indirectly associated with social school readiness, mediated by social competence and emotional competence (β=.09). Likewise, EF has a strong, significant, indirect effect on social school readiness (β=.92) through EC and competence factors (Hypotheses 8 and 9 were confirmed).

Table 3
Standardized Effects: Direct, Indirect, and Total

Predictors	Direct effects	Indirect effects	Total
on effortful control			
of executive functioning	.94*	.000	.94*
on social competence			
of effortful control	.61*	.000	.61*
of executive functioning	.000	.57*	.57*
on emotional competence			
of effortful control	.73*	.000	.73*
of executive functioning	.000	.69*	.69*
on social school readiness			
of social competence	.13*	.000	.13*
of emotional competence	.194*	.000	.194*
of effortful control	.88*	.09*	.976*
of executive functioning	.000	.922*	.922*

**Note: *** $p < 0.001$

Discussion

The primary objectives of the current study were to investigate self-regulation (specifically EF and EC) in young children and to examine the effect of children's performance on the structure of these two factors. According to Chae (2022), EC comprises a measure of cognitive efficiency that encompasses the capacity for inhibitory control (IC), attentional control, and the activation of temperament-related processes. EF, on the other hand, is a measure of the efficiency of self-directed action that involves IC, working memory, and shifting/cognitive flexibility, with a particular emphasis on cognitive aspects. Self-regulation is a critical aspect of child development that encompasses the ability to control and manage one's emotions, thoughts, and behaviors.

EF and EC are two main components of self-regulation that play a key role in children's socioemotional competence and social school readiness. To the best of our knowledge, few studies have examined the relationships between laboratory and performance-based behavioral assessments of EC and EF. Recently, Lin et al. (2019) presented a one-factor model examining self-regulation with two components, 'hot' (as EC) and 'cool' (as EF), which loaded onto a general self-regulation factor. They also highlighted the similarities between EC and EF during early childhood and the need for integrative, whole-child approaches to understanding the neurophysiological and behavioral basis of self-regulation and its development. Based on these findings, the present research sought to better understand self-regulation in young children with an integrative approach using path analysis to examine the causal effects of the broad factors of self-regulation (EF and EC) on children's socio-emotional competence related to social school readiness. The results indicated that, of these two important facets of self-regulation, only EC can directly and indirectly affect children's outcomes. However, EF is indirectly related to children's socio-emotional competence and is associated with social school readiness mainly through EC.

Our findings suggest that EC is positively associated with social school readiness in children. Moreover, EC is found to be a partial mediator in the relationship between EF and social school readiness. Consistent with the literature, EC is associated with greater participation in class, a better relationship with teachers, and superior academic performance and motivation (e.g., Rueda et al., 2010). However, we did not find any significant relationship between EF and social school readiness directly. In this regard, according to Zorza et al. (2019), the relationship between EF and EC can change in the life span. As a facet of temperament, EC is connected to the voluntary control of behavioral approach and avoidance tendencies (Chen et al., 2015). Therefore, combined with EF, EC regulates behavior in social situations by activating the control mechanism. Furthermore, since similar neural networks are

associated with both EF and EC, specifically the anterior cingulate cortex and the dorsolateral prefrontal cortex (Sulik et al., 2016), the partial overlap between EC and EF and EC's mediating effect on EF and social school readiness are not surprising.

The study provides initial evidence supporting the idea that interventions targeting early social school readiness could be a useful avenue for promoting the 'hot' self-regulation facet, i.e., EC, in preschool children, to benefit from EF and its outcomes.

As Blair (2002) stated, the development of EF skills provides a critical biological foundation for cognitive and emotional functions. We expected that the 'cold' cognitive aspect of self-regulation (i.e., EF) would be connected to social school readiness. In the alternative model of the present research, EF indirectly predicted social school readiness as a facet of academic performance. These findings are consistent with past research indicating that EFs, specifically working memory, affect the development of various critical skills such as language, spelling, writing, reading comprehension, counting, and mathematics in kindergarteners and children in the early elementary grades (Bierman et al., 2008b; Blair & Razza, 2007; Mann et al., 2017). Previously, research consistent with this study demonstrated that a higher level of EF leads to higher math achievement at age 7 (McClelland et al., 2007), growth in math and reading in kindergarten (Welsh et al., 2010), improved capacity to remember directions and instructions and follow through in the pursuit of goal-directed activities (Gathercole & Pickering, 2000), engagement in adaptive behaviors (Razza & Raymond, 2015), and improved early literacy and numeracy skills (Welsh et al., 2010).

Our SEM results are consistent with the results of Bierman et al.'s (2008a) work on EF, showing that the characterization of cognitive growth as a set of skills proceeding, but separate from, social-emotional and self-regulatory capacities may not correctly illustrate specific development during the preschool years. As stated earlier, the direct paths between EF and social/emotional competence and social school readiness were not significant. However, EF skills, which regulate attention and self-control and coordinate emotion, cognition, and behavior mediated by EC, are crucial to fostering the focused and goal-oriented behavior leading to higher cognitive and social school readiness.

Moreover, early childhood is an important period for the development of EFs and EC and may be associated with brain development, including changes in the gray and white matter and anatomical and physiological alterations in the prefrontal cortex (Lin et al., 2019). Individual differences in age-related changes in the brain could be more critical when motivational factors are required for the task or assessment. Therefore, consistent with previous research (e.g., Kim-Spoon et al., 2019), the present results contribute to the literature on performance-based assessments of self-regulation and highlight the conceptual and empirical overlap between EC and EF in early childhood.

In contrast to the one-factor models of early self-regulation presented by Kim-Spoon et al. (2019) and Meuwissen and Carlson (2019), the SEM indices in our study considered EF and EC as distinct constructs, and the effect of EF on social school readiness was mediated by EC. However, EF and EC are conceptually and empirically linked with different theoretical frameworks. Recent findings of the study on bivariate twin models by Rea-Sandin et al. (2022) also indicated that EF and EC share a common foundation in terms of self-regulation, with weak correlations between them possibly due to discrepancies in measurement rather than conceptual differences. Gaining a better understanding of the overlap between EF and EC could potentially help researchers to identify the most effective ways to foster adaptive self-regulation.

The present study, consistent with the literature, also stressed differentiated self-regulation throughout childhood (e.g., Huizinga et al., 2006; Lee et al., 2013). According to Brydges et al. (2014), data from children aged 8-10 years indicated that the factor structure of EF changed from a one-factor to a two-factor structure in which working memory was separable from, but moderately related to, inhibition and cognitive flexibility. Therefore, the overlap between EF and EC is suggested whenever a one-factor or a two-factor model of self-regulation is considered.

Conclusion

As expected, our results provide some insight into the possibly different roles of self-regulation factors in children's competence. Implicating academic and social-emotional aspects of social school readiness in school success depends on the efficient regulation of critical thinking and behavior (Blair, 2002). Social and emotional competences, including prosocial behavior, following directions, cooperation, and listening (Rimm-Kaufman et al., 2000) require a higher level of EC and EF. Children with better social skills that result from self-regulated behavior often have more positive attitudes toward school and experience greater success adjusting to school, in addition to getting better grades and gaining higher achievements (Ladd et al., 1999). Moreover, as also stated by Denham (2006), the present study suggests that higher social competence can help children be more readily accepted by their peers and

teachers, initiate positive relationships with teachers, and have positive feelings about school. In addition, young children can benefit from the reciprocal advantages of improved social/emotional competence and academic performance. Consistent with the literature, academic competence predicted social competence, and vice versa, from second to third grades.

While there was a significant direct path between EC and academic and social competencies in children, EF also had positive indirect effects on social and emotional competence mediated by EC. Therefore, the contributions of EF and EC are significant for school adjustment in children, confirming previous research (Diamond, 2013). Specifically, the association between self-regulation factors and competence in preschoolers is consistent with the existing work suggesting that those who are better able to self-control demonstrate higher-quality relationships (Farley & Kim-Spoon, 2014).

In conclusion, children with a better ability to self-regulate are also more socially competent (McKown et al., 2009), and this competence results from high EF (based on parent reports and behavioral performance) and EC, factors that can lead to better social and emotional school readiness (Holmes et al,, 2016). Taken together, these findings suggest that children with better self-regulation abilities are likely to exhibit greater competence through a variety of mechanisms leading to an improved ability to foster positive adjustment in school in the early years.

Practical Implications

Children begin to develop the capacity to self-regulate their learning from early school years. As a key factor for promoting psychological well-being, self-regulation will lead to physical, emotional, social, and educational achievement. Its main role in managing thoughts and feelings can predict future goal-directed actions; this means that supporting self-regulation development in early childhood is an investment in later success and diminishes behavioral difficulties in the future. The result of the current study not only highlighted the importance of self-regulation in teaching and learning, but also demonstrated that best practices in self-regulation enhancement should include both emotional and cognitive training together.

Given the importance of self-regulation knowledge throughout one's academic life and beyond, developing the knowledge and skills to effectively activate and guide young children's self-regulation are among the important tasks of teachers. If teachers expect students to self-regulate their learning, they should be capable of modeling and explaining self-regulation skills to their students. By empowering students and teachers to self-regulate their learning and teaching, this concept becomes more widespread and will be integrated into the entire school practice. Teachers can advance their self-regulation knowledge and competences by receiving explicit instructions in professional development programs and in-service training.

Limitations and Suggestions for Future Research

Although this study reported significant details about the associations between self-regulation and social school readiness, it was limited in terms of methodological approach and scope. Moreover, a small set of instruments was administered. Although considerable progress has been made in EF and EC measurement during the preschool years, young children still find it difficult to complete long tasks. Future research should include larger and more diverse samples, administer additional measures to support SEM, and use experimental designs to clarify the mechanisms of change. Still, our findings expand the existing early childhood research by delineating the association between two major aspects of self-regulation and social and emotional school readiness. These findings demonstrate the importance of identifying detailed information about the mechanism of school success in future studies.

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Conflicts of interest

The authors declare no conflict of interest.

Availability of data and material

Not applicable

Code availability

Not applicable

Ethics approval

The Education Department of Tehran approved this study, which acts in lieu of IRB approval. Sampling was

performed with the permission and cooperation of the preschool centers.

Consent to participate

Ethical considerations based on the Declaration of Helsinki were adhered to throughout the study. The mothers provided informed consent to participation, to which the children also verbally assented.

Consent for publication

The mothers consented to the publication of the results of the study, to which the children also verbally assented.

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