Routledge
Taylor & Francis Group

Applied Developmental Science

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/hads20

# Unique and joint contributions of behavioral and emotional self-regulation to school readiness

Carolina Guedes, Tiago Ferreira, Teresa Leal & Joana Cadima

**To cite this article:** Carolina Guedes, Tiago Ferreira, Teresa Leal & Joana Cadima (2023) Unique and joint contributions of behavioral and emotional self-regulation to school readiness, Applied Developmental Science, 27:2, 136-155, DOI: 10.1080/10888691.2022.2045200

**To link to this article:** https://doi.org/10.1080/10888691.2022.2045200

APPLIED DEVELOPMENTAL SCIENCE
2023, VOL. 27, NO. 2, 136–155
https://doi.org/10.1080/10888691.2022.2045200

Routledge
Taylor & Francis Group



# Unique and joint contributions of behavioral and emotional self-regulation to school readiness

Carolina Guedes, Tiago Ferreira, Teresa Leal, and Joana Cadima

University of Porto

**ABSTRACT**

This study aimed to examine the unique and joint contributions of behavioral and emotional self-regulation to key but understudied emergent literacy and early social skills, disentangling sex-differentiated paths. The participants were 231 Portuguese preschoolers (50% boys; $M_{age}$ = 59.5 months; $SD$ = 8.5) enrolled in 47 classrooms. In the first assessment wave, the children's behavioral self-regulation and receptive vocabulary were individually assessed. The teachers reported on children's emotional self-regulation. In the second assessment wave, individual assessments on children's expressive vocabulary, syntactic knowledge, oral-narrative production, and social problem-solving skills were conducted. The results showed that the children's emergent literacy and early social skills were more related to their behavioral self-regulation than to their emotional self-regulation. Child sex moderated the links between behavioral self-regulation and oral-narrative production skills and the link between emotional self-regulation and early social skills. These findings may have important implications for planning early interventions for developing self-regulation skills.

## Introduction

It is well established that children's skills upon school entry are foundational for their later school success (e.g., Duncan et al., 2007). School readiness encompasses a broad range of skills, such as language, literacy, self-regulation, and social skills (Blair & Raver, 2015). These skills support children's learning and have long-lasting effects on school achievement (Duncan et al., 2007). Despite the robust evidence of the importance of school readiness skills, there is still a debate on the core skills for school readiness, with studies examining different constellations of skills.

While it is widely believed that a broad range of school readiness skills should be considered, much more research attention has been given to some than to other equally crucial skills. Specifically, although emergent literacy skills are generally acknowledged as a central aspect of school readiness, components such as letter knowledge and phonological awareness have received more attention than other important literacy skills, such as syntactic knowledge and oral-narrative production skills (Roth et al., 2002). Also underlying school readiness are several interrelated components of children's social skills (Denham, 2006). While prosocial behavior has been largely explored in relation to school readiness (Di Norcia et al., 2015), children's social problem-solving skills have received much less attention (Denham, 2006). It thus seems important to conduct studies aligned with the most recent concepts of school readiness (Lonigan et al., 2015) acknowledging that a broad set of key skills yet understudied are crucial for school readiness.

Under the study of school readiness, self-regulation is now well established as a core foundational skill for children's learning on key domains such as emergent literacy and social skills (Allan et al., 2014; Korucu et al., 2017; Matthews et al., 2009; McClelland et al., 2014; Robson et al., 2020). Nevertheless, self-regulation is a broad and complex construct that has been conceptualized differently across studies. While some authors have emphasized its behavioral components (McClelland et al., 2014), others have focused on its emotional components (Graziano et al., 2007). Multiple components of self-regulation are used across studies, and it is difficult to clarify the unique contributions of all these components to children's school readiness skills (Harrington et al., 2020; Ursache et al., 2012). Thus, in this study, we sought to determine the

**CONTACT** Joana Cadima jcadima@fpce.up.pt Centro de Psicologia da Universidade do Porto, Faculdade de Psicologia e de Ciências da Educação da Universidade do Porto, Rua Alfredo Allen, 4200-135 Porto, Portugal.

unique and joint contributions of both the behavioral and emotional components of self-regulation to understudied school readiness skills.

We also examined the sex-differentiated patterns of these associations. Several studies have reported the higher performance of girls compared to boys in self-regulation tasks (e.g., Matthews et al., 2009) and in core school readiness skills such as emergent literacy and social skills (e.g., Fung et al., 2019; Ready et al., 2005), but few studies have explored the role of sex (Ursache et al., 2012) as a moderator of the association between self-regulation and school readiness outcomes. The scarce evidence available is inconsistent, with some studies indicating sex-differentiated paths (e.g., Denham et al., 2003) and others indicating otherwise (e.g., Slot & von Suchodoletz, 2018). Thus, further research must be conducted to determine which components of self-regulation can enable preschool boys and girls to make the most out of their school learning experiences.

### Behavioral and emotional self-regulation

Self-regulation is a broad, multidimensional construct that can be defined as the ability to regulate one's cognition, behavior, and emotions in various situations (McClelland & Cameron, 2012). Behavioral self-regulation includes a set of cognitive skills, also known as executive functions, that enable us to attain our goals (Bailey & Jones, 2019; Jones et al., 2016). In the current study, we specifically focused on the following executive function skills under behavioral self-regulation: working memory, inhibitory control, and attentional/cognitive flexibility skills (Bailey & Jones, 2019; Jones et al., 2016; McClelland & Cameron, 2012). These executive function skills allow children to capitalize on cognitive processes that ultimately lead to learning and development (Bodrova & Leong, 2006) by enabling them to hold information in their memory while processing other information, remember directions, take turns in a conversation or in a game with rules, pay attention and rule out possible distractors, shift their attention between tasks when necessary, suppress undesired responses so they can display more adaptive ones, and stay on task (Ursache et al., 2012).

Emotional self-regulation refers to the ability to modulate and express one's emotions, affections, and motivations (McClelland et al., 2010). It enables children to follow rules and engage with others in groups with different social arrangements (Bodrova & Leong, 2006) by managing, modulating, inhibiting, and enhancing their emotions appropriately, particularly in disturbing situations (Denham, 2006; Ursache et al., 2012). Emotional self-regulation has been operationalized through two domains: the first targets children's empathy, emotional self-awareness and the appropriateness of children's affective display; the second targets affective lability processes such as children's lack of flexibility, mood shifts and dysregulated negative affect (Shields & Cicchetti, 1997).

The aforementioned components of self-regulation, although interrelated, can have unique contributions to several school readiness skills (Allan et al., 2014; Edossa et al., 2018; McClelland & Cameron, 2012), but most of the previous studies have examined them separately. With a developmental lens, Zelazo and Müller (2011) have argued that to promote a more complex understanding of self-regulation, studies should focus on both behavioral and emotional components. Conceptually, behavioral self-regulation can be especially important for school readiness skills related to achievement because both call for cognitive processes that do not involve emotional arousal and that rely on abstract and decontextualized tasks (Zelazo & Müller, 2011). As for the emotional self-regulation skill, it seems particularly important for early social skills because both call for processes that children carry out affectively (Zelazo & Müller, 2011). However, historically, behavioral self-regulation has been given more attention, leaving much to know about the unique contribution of emotional self-regulation to the development of important school readiness skills, and about the way behavioral and emotional self-regulation jointly relate to these skills (Zelazo & Müller, 2011).

### Contributions of behavioral and emotional self-regulation to emergent literacy skills

There is mixed evidence of the unique and joint contributions of behavioral and emotional self-regulation to school readiness achievement skills. Some previous studies have suggested that behavioral self-regulation is more closely related to children's literacy skills than emotional self-regulation is (Allan et al., 2014; O'Toole et al., 2020; Willoughby et al., 2011) whereas others have suggested a joint contribution of behavioral and emotional self-regulation skills to children's literacy skills (Backer-Grøndahl et al., 2019; Howse et al., 2003). Most of these prior studies focused on well-studied emergent literacy skills related to later decoding, such as the phonological awareness and letter–word identification skills (e.g., Willoughby et al.,

2011). Much less is known about the unique and joint contributions of behavioral and emotional self-regulation to emergent literacy skills related to later reading comprehension, such as syntactic knowledge and oral-narrative production skills (Roth et al., 2002). Syntactic knowledge and oral-narrative production skills have been shown to be important for children's learning (Brimo et al., 2018; Suggate et al., 2018) but few studies were conducted to better grasp what influences the acquisition of these skills. Following Zelazo and Müller (2011) conceptual framework, the current study makes an important contribution to the current state of the art by adding emotional self-regulation skills to the picture and by disentangling the unique and joint contributions of behavioral and emotional self-regulation to these skills.

Emergent literacy includes a broad set of skills that develop during early childhood and that contribute to later reading and writing (Lonigan et al., 2008; Whitehurst & Lonigan, 1998). According to Lonigan et al. (2008), most of the emergent literacy skills related to later reading comprehension are understudied compared to the skills related to later decoding. In the current study, we focused on the language and oral-narrative production skills, which, according to Whitehurst and Lonigan's (1998) framework, concern fundamental emergent literacy processes. Language comprises, among others, expressive vocabulary and syntactic knowledge while oral-narrative production involves decontextualized language (Dickinson & Snow, 1987; Whitehurst & Lonigan, 1998).

### Expressive vocabulary

Expressive vocabulary is widely acknowledged to be essential for children's future academic success (NICHD Early Childhood Research Network, 2005; Storch & Whitehurst, 2002). Many studies have established the predictive value of behavioral self-regulation to children's expressive vocabulary skills in preschool and through first grade (Bohlmann & Downer, 2016; Cadima et al., 2019; Gestsdottir et al., 2014; McClelland et al., 2014; Ponitz et al., 2009; Sektnan et al., 2010), but few studies have looked into the contributions of emotional self-regulation to expressive vocabulary.

### Syntactic knowledge

Children's syntactic knowledge is another important indicator of language development that is believed to be crucial for children's reading comprehension (Brimo et al., 2018). Children with syntactic knowledge implicitly understand basic language rules, and this enables them to understand instructions and conversations and to engage in a progressively more mature discourse (Sim-Sim, 2014). Syntactic knowledge capitalizes on children's ability to integrate information and to intertwine recent materials and knowledge stored in their long-term memory, thus calling upon skills related to behavioral self-regulation such as the working memory and attentional/cognitive flexibility skills (Lonigan et al., 2017). Few studies, however, have examined its links with self-regulation, particularly with emotional self-regulation. The few studies that investigated the link between syntactic knowledge and behavioral self-regulation suggested that preschoolers' behavioral self-regulation skills are related to their ability to use syntactic knowledge (Fuhs et al., 2014; Lonigan et al., 2017; Verhagen & Leseman, 2016).

### Oral-narrative production

Children's ability to produce oral narratives is another important indicator of their emergent literacy development (Curenton & Justice, 2004), with a recent study showing that preschoolers' oral-narrative production skills are predictors of reading comprehension at age 12 (Suggate et al., 2018). The oral-narrative production skill can be defined as the ability to tell a fictional or real event sequentially and coherently (Engel, 2012). Underlying good oral-narrative production skills are behavioral self-regulation skills (Friend & Bates, 2014). To construct a well-structured oral narrative with a coherent causal chain and a temporal sequence, children must first be able to concentrate on each segment, shift their focus between segments, and rule out distractions, storing information in their mind while processing the next segment. This allows them to properly tell what happened first and what happened next, and to establish relations between segments, maintaining their focus to tell a complete and coherent story (Friend & Bates, 2014). The few studies that have been conducted on the link between behavioral self-regulation and oral-narrative production skills have shown the importance of the former to the latter (Dealy et al., 2019; Friend & Bates, 2014). Nonetheless, to the best of our knowledge, there have been no studies to date that examined the unique and joint contributions of both the components of self-regulation to children's oral-narrative production skills.

### Contributions of behavioral and emotional self-regulation to early social skills

The previous studies that examined the contributions of behavioral and emotional self-regulation to early social skills suggested that early social skills have a stronger link to emotional self-regulation than to behavioral self-regulation (Backer-Grøndahl et al., 2019; Di Norcia et al., 2015; Kim et al., 2013). However, there are notable differences in how social skills are conceptualized and measured across studies. For instance, most of the previous studies examined children's social skills according to teacher reports, focusing either on maladjustment or externalizing and internalizing behavior (Backer-Grøndahl et al., 2019; Kim et al., 2013), prosocial or oppositional behavior, dependent behavior (Di Norcia et al., 2015), or interpersonal skills (Ponitz et al., 2009). To grasp the association between self-regulation and early social skills, it seems important to use not only measures related to the multiple components of self-regulation (McClelland & Cameron, 2012) but also reliable and ecologically valid measures of social outcomes (e.g., Denham, 2006).

According to the seminal work of the Collaborative to Advance Social and Emotional Learning (CASEL) group, social skills have several intertwined components, such as the skill of developing an awareness of one's self and of others, the skill of acquiring positive values and attitudes, responsible decision-making skills, and social interaction skills (Payton et al., 2000). Among these, the responsible decision-making or social problem-solving skills, albeit understudied, have been shown to be important for later academic achievement and school adjustment (Denham, Bassett, Zinsser, et al., 2014; Denham & Bassett, 2020). The responsible decision-making skill can be defined as the ability to identify a challenging situation, assess its risks, and mobilize resources useful for resolving the situation at hand while showing an understanding of others' feelings (Payton et al., 2000). The social problem-solving skill is the basis of effective and responsible decision making over one's lifespan (Denham, 2006). Children need social problem-solving skills when they engage with their peers in interactions that often imply some level of conflict, which requires the skill to regulate their emotions and behaviors (Denham, 2006).

It has been argued that children should be capable to integrate their behavioral and emotional self-regulation skills so they would be able to effectively resolve a peer conflict or an emotionally charged situation (Denham, 2006). Children who can regulate their emotions are more capable of understanding the possible consequences of an emotional response or behavior and of acknowledging and recognizing their peers' and others' social needs and emotions (Denham, 2006). Specifically, children should be able to activate appropriate subdominant responses and inhibit less adaptive ones, overcome their frustration, and remain balanced and calm during an altercation (Denham, Bassett, Way, et al., 2014). Few studies, however, have examined the contributions of emotional and behavioral self-regulation to the social problem-solving skill, and their results are mixed: while in one study there was evidence that both behavioral and emotional self-regulation are related to the social problem-solving skill (Denham, Bassett, Zinsser, et al., 2014), another study suggested that behavioral self-regulation has a more important contribution to the social problem-solving skill (Denham, Bassett, Way, et al., 2014). Thus, further studies must be conducted on this matter.

### Sex differentiated paths

There is inconsistent evidence of the association between child sex and school readiness. Although some studies have reported that girls have an advantage over boys in terms of self-regulation, literacy, and social skills (e.g., Fung et al., 2019; Matthews et al., 2009; Ready et al., 2005), others have failed to establish this (e.g., Graziano et al., 2007; Slot & von Suchodoletz, 2018). Additionally, the studies examining the role of sex as a moderator in the association between children's self-regulation and their emergent literacy skills have yielded mixed results. A possible explanation for these mixed findings is that while some studies have focused on behavioral self-regulation, others have focused on emotional self-regulation. Regarding behavioral self-regulation, while some studies failed to find sex-differentiated paths (Montroy et al., 2014; Slot & von Suchodoletz, 2018; Wanless et al., 2013), others some found that child sex is an important moderator of such association (e.g., Son et al., 2013). For instance, a study involving South Korean preschoolers found that behavioral self-regulation is more strongly related with boys' early reading than with girls' (Son et al., 2013). Fewer studies have focused on examining the moderating role of child sex in the association between emotional self-regulation and school readiness skills. In one exception, Denham et al. (2003) reported that the association between emotional self-regulation and social skills was stronger for girls than for boys (Denham et al., 2003).

Therefore, the current study adds to the current knowledge by providing a first glimpse into the moderator role of child sex in the association between behavioral and emotional self-regulation and children's school readiness skills.

### The current study

The current study had two main objectives, with two hypotheses drawn for each. Although the importance of self-regulation for school readiness is widely acknowledged (Blair & Raver, 2015), there has been little discussion about the unique contributions of the behavioral and emotional components of self-regulation to distinct school readiness domains. In this study, we sought to address this gap by examining children's behavioral and emotional self-regulation, understudied emergent literacy and early social skills to determine if there is an association between the first and the last two. Based on developmental conceptual underpinnings that stipulate that behavioral and emotional self-regulation, although interrelated, can be particularly important for a different set of skills (Zelazo & Müller, 2011), two hypotheses were drawn for this objective: (1) expressive vocabulary (e.g., Cadima et al., 2019), syntactic knowledge (e.g., Lonigan et al., 2017), and oral-narrative production skills (e.g., Friend & Bates, 2014) are uniquely related to behavioral self-regulation; and (2) there is a joint contribution of behavioral and emotional self-regulation to the social problem-solving skill (Denham, Bassett, Zinsser, et al., 2014).

The second aim of the current study was to determine if sex moderates the aforementioned associations. We expected that there would be sex-differentiated paths in the examined associations. Specifically, based on the previous research, we drew two hypotheses: (1) sex moderates the association between emotional self-regulation and early social skills, with a stronger association for girls than for boys (Denham et al., 2003); and (2) sex does not moderate the association between behavioral self-regulation and emergent literacy skills (e.g., Slot & von Suchodoletz, 2018).

This study makes unique contributions to the current literature by clarifying the roles of each component of self-regulation in the development of several school readiness skills and by providing valuable information on potential targets for early intervention. The study also broadens the scope of school readiness (Lonigan et al., 2015) by incorporating into it a broader set of dimensions that have been understudied despite the fact that they have been theoretically acknowledged.

## Method

### Participants

The participants were 231 preschoolers (50% boys) and their teachers. Preschool in Portugal serves children aged 3–6 years (children start primary school at age 6), and although not compulsory, it has a 91% attendance rate (European Commission/EACEA/Eurydice, 2019). In Portugal, preschool teachers have at least a bachelor's degree in early childhood education obtained through a 3-year university training course. There are both public and private preschools (the latter either for-profit or non-profit), but all preschools are under the tutelage of the Ministry of Education.

The participants in the current study were drawn from a larger project that aimed to investigate self-regulation growth in at-risk preschool children and its links with the quality of teacher-child interactions. The project was run in socially disadvantaged areas situated in the large metropolitan area of Porto (Portugal). The preschools that participated in the project were public and supported by the nationally funded action TEIP (Territórios Educativos de Intervenção Prioritária; Priority Intervention Territories Program), serving populations at risk for poverty or social exclusion. The TEIP program provides more economic and human resources to the participating schools, aiming to improve their students' academic success and to decrease the rate of early school dropout. The teachers working in TEIP schools are expected to follow the national-curriculum guidelines. Thus, the activities and materials in the TEIP preschools are similar to those in the non-TEIP preschools.

Eleven school clusters (large groups comprised of several individual schools) were initially invited to participate in the current study. Four refused to participate and seven (64%) gave their consent to participate. The seven school clusters that agreed to participate in the study had 47 preschool classrooms combined, with all the lead teachers agreeing to participate in the study. On average, five children per classroom participated in the study (range: 2–7). The children had an average age of 59.5 months ($SD = 8.5$) at the first assessment wave. As for the participants' sociodemographic characteristics, 49% of the mothers reported having attended school for 9 years at most (1–9 years of schooling), 38% reported having

completed secondary school (10–12 years of schooling), and 13% reported having taken postsecondary and/or tertiary education programs (data regarding the mothers' education was available for 65% of the sample [$n = 151$]). The family income (data available for 68% of the sample [$n = 157$]) was below the national minimum wage for 27% of the families, and most of the families (51%) reported a monthly income that corresponded to one to two national minimum wages. Concerning the mother's professional situation (data available for 74% of the sample [$n = 171$]), 35.7% were unemployed and 54.4% worked outside the home.

All the participating teachers ($n = 47$) were the classroom lead teachers, all of whom were women. They had on average 25.3 years of teaching experience ($SD = 6.4$; $n = 42$). Most of them (88.6%) had a bachelor's degree in education, and a small percentage (11.4%) had a masters' degree (data available for 35 teachers). The classrooms' group sizes ($n = 42$) ranged from 15 to 25 children, with an average of 21.7 children enrolled per classroom ($SD = 3.1$).

## Measures

### Behavioral self-regulation

To assess children's behavioral self-regulation skills, we used the Head–Toes–Knees–Shoulders task (HTKS; Ponitz et al., 2009), a direct assessment measure of three self-regulation subskills: attention focusing, inhibitory control, and working memory. This task consists of a short game with paired rules. In the first part of the game, the researcher asks children to touch their head when told to touch their toes, and to touch their toes when told to touch their head. In the second part of the game, a knees-shoulders command is added: the researcher asks children to touch their knees when told to touch their shoulders, and to touch their shoulders when told to touch their knees. Each part is comprised of 10 items, each scored 0 (incorrect response) to 2 (correct response), with 1 point given for self-corrected responses (i.e., when the child starts with an incorrect response but promptly shifts to the correct response autonomously). The global scores for the HTKS task thus ranged from 0 to 40. HTKS is a widely used measure, and the previous studies across several countries, including Portugal, have demonstrated its reliability (Cadima et al., 2015; Fuhs et al., 2013; von Suchodoletz et al., 2013; Wanless et al., 2011). In the current study, it showed good internal consistency (Cronbach's alpha [$\alpha$] = 0.94).

### Emotional self-regulation

The participating children's emotional self-regulation skills were assessed through teachers' reports using the Emotion Regulation Checklist (ERC; Shields & Cicchetti, 1997). Following the measure's authors (Shields & Cicchetti, 1997) and recent studies (e.g., Cadima et al., 2016), in the current study we use two subscales of the ERC. The Lability/Negativity subscale evaluates the teacher's perceptions of the child's mood shifts, dysregulated negative affect, and intensity of emotions and has 11 items (e.g., "Is prone to angry outbursts/tantrums easily"). The Emotion Regulation subscale assesses the teacher's perceptions of the child's ability to control and express his/her emotions in a socially adaptive way, and has seven items (e.g., "Is empathic toward others"). In each item, the teacher is asked to rate the child's characteristic using a 4-point scale (1 = never; 4 = almost always). The measure validity has been addressed through correlations with previously established measures of children's emotional self-regulation (Shields & Cicchetti, 1997). ERC is adapted to and validated for the Portuguese population (Melo, 2005), and previous studies in Portugal have provided support for its two-factor structure through preschool teachers' reports on their pupils (e.g., Cadima et al., 2016). In the current sample, ERC showed good internal consistency for the Lability/Negativity subscale ($\alpha = 0.85$) and for the Emotion Regulation subscale ($\alpha = 0.78$).

### Emergent literacy skills

The participating children's emergent literacy skills, specifically their expressive vocabulary, syntactic knowledge, and oral-narrative production skills, were directly assessed. Their receptive vocabulary were also directly assessed, and such skill was used as a control variable.

***Expressive vocabulary.*** The children's expressive vocabulary was assessed with the Vocabulary subtest of the Wechsler Preschool and Primary Scale of Intelligence (WPPSI; Wechsler, 2010). In this task, the child is asked to explain the meaning of 21 words. The Vocabulary subtest has 21 items scored from 0 to 2. The item scores are summed up to obtain a global score ranging from 0 to 42. The validity and reliability of WPPSI are well documented (Wechsler, 2003). The measure is widely used, including in Portugal (Cadima et al., 2019). In the current study, it showed good internal consistency ($\alpha = 0.81$).

***Syntactic knowledge.*** The children's syntactic knowledge was measured as their ability to understand complex sentences, and were assessed with the Complex Sentences Comprehension task from the Portuguese Oral Language Assessment Tool (ALO – Avaliação da Linguagem Oral; Sim-Sim, 2014). In this task, the researcher reads a complex sentence (i.e., a sentence in the passive voice and/or that has several clauses) aloud and asks the child a question to assess the extent to which he/she understands the sentence (e.g., "The mother's red car has a flat tire. What color is the mother's car?"). There are 32 items in all. In the current study, a short version with only 10 items (sentences) was used, with each item scored 0 (incorrect answer) or 1 (correct answer). The global score for the task ranged from 0 to 10. This task was created in Portugal and has shown good psychometric properties (Sim-Sim, 2014). It showed an acceptable internal consistency ($\alpha = 0.62$) in the current study.

***Oral-narrative production.*** The children's oral-narrative production was assessed using a sequence of six pictures showing children and adults having fun in a swimming pool. In this task, the child is asked to create and tell a story based on the sequence of pictures. In this study, the children's oral narratives were audio recorded, transcribed, and coded using a narrative complexity scale coding system with four subscales: Elements, Sequence, Syntax, and Decontextualized Language (Friend & Bates, 2014). According to previously specified criteria, 1–6 points were given for the first three subscales, and 1–5 for the last. Specifically, for the Elements subscale, 1 point was given for each main element that the child would be able to provide in his/her oral narrative across the six pictures (e.g., for the first picture, 1 point was given when the child stated the idea that people were playing in a swimming pool; in the next image, 1 point was added if the child stated the idea that the kid in the story asked to climb the ladder). For the Sequence subscale, 1 point was given if the child described images in isolation, without making connections between scenes. A child could get as much as 6 points if he/she would be able to tell a very coherent story. For the Syntax subscale, 1 point was given if the child always used the same verb tense. A child could get as much as 6 points if he/she used two or more complex sentences. Finally, for the Decontextualized Language subscale, 1 point was given if the child told the location of the action. A child could get as much as 5 points if he/she assigned roles or functions to the story characters. More information about the coding system is available upon request. The Cronbach's alpha value was 0.80. A Confirmatory factor analysis was performed to create a latent variable for the oral-narrative production skill. The results indicate a good model fit ($\chi^2$ [2] = 0.95; $p$ = .62; comparative fit index [CFI] = 1.00; root mean square error of approximation [RMSEA] = .00; standardized root mean square residual [SRMR] = .01), with factor loadings ranging from .62 to .87.

***Receptive vocabulary.*** To control for the children's initial receptive vocabulary, the Peabody Picture Vocabulary Test - Revised (PPVT-R; Dunn, 1986) was used. In this task, the assessor shows a set of four pictures at a time and asks the child to point to a specific word. The task begins with an age-appropriate item and finishes when the child gives eight incorrect answers in a row. This task has been widely used, including in Portugal, with studies suggesting its reliability and validity as a measure for preschool children (e.g., Cadima et al., 2019). It showed good internal consistency ($\alpha = 0.93$) in the current study.

### *Early social skills: social problem-solving skill*

To evaluate the children's ability to predict their behavioral decisions and associated emotions, we used the Challenging Situations Task (CST; Denham et al., 1994). Four situations depicting peer provocation during play are presented to the child verbally with the support of an image. For each situation, the child is asked to share with the assessor how he/she would feel in such a situation, choosing one of four possible emotions presented verbally with the support of schematic drawings (happy, sad, angry, just okay). Then the child is asked to choose from among four possible answers (behavioral choices; presented verbally with the support of schematic drawings) to the question "What would you do?". The four possible answers are as follows: (1) negotiate with peer (prosocial); (2) hit peer (or carry out any other aggressive behavior); (3) play with something else instead (avoidance); and (4) cry. The final score is based on the number of each emotional and behavioral response picked by the child in the four situations. Following the previous research by Denham et al. (2012), the current study focused on sad and angry emotional responses and prosocial and aggressive behavior responses. The situations where a child picked the sad-emotion and prosocial-behavior responses were counted to create a composite of effective social problem-solving skill (sad-prosocial) (Denham et al., 2012). The situations where the child picked the angry-emotion and aggressive-behavior responses were also counted to create a composite of

less effective social problem-solving skill (angry-aggressive) (Denham et al., 2012). For instance, if across the four situations the child selected the sad response (4 points) and the prosocial behavior (4 points), 8 points would be given for the sad-prosocial social problem-solving skill. In the current study, Cronbach's alpha was .48 for the effective problem-solving skill scale (sad-prosocial) and .51 for the less effective social problem-solving skill scale (angry-aggressive). These values are consistent with those reported by Denham et al. (2012), and are probably due, as suggested by the authors, to the low number of items per scale. Thus, following the procedures recommended by Denham et al. (2012), we determined the internal consistency of CST in the current study through the average inter-item correlations. The inter-item correlations ranged from .15 to .33 (consistent with that in the study by Denham et al. [2012]) and were considered acceptable according to recent guidelines (Clark & Watson, 2019).

### Procedure

The current study was approved by the Portuguese National Commission of Data Protection (Project XXX). Before data collection, the directors, teachers, and parents in the participating preschools signed informed-consent forms containing information about the project. Data were collected across two assessment waves. In the first assessment wave, the children's behavioral self-regulation and receptive vocabulary skills were directly assessed, and the teachers were asked to report on children's emotional self-regulation. In the second assessment wave, the children's expressive vocabulary, syntactic knowledge, oral-narrative production, and social problem-solving skills were individually assessed. The first assessment wave occurred in the fall semester (beginning of the school year) and the second occurred in the spring semester (end of the school year). The assessment protocols were piloted with one educator and four children before the data collection. Five research assistants conducted direct evaluations. To ensure measures' correct administration, the research assistants were given access to a manual with detailed instructions for the correct administration of each measure, along with a list of all the materials needed and the specific procedural rules, and team meetings were conducted to answer the research assistants' questions and listen to their concerns. The assessments were conducted in a quiet room in the participating preschools. Each assessment lasted for approximately 30 minutes and was usually completed in a single session.

### Data analysis

To find the answers to our research questions, we conducted data analysis in two steps. First, we estimated a series of path models to examine the contributions of the behavioral and emotional self-regulation skills to children's emergent literacy and early social skills, controlling for the children's age, sex, and receptive vocabulary. Each outcome was estimated in separate models, using behavioral self-regulation, lability, emotion regulation, and the set of control variables as predictors. For the sake of parsimony and given that preliminary analysis showed similar results when controlling for mother's education, this variable was not included as a control variable in the final models. The outcomes related to the social problem-solving, expressive vocabulary, and syntactic knowledge were all modeled as observable variables while the oral-narrative production was entered in the models as a latent variable. This option was based on the authors' (i.e., Friend & Bates, 2014) recommendations for this task.

We executed the second set of models through multiple-group analysis to test our hypothesis of the presence of sex-differentiated paths in the association between the behavioral and emotional self-regulation skills on the one hand and the emergent literacy and early social skills on the other. To conduct multiple-group analysis, we fitted a series of models to the data from the two groups of interest: boys and girls. We estimated each outcome in separate models using the children's lability/negativity, emotion regulation, and behavioral self-regulation skills separately as predictors. All the models included the set of control variables (i.e., the children's age, sex, and receptive vocabulary). The associations were estimated across a series of models: from a free model (no constraints were imposed across groups) to a nested model (more constrained) and up to a fully constrained model (equality constraints were imposed on all the paths across groups). The model fit values were then sequentially compared through a series of difference tests, as suggested by Chen (2007): the chi square test, CFI, RMSEA, and SRMR. The chi square difference test was computed with the Satorra-Bentler scaled test (Satorra & Bentler, 2010) because the MLR estimator was used in the model estimation given its robustness to non-normality. The cases where the chi square difference was significant indicated that imposing

**Table 1.** Descriptive statistics and comparisons of the study variables for boys and girls.

| | | | Boys $N = 115$ | | Girls $N = 116$ | | |
|---|---|---|---|---|---|---|---|
| Variables | *M* | *SD* | *M* | *SD* | *M* | *SD* | |
| Age | 59.49 | 8.53 | 60.13 | 7.86 | 58.84 | 9.14 | $t(205) = 1.08$ |
| Prior Vocabulary | 33.39 | 15.12 | 33.43 | 14.38 | 33.34 | 15.93 | $t(206) = .04$ |
| Behavioral SR | 20.20 | 14.14 | 18.43 | 13.98 | 21.98 | 14.15 | $t(208) = -1.83$ |
| Emotional SR (Lability/Negativity) | 1.79 | .56 | 1.89 | 0.57 | 1.68 | 0.53 | $t(200) = 2.67^{**}$ |
| Emotional SR (Emotion Regulation) | 3.31 | .52 | 3.30 | 0.51 | 3.32 | 0.51 | $t(200) = -.31$ |
| Expressive Vocabulary | 19.86 | 6.64 | 19.56 | 6.29 | 20.21 | 7.05 | $t(201) = -.70$ |
| Syntactic Knowledge | 4.83 | 2.10 | 4.70 | 2.07 | 4.97 | 2.12 | $t(201) = -.90$ |
| Narrative (Elements) | 4.60 | 1.52 | 4.65 | 1.32 | 4.54 | 1.74 | $t(120) = .46$ |
| Narrative (Sequence) | 2.62 | 1.50 | 2.73 | 1.51 | 2.49 | 1.50 | $t(149) = .95$ |
| Narrative (Syntax) | 2.21 | 1.73 | 2.23 | 1.55 | 2.18 | 1.95 | $t(124) = .16$ |
| Narrative (Decontextualized) | 1.53 | 1.18 | 1.52 | 1.15 | 1.54 | 1.22 | $t(149) = -.07$ |
| Sad-Prosocial | 3.47 | 1.82 | 3.10 | 1.79 | 3.89 | 1.77 | $t(201) = -3.17^{**}$ |
| Angry-Aggressive | 1.82 | 1.55 | 2.09 | 1.71 | 1.52 | 1.30 | $t(201) = 2.68^{**}$ |

*Note.* SR = Self-Regulation; Decontextualized = Decontextualized Language.
$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

constraints on both groups significantly worsened the model fit, and as such, the groups could not be assumed to be equal on that specific path. When this was the case, to have a good model fit in both groups, different estimates were derived for boys and girls, meaning the association was moderated by the child's sex. We also used CFI, RMSEA, and SRMR to assess the model fit differences, with differences larger than −.010, .015, and .030, respectively, signifying that caution should be taken in constraining the paths to make them equal between groups, even when the chi square difference test result is non-significant. After considering the chi square difference test's results and the differences among other fit indices, the best-fitting model was selected.

Mplus (Muthén & Muthén, 1998–2012) was used to compute the models. Because the participating children were nested in classrooms, the intraclass correlation coefficients (ICCs) were computed to determine the proportion of variance at the classroom level for each study variable. The ICCs ranged from .18 to .34 for the self-regulation measures, from .02 to .17 for the emergent literacy variables, and from .01 to .16 for the early social skills, pointing to some classroom-level variance. Thus, the complex option in Mplus was used for all the models to address the nesting and the non-independence of the observations. This approach adjusts the standard error estimates for biases from the clustered design of the sample (Williams, 2000). In the current study, the percentages of missing values ranged from 9% to 34% (average = 19%). Little's missing completely at random (MCAR) test was not significant, suggesting that data were missing completely at random ($\chi^2$ [102] = 116.66; $p = 0.152$). Full information maximum likelihood estimation (FIML) was used to handle the missing data; it uses all the available information to estimate the parameters, thus preventing sample size reduction and enhancing the statistical power (Enders & Bandalos, 2001).

## Results

### Descriptive statistics and results of preliminary analysis

The descriptive statistics obtained in the current study are presented in Table 1 while the zero-order correlations between the study variables are presented in Table 2. The older children gave more sad-prosocial solutions to the social problems presented in the CST task and showed greater behavioral self-regulation and emergent literacy skills. At the same time, they showed less likelihood of giving an angry-aggressive solution for the presented social problems. Their teachers also considered them showing more lability/negativity. As expected, all the emergent literacy skills were correlated, and the same was true for both subscales measuring emotional self-regulation. Moreover, behavioral self-regulation did not show a significant correlation with either of the two emotional self-regulation subscales.

### Results of path analysis

To determine the contributions of behavioral and emotional self-regulation to children's emergent literacy and early social skills, a series of path models were tested controlling for the children's age, sex, and prior receptive vocabulary. Table 3 summarizes the results. The model fit information is not presented because all the models were saturated. Regarding

**Table 2.** Summary of zero-order correlations for the study variables.

| | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | 11. | 12. | 13. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Age | 1 | | | | | | | | | | | | |
| 2. Prior Vocabulary | .60*** | 1 | | | | | | | | | | | |
| 3. Behavioral SR | .48*** | .65*** | 1 | | | | | | | | | | |
| 4. Emotional SR (Lability/Negativity) | .17* | .03 | −.07 | 1 | | | | | | | | | |
| 5. Emotional SR (Emotion Regulation) | .06 | .17* | .12 | −.21** | 1 | | | | | | | | |
| 6. Expressive Vocabulary | .50*** | .61*** | .51*** | −.04 | .30*** | 1 | | | | | | | |
| 7. Syntactic Knowledge | .34*** | .46*** | .46*** | −.07 | .17* | .52*** | 1 | | | | | | |
| 8. Narrative (Elements) | .23** | .34*** | .29** | .03 | .04 | .44*** | .23** | 1 | | | | | |
| 9. Narrative (Sequence) | .29*** | .37*** | .30*** | −.04 | .19* | .50*** | .08 | .54*** | 1 | | | | |
| 10. Narrative (Syntax) | .30*** | .30*** | .24** | −.06 | .21* | .42*** | .20* | .40*** | .61*** | 1 | | | |
| 11. Narrative (Decontextualized) | .26** | .20* | .14 | .11 | .09 | .36*** | .11 | .44*** | .59*** | .49*** | 1 | | |
| 12. Sad-Prosocial | .18* | .32*** | .36*** | −.08 | .09 | .26*** | .26*** | .14 | .14 | .08 | .02 | 1 | |
| 13. Angry-Aggressive | −.15* | −.10 | −.22** | .10 | −.05 | −.14* | −.04 | −.04 | −.13 | −.12 | −.09 | −.60*** | 1 |

*Note.* SR = Self-Regulation; Decontextualized = Decontextualized Language.
*$p < .05$. ** $p < .01$. *** $p < .001$.

**Table 3.** Summary of the analysis results predicting emergent literacy and early social skills.

| | Emergent literacy | | | | | | Early social skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Expressive vocabulary | | Syntactic knowledge | | Oral-narrative production | | Sad-prosocial | | Angry-aggressive | |
| | $\beta$ | SE | $\beta$ | SE | $\beta$ | SE | $\beta$ | SE | $\beta$ | SE |
| Age | .22** | .08 | .07 | .08 | .15 | .10 | .04 | .11 | −.14 | .13 |
| Sex | .01 | .06 | −.05 | .08 | −.10 | .09 | .23** | .08 | −.23*** | .06 |
| Prior Vocabulary | .30** | .09 | .22* | .09 | .25* | .12 | .15 | .11 | .08 | .14 |
| Behavioral SR | .22** | .07 | .31*** | .08 | .15 | .11 | .19* | .09 | −.14 | .12 |
| Emotional SR (Lability/Negativity) | .03 | .07 | −.04 | .08 | .02 | .08 | −.04 | .07 | .07 | .09 |
| Emotional SR (Emotion Regulation) | .18* | .08 | .04 | .08 | .09 | .11 | .05 | .07 | −.02 | .07 |

*$p < .05$. ** $p < .01$. *** $p < .001$.

children's behavioral self-regulation, the results revealed that they were positively related with the children's expressive vocabulary ($\beta = .22$; standard error *[SE]* = .07; $p = .002$), syntactic knowledge ($\beta = .31$; $SE = .08$; $p < .001$), and sad-prosocial solutions to social problems ($\beta = .19$; $SE = .09$; $p = .036$).

The children's emotion regulation was associated with their later expressive vocabulary skills ($\beta = .18$; $SE = .08$; $p = .033$). The control variables also showed associations with the outcome variables; thus, the older children scored higher for the expressive vocabulary skill, and the receptive vocabulary skill was significantly related with all the emergent literacy outcomes.

### *Results of multiple group analysis*

The preliminary analysis revealed differences between the boys' and the girls' mean levels of social problem-solving and lability/negativity (Table 1). The girls gave more sad-prosocial solutions to the presented social problems compared to the boys ($t$ [201] = −3.17; $p = .002$). The boys gave more angry-aggressive solutions to the presented social problems ($t$ [201] = 2.68; $p = .008$) and showed greater lability/negativity according to teacher's report ($t$ [200] = 2.67; $p = .008$) compared to the girls. There were no significant differences between the boys' and the girls' ages and between their emergent literacy and behavioral self-regulation skills. The zero-order correlations by child sex are presented in Table 4. Table 5 presents a summary of the model fit indices and chi square changes between the freely estimated model and the more constrained model for each of the associations under analysis.

The multiple-group analysis revealed some sex-differentiated paths in the association between the children's behavioral and emotional self-regulation skills and their later emergent literacy skills (Table 6) and early social skills (Table 7). The children's behavioral self-regulation skills were associated with the boys' later oral-narrative production skills but not with the girls' ($\beta = .33$; $SE = .11$; $p = .001$). Concerning emotional self-regulation, the girls with more lability/negativity gave more angry-aggressive solutions to the presented social problems compared to the boys ($\beta = .33$; $SE = .09$; $p < .001$).

## Discussion

The purpose of the current study was to analyze the associations between distinct components of self-regulation – behavioral and emotional – and two core school readiness domains – emergent literacy and early social skills – for preschool boys and girls.

**Table 4.** Summary of zero-order correlations for the study variables by child sex.

| | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | 11. | 12. | 13. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Age | 1 | .58*** | .38*** | .07 | .16 | .47*** | .19 | .28* | .43*** | .31** | .40*** | .18 | −.24* |
| 2. Prior Vocabulary | .62*** | 1 | .59*** | .14 | .19 | .64*** | .41*** | .39*** | .46*** | .30** | .29* | .29** | −.07 |
| 3. Behavioral SR | .59*** | .71*** | 1 | −.02 | .10 | .53*** | .46*** | .42*** | .44*** | .42*** | .21 | .34*** | −.22* |
| 4. Emotional SR (Lability/Negativity) | .23* | −.07 | −.08 | 1 | −.04 | −.05 | −.08 | −.06 | −.06 | .06 | .18 | .05 | −.11 |
| 5. Emotional SR (Emotion Regulation) | −.01 | .14 | .14 | −.38*** | 1 | .32** | .19 | .01 | .19 | .22 | .12 | .02 | −.04 |
| 6. Expressive Vocabulary | .53*** | .58*** | .51*** | −.01 | .29** | 1 | .52*** | .41*** | .52*** | .35*** | .37*** | .20* | −.14 |
| 7. Syntactic Knowledge | .48*** | .51*** | .46*** | −.05 | .14 | .51*** | 1 | .38*** | .15 | .26* | .05 | .16 | .08 |
| 8. Narrative (Elements) | .18 | .30* | .18 | .10 | .06 | .47*** | .11 | 1 | .46*** | .33** | .37** | .17 | −.05 |
| 9. Narrative (Sequence) | .14 | .27* | .16 | −.03 | .19 | .49*** | .02 | .63*** | 1 | .51*** | .59*** | .18 | −.22* |
| 10. Narrative (Syntax) | .28* | .30* | .07 | −.17 | .20 | .48*** | .14 | .44*** | .71*** | 1 | .50*** | .22* | −.23* |
| 11. Narrative (Decontextualized) | .12 | .11 | .06 | .04 | .06 | .36** | .18 | .50*** | .58*** | .48*** | 1 | .05 | −.16 |
| 12. Sad-prosocial | .26* | .36*** | .34** | −.14 | .16 | .32** | .35*** | .14 | .14 | −.03 | −.01 | 1 | −.60*** |
| 13. Angry-Aggressive | −.09 | −.14 | −.14 | .31** | −.07 | −.14 | −.20* | −.03 | −.04 | −.01 | .01 | −.57*** | 1 |

*Note.* Intercorrelations for boys are presented above the diagonal, and intercorrelations for girls are presented below the diagonal.
*$p < .05$. ** $p < .01$. *** $p < .001$.

**Table 5.** Sex-differentiated paths models.

| | $\chi^2$ | *df* | *CFI* | *RMSEA* | *SRMR* | $\Delta\ \chi^2$ (df)[c] |
|---|---|---|---|---|---|---|
| 1. Behavioral self-regulation -> Expressive vocabulary | | | | | | |
| Freely estimated | 2.17 | 2 | .998 | .031 | .020 | |
| Fully constrained | 2.26 | 3 | 1 | 0 | .024 | .03 (1) |
| 2. Lability/Negativity -> Expressive vocabulary | | | | | | |
| Freely estimated | .94 | 2 | 1 | 0 | .016 | |
| Fully constrained | 2.26 | 3 | 1 | 0 | .023 | 1.72 (1) |
| 3. Emotion Regulation -> Expressive vocabulary | | | | | | |
| Freely estimated | 1.91 | 2 | 1 | 0 | .025 | |
| Fully constrained | 2.34 | 3 | 1 | 0 | .026 | .46 (1) |
| 4. Behavioral self-regulation -> Syntactic knowledge | | | | | | |
| Freely estimated | .17 | 1 | 1 | 0 | .004 | |
| Fully constrained[a] | 2.31 | 2 | .994 | .042 | .026 | 1.74 (1) |
| 5. Lability/Negativity -> Syntactic knowledge | | | | | | |
| Freely estimated | .99 | 1 | 1 | 0 | .02 | |
| Fully constrained[a] | 1.52 | 2 | 1 | 0 | .027 | .53 (1) |
| 6. Emotion Regulation -> Syntactic knowledge | | | | | | |
| Freely estimated | .96 | 1 | 1 | 0 | .018 | |
| Fully constrained | 3.55 | 3 | .982 | .047 | .044 | 2.46 (2) |
| 7. Behavioral self-regulation -> Oral-narrative production | | | | | | |
| Freely estimated | 37.41 | 30 | .969 | .060 | .062 | |
| Fully constrained[b] | 42.31 | 31 | .953 | .074 | .082 | 5.30 (1)* |
| 8. Lability/Negativity -> Oral-narrative production | | | | | | |
| Freely estimated | 39.38 | 30 | .955 | .072 | .073 | |
| Fully constrained | 39.60 | 31 | .959 | .068 | .074 | .02 (1) |
| 9. Emotional Regulation -> Oral-narrative production | | | | | | |
| Freely estimated | 29.25 | 30 | 1 | 0 | .066 | |
| Fully constrained | 29.40 | 31 | 1 | 0 | .066 | .03 (1) |
| 10. Behavioral self-regulation -> Sad-Prosocial | | | | | | |
| Freely estimated | .05 | 2 | 1 | 0 | .004 | |
| Fully constrained | .14 | 3 | 1 | 0 | .006 | .09 (1) |
| 11. Lability/Negativity -> Sad-Prosocial | | | | | | |
| Freely estimated | .95 | 2 | 1 | 0 | .026 | |
| Fully constrained | 1.41 | 3 | 1 | 0 | .028 | .47 (1) |
| 12. Emotion Regulation -> Sad-Prosocial | | | | | | |
| Freely estimated | .84 | 2 | 1 | 0 | .023 | |
| Fully constrained | 1.65 | 3 | 1 | 0 | .034 | .75 (1) |
| 13. Behavioral self-regulation -> Angry-Aggressive | | | | | | |
| Freely estimated | 0 | 0 | 1 | 0 | 0 | |
| Fully constrained [a] | .80 | 1 | 1 | 0 | .014 | .80 (1) |
| 14. Lability/Negativity -> Angry-Aggressive | | | | | | |
| Freely estimated | 2.12 | 2 | .982 | .028 | .024 | |
| Fully constrained | 10.83 | 3 | 0 | .179 | .059 | 12.10 (1)** |
| 15. Emotion Regulation -> Angry-Aggressive | | | | | | |
| Freely estimated | .91 | 1 | 1 | 0 | .017 | |
| Fully constrained[a] | 1.23 | 2 | 1 | 0 | .021 | .25 (1) |

[a] In these models, age was estimated freely.
[b] In this model, behavioral self-regulation was estimated freely.
[c] Chi-square difference test results based on Satorra-Bentler scaling correction *$p<.05$. **$p<.01$. ***$p<.001$.

Concerning the first objective of this study, overall, the results suggest differential contributions of the behavioral and emotional self-regulation skills to school readiness skills, with behavioral self-regulation more closely associated with the emergent literacy and early social skills compared to emotional self-

**Table 6.** Summary of the best-fitting models predicting emergent literacy skills by child sex.

| | Expressive vocabulary | | | | | | Syntactic knowledge | | | | | | Oral-narrative production | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Boys | | | Girls | | | Boys | | | Girls | | | Boys | | | Girls | | |
| | *B* | *SE* | *β* | *B* | *SE* | *β* | *B* | *SE* | *β* | *B* | *SE* | *β* | *B* | *SE* | *β* | *B* | *SE* | *β* |
| Age | .12[a] | .06 | .16* | .12[a] | .06 | .15* | −.03 | .02 | −.10 | .05 | .03 | .18 | .01[a] | .01 | .13 | .01[a] | .01 | .12 |
| Prior Vocabulary | .17[a] | .03 | .41*** | .17[a] | .03 | .35*** | .03[a] | .01 | .24** | .03[a] | .01 | .24** | .02[a] | .01 | .29* | .02[a] | .01 | .27* |
| Behavioral SR | .09[a] | .03 | .22** | .09[a] | .03 | .17** | .04[a] | .01 | .28*** | .04[a] | .01 | .25** | .02[b] | .01 | .33** | −.01[b] | .01 | −.07 |
| Emotional SR (Lability/Negativity) | −.96[a] | .92 | −.08 | −.96[a] | .92 | −.07 | −.42[a] | .31 | −.11 | −.42[a] | .31 | −.10 | −.05[a] | .15 | −.03 | −.05[a] | .15 | −.02 |
| Emotional SR (Emotion Regulation) | 2.60[a] | 1.14 | .20* | 2.60[a] | 1.14 | .20* | .32[a] | .33 | .07 | .32[a] | .33 | .08 | .16[a] | .20 | .09 | .16[a] | .20 | .07 |

*Note.* SR = Self-Regulation.
[a]The best-fitting model was the more constrained model, where equality constraints across boys and girls paths forced equal unstandardized estimates on both groups.
[b]Significant chi-square changes were only observed when the contributions of behavioral self-regulation on oral-narrative production were constrained to be equal for boys and girls, $\Delta\ \chi^2_{SB}(1) = 5.30$, $p = .021$.
*$p < .05$. ** $p < .01$. *** $p < .001$.

**Table 7.** Summary of the best-fitting models predicting early social skills by child sex.

| | Sad-prosocial | | | | | | Angry-aggressive | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Boys | | | Girls | | | Boys | | | Girls | | |
| | *B* | *SE* | *β* | *B* | *SE* | *β* | *B* | *SE* | *β* | *B* | *SE* | *β* |
| Age | .00[a] | .02 | .01 | .00[a] | .02 | .01 | −.06 | .03 | −.29* | .01 | .03 | .10 |
| Prior Vocabulary | .02[a] | .01 | .17 | .02[a] | .01 | .19 | .02 | .01 | .17 | −.01 | .02 | −.06 |
| Behavioral SR | .03[a] | .01 | .22* | .03[a] | .01 | .24* | −.02[a] | .01 | −.18* | −.02[a] | .01 | −.23* |
| Emotional SR (Lability/Negativity) | −.25[a] | .23 | −.07 | −.25[a] | .23 | −.07 | −.29[b] | .28 | −.09 | .86[b] | .24 | .33*** |
| Emotional SR (Emotion Regulation) | .19[a] | .25 | .05 | .19[a] | .25 | .06 | −.05[a] | .18 | −.02 | −.05[a] | .18 | −.02 |

*Note.* SR = Self-Regulation.
[a] The best-fitting model was the more constrained model, where equality constraints across boys and girls paths forced equal unstandardized estimates on both groups.
[b] Significant chi-square changes were only observed when the contributions of lability on angry-aggressive solutions to social problems were constrained to be equal for boys and girls, $\Delta\ \chi^2_{SB}\ (1) = 12.10$, $p = .001$.
*$p < .05$. ** $p < .01$. *** $p < .001$.

regulation. Regarding the study's second objective, although the behavioral and emotional self-regulation skills generally had similar influences on both the boys' and the girls' emergent literacy and early social skills, two interesting sex-differentiated paths emerged: (1) the boys with more advanced behavioral self-regulation skills were able to produce better oral narratives, which was not true for the girls; and (2) the girls with more difficulties in regulating their emotions were more likely to give angry-aggressive solutions to the presented social problems.

### *Contributions of behavioral and emotional self-regulation to emergent literacy skills*

The results of this study indicate that the participating children's behavioral self-regulation had a unique contribution to their syntactic knowledge and a joint contribution with their emotional self-regulation to their expressive vocabulary skills. Their behavioral and emotional self-regulation skills were not associated with their oral-narrative production skills, but the moderation analyses revealed sex-differentiated paths for the association between the behavioral self-regulation and oral-narrative production skills, favoring the boys. The study results highlight the importance of studying the predictors for a broad diversity of understudied emergent literacy skills and support the idea that specific components of self-regulation relate uniquely with the development of specific emergent literacy skills while other skills are best predicted by a combination of both self-regulation components.

#### *Expressive vocabulary*

In the current study, behavioral and emotional self-regulation had a joint contribution to the participating children's expressive vocabulary, which goes beyond our initial hypothesis that only behavioral self-regulation is associated with the expressive vocabulary (Cadima et al., 2019; Zelazo & Müller, 2011). The link between the children's behavioral self-regulation and expressive vocabulary was expected and is aligned with the previous findings (e.g., Cadima et al., 2019; McClelland et al., 2014). Our findings add to the literature by showing that the association between children's behavioral self-regulation and expressive vocabulary skills hold even after controlling for the association with emotional self-regulation. As

suggested by Willoughby et al. (2011), most of the previous studies focused on the links between behavioral self-regulation and expressive vocabulary. As both self-regulation components may be correlated with their expressive vocabulary skills, the results of the aforementioned studies may not show an exclusive link between the behavioral self-regulation and expressive vocabulary but mirror a shared association between behavioral and emotional self-regulation. As these two components of self-regulation were included in our study, our findings highlight the importance of disentangling their contributions to the expressive vocabulary skill.

The results of this study also add to those of the previous studies by indicating that emotional self-regulation, alongside behavioral self-regulation, is important for children's expressive vocabulary. Children's ability to define specific words seems to be affected not only by their capacity to stay on task and to rule out distractions but also by their ability to respond positively to challenges, express their emotions in a socially acceptable way, and show an ability to deal with frustration and to recover from negative emotions. A possible explanation of this result is that in preschool, the children are provided with several informal opportunities to practice the use of productive language while playing with their peers (Bohlmann & Downer, 2016). Playing with one's peers is often seen as an emotionally charged situation for children as they may get involved in conflicts and negotiations. In contrast, other emergent literacy skills can be more dependent on teacher instruction and teacher-directed activities related to the quality of the literacy experiences provided (Bohlmann & Downer, 2016). It is then possible that children's emotional self-regulation is associated with their expressive vocabulary skills through their broad range of experiences in preschool. Children who approach challenges with a positive spirit, overcoming frustration and dealing with negative emotions in a more adaptive way, may get the most out of conversations, discussions, and exchanges of opinions and ideas and may be able to further develop their expressive vocabulary. Further research is needed, however, to confirm this.

### Syntactic knowledge

The syntactic knowledge skills of the participating children were found to be related with their behavioral self-regulation, which supports our initial hypothesis and confirms the findings of Lonigan et al. (2017). As expected, emotional self-regulation was found not to be associated with the syntactic knowledge skill. As syntactic knowledge refers to children's understanding of basic language rules, it seems to rely mostly on skills such as inhibitory control, attentional/cognitive flexibility, and working memory, as suggested by previous studies (Fuhs et al., 2014; Verhagen & Leseman, 2016). It is also possible that, as previously suggested, learning opportunities for the acquisition of syntactic knowledge are more emotionally neutral and are not much related with informal preschool opportunities where strong emotions can arise, such as peer play.

### Oral-narrative production

In addition, as expected, the children's emotional self-regulation was found not to be associated with their oral-narrative production, but neither were their behavioral self-regulation, contrary to our initial hypothesis and the previous studies' conclusions (Dealy et al., 2019; Friend & Bates, 2014). However, interestingly, this association became significant for the boys but not for the girls when sex was analyzed as a moderator, indicating that child sex has an important role to play in this mechanism, as will be further discussed later. This can relate to the case where mechanisms other than behavioral self-regulation influence oral-narrative production, such as parental and teacher warmth, sensitivity, and investment in stimulating children's cognition (e.g., Lugo-Gil & Tamis-LeMonda, 2008). Additionally, producing oral narratives requires the integration of several higher-level language and cognitive skills, and it is possible that children's exposure to literacy environments and proficiency in other language skills influence their oral-narrative production skills more than their self-regulation skills do. Moreover, it should be noted that although studies have reported an association between behavioral self-regulation and oral-narrative production skills, Dealy et al. (2019) reported a full mediation, which included direct and indirect paths from behavioral self-regulation to the oral-narrative production skill. Thus, behavioral self-regulation of the children in the study by Dealy et al. (2019) at age 4 was associated with the same skill at age 6, which in turn were linked to their concurrent oral-narrative production skills. Due to our study design, however, it was not possible for us to test this as a hypothesis. However, there is a possibility that a similar indirect effect applies to the current sample. The current study's findings, along with those of the few previous studies that examined the contributions of behavioral self-regulation to the oral-narrative production skill, underline the importance of conducting further

research to examine more in-depth which mechanisms influence children's development of oral-narrative production skills.

### Contributions of behavioral and emotional self-regulation to early social skills

Partially supporting our second hypothesis is the finding that behavioral self-regulation seems to support children's efficient problem solving, but an association between emotional self-regulation and social problem-solving skills was found only in the girls. Interestingly, Denham, Bassett, Way, et al. (2014) found that children's behavioral self-regulation has a stronger association with their social problem-solving skills compared to their emotional self-regulation, despite the fact that both showed significant links with children's social problem-solving skills. In another study, it was reported that children's behavioral self-regulation has an important indirect influence, on top of a direct influence, on their social problem-solving skills through their emotional self-regulation (Denham, Bassett, Zinsser, et al., 2014). As proposed by Denham, Bassett, Way, et al. (2014), children's attention, working memory, and ability to inhibit inadequate responses can be of paramount importance for their responses to the CST task by preventing them from choosing a prepotent behavioral response (e.g., hitting) and instead making them select a more adaptive one (e.g., inviting the peer to play), which requires that they not lose sight of the ultimate prosocial goal of maintaining a positive relationship with their peers and thus calls for working memory and attention shifting skills.

It was also expected that emotional self-regulation had an important role to play in children's social problem solving because the CST task also requires children to acknowledge how they would feel in a situation where they were involved in a conflict with their peers. However, our initial hypothesis was confirmed only for the girls. It is possible that the participating children's emotional responses to the CST were driven exclusively by their behavioral self-regulation skills, such as their ability to choose an emotion that they know is considered socially acceptable (sad) instead of an automatic prepotent emotional response (angry). Preschool teachers often conduct activities with their pupils to model the adequate, positive, and expected behavioral and emotional responses to challenging situations and to thus enhance their social skills (OECD, 2019). The teachers also model the same during the daily situations that arise in the preschool setting while children interact with each other (OECD, 2019). Perhaps the children who participated in this study engaged in the CST task similarly to how they engage in the same tasks and situations when their teachers try to address their need to develop social skills. Thus, the children could have approached the CST task primarily cognitively and could not have felt emotionally triggered by the dilemmas presented.

### Sex-differentiated paths

Similar to the previous studies involving Portuguese preschoolers, in the current study, overall, no significant differences were found between the girls' and the boys' mean behavioral self-regulation levels (Cadima et al., 2019), and the girls showed less labile/negative emotional behaviors than the boys (Cadima et al., 2016). Additionally, the results of the current study are aligned with those of the previous studies that suggested that behavioral self-regulation is related to the emergent literacy skills for both boys and girls (e.g., Montroy et al., 2014; Slot & von Suchodoletz, 2018). This finding adds to those of the previous studies conducted in Portugal by indicating that not only behavioral self-regulation appears to be similar for girls and boys, but also its importance for school readiness skills seems to be mostly identical. Although the aforementioned findings confirmed our initial hypothesis of the absence of sex-differentiated paths in the association between behavioral self-regulation and emergent literacy skills, two exceptions should be mentioned.

First, the boys with more advanced behavioral self-regulation skills were able to produce better oral narratives, which was not true for the girls. This finding is consistent with that of the previous studies that early reading varies as a function of behavioral self-regulation for boys but not for girls (Son et al., 2013). Compared to girls, boys seem to rely more heavily on skills related to behavioral self-regulation (e.g., working memory, inhibitory control, and attentional/cognitive flexibility skills) to produce oral narratives. As previously speculated (Son et al., 2013), one possible explanation for this is that boys tend to have greater difficulty applying positive learning approaches in preschool (Buek, 2019; Ready et al., 2005). This means that boys may be less self-reliant, independent, flexible, and organized, which may reflect negatively on their classroom skills, making it more difficult for them to take full advantage of the classroom resources and to use effective strategies of carrying out

classroom tasks (Buek, 2019; Ready et al., 2005). To compensate for their greater difficulties, boys can rely more explicitly and deliberately on their behavioral self-regulation skills when asked to produce more complex oral narratives (Son et al., 2013). Girls, on the other hand, have been found to have more positive attitudes toward and approaches to learning and thus may be more motivated to perform the task of oral-narrative production, relying less on skills related to that of behavioral self-regulation to produce complex oral narratives. Additionally, it is possible that girls lean on skills other than that of behavioral self-regulation to produce oral narratives, such as expressive language, meta-representational, and perspective-taking skills and the skill of acquiring general knowledge of an archetypal story structure (Curenton & Justice, 2004; Schick & Melzi, 2010). However, more studies are needed to confirm this.

Additionally, and in agreement with our initial hypothesis, sex moderated the association between the children's emotional self-regulation and early social skills (Denham et al., 2003). Specifically, the girls with greater difficulties regulating their emotions and thus showing more lability/negativity according to their teachers were more likely to choose angry-aggressive solutions to the presented social problems involving peer altercations. Additionally, a closer look at our descriptive statistics will lead to the conclusion that the teachers rated the boys as having more lability/negativity than the girls, and the boys were also more likely to choose angry-aggressive solutions to the social problems presented in the CST task. These results point to the possibility that girls who are more labile/negative and thus less capable of regulating their emotions may be particularly vulnerable and may have a greater risk of developing less adaptive social responses than boys. It is possible that boys' exhibitions of angry-aggressive patterns of response to social problems are less directly related to their emotional self-regulation skills and more closely related to a myriad of social skills. For instance, it has been suggested that boys who have developed high-quality friendships marked by positive affect and intimacy in preschool have more advanced social skills in elementary school, which is not the case for girls (Engle et al., 2011). However, as one of our objectives in this study was to determine the contributions of behavioral and emotional self-regulation to boys' and girls' early social skills, further studies are needed to further validate the aforementioned claim.

### Limitations, strengths, and future research

This study was not without limitations. First, our sample could not have been representative of all Portuguese preschoolers as it was a fairly disadvantaged sample. Second, although the models that we used included a set of important covariates, it was not possible to control for children's previously acquired social skills. Third, the internal consistency of the CST scales was low according to conventional standards. The Cronbach's alpha values reported in the current study are consistent with those reported by Denham et al. (2012) and can be assigned to the low number of items per scale. At the same time, inter-item correlations were also similar to those reported by Denham et al. (2012) and are considered acceptable according to recent guidelines (Clark & Watson, 2019). Thus, although further studies are needed to study the internal consistency of the CST, the current study provides further evidence that the CST can be an interesting measure to assess children's emotion and behavior responses to challenging situations. Fourth, the children's emotional self-regulation skills were measured only through the teachers' reports while the children's behavioral self-regulation skills were individually assessed. Several studies (e.g., Allan et al., 2018) have shown that different informants give unique perspectives on children's skills as these are based on children's behavior across multiple contexts. Thus, despite the good psychometric qualities of ERC, it will be good for future studies to combine teacher reports on children's emotional self-regulation skills with individual assessments and with other informants' (e.g., parents) views. Fifth, it should be kept in mind that no strict causality links can be drawn from our findings. Other important processes not considered in the current study could have had an important role in shaping the associations under study. Moreover, further studies should explore the reciprocal interplay between behavioral and emotional self-regulation and school readiness skills, given prior results indicating important nuances in the bidirectional associations between them (e.g., ten Braak et al., 2019).

Despite these limitations, several strengths of the study are worth mentioning. The study's major strength was that its results contribute to more in-depth knowledge about the underpinnings of understudied important emergent literacy and early social skills: syntactic knowledge, oral-narrative production, and social problem-solving skills. Indeed, it has been argued that to prepare children for primary school, a broad and comprehensive set of skills that can be

targeted from an early age in the preschool setting must be considered (Lonigan et al., 2015). Nonetheless, more longitudinal studies are needed to provide more insights on which other cognitive and social skills may act as important precursors of later school success.

The second strength of the current study was that it disentangled two important components of self-regulation, namely the behavioral and emotional components (McClelland & Cameron, 2012), and used ecologically valid and reliable measures of emergent literacy and early social skills (e.g., Denham, 2006). Several studies (e.g., Wanless et al., 2013) have noted important nuances in child outcomes depending on how the predictors were measured; thus, it may be interesting to conduct studies observing children's emotional self-regulation skills in the classroom setting to complement the teacher reports. Finally, our findings add to a body of research focusing on the role of child-level variables in child development by analyzing sex-differentiated paths, highlighting important nuances that should be acknowledged and properly addressed, particularly regarding the oral-narrative production and social problem-solving skills.

## Implications and conclusion

The preschool years are of critical importance for children's future development and learning, making the early years a golden period for targeting key skills such as that of self-regulation, which can trigger a positive developmental cascade (Zelazo & Carlson, 2012). A recent review indicated that targeting children's self-regulation skills improved their outcomes, such as the possession of varied approaches to learning, improved language, and prosocial behavior, highlighting the usefulness of targeting self-regulation as means to also improve other key developmental skills (Murray et al., 2015).

The results of the current study are valuable for the planning of early interventions for developing preschool children's self-regulation skills. Specifically, the study's results open an avenue for designing interventions for developing children's behavioral self-regulation skills to enhance their problem-solving skills, expressive vocabulary, syntactic knowledge, and oral narrative production, although this latter may be especially relevant for young boys. Alongside, it seems important to target emotional self-regulation to promote expressive vocabulary and enhance problem-solving skill strategies, especially for particularly labile and negative young girls. Our findings also add to the current efforts to improve school readiness by suggesting the usefulness of interventions for developing both domains of self-regulation of children, which can boost children's outcomes across a wider range of social and cognitive skill domains.

The current study contributed to the relevant literature by determining and providing important insights on how behavioral and emotional self-regulation uniquely contribute to key but understudied emergent literacy skills (i.e. the syntactic knowledge and oral-narrative production skills). Moreover, this study also examined children's problem-solving skill, an important but understudied social skill among preschool-aged children. In sum, the current study points to the importance of disentangling the contributions of behavioral and emotional self-regulation to key, but understudied, emergent literacy and early social skills.

## Funding

This work was supported by the FCT under Grants SFRH/BD/138821/2018 and PTDC/MHC-CED/5218/2012, and by the Center for Psychology at the University of Porto, Portuguese Science Foundation (FCT UIDB/00050/2020).

## ORCID

Carolina Guedes http://orcid.org/0000-0001-7415-019X
Tiago Ferreira http://orcid.org/0000-0002-2884-2547
Teresa Leal http://orcid.org/0000-0002-9056-3266
Joana Cadima http://orcid.org/0000-0002-8814-8899

## Data availability statement

The data supporting the findings of this study may be obtained from the corresponding author (J. Cadima) upon reasonable request.

## References

Allan, D. M., Allan, N. P., Lonigan, C. J., Hume, L. E., Farrington, A. L., & Vinco, M. H. (2018). The influences of multiple informants' ratings of inattention on preschoolers' emergent literacy skills growth. *Learning and Individual Differences*, *65*, 90–99. https://doi.org/10.1016/j.lindif.2018.05.014

Allan, N. P., Hume, L. E., Allan, D. M., Farrington, A. L., & Lonigan, C. J. (2014). Relations between inhibitory control and the development of academic skills in preschool and kindergarten: A meta-analysis. *Developmental Psychology*, *50*(10), 2368–2379. https://doi.org/10.1037/a0037493

Backer-Grøndahl, A., Naerde, A., & Idsoe, T. (2019). Hot and cool self-regulation, academic competence, and maladjustment: Mediating and differential relations. *Child*

*Development*, *90*(6), 2171–2188. https://doi.org/10.1111/cdev.13104

Bailey, R., & Jones, S. M. (2019). An integrated model of regulation for applied settings. *Clinical Child and Family Psychology Review*, *22*(1), 2–23. https://doi.org/10.1007/s10567-019-00288-y

Blair, C., & Raver, C. C. (2015). School readiness and self-regulation: A developmental psychobiological approach. *Annual Review of Psychology*, *66*, 711–731. https://doi.org/10.1146/annurev-psych-010814-015221

Bodrova, E., & Leong, D. J. (2006). Self-regulation as a key to school readiness: How early childhood teachers can promote this critical competency. In M. Zaslow & I. Martinez-Beck (Eds.), *Critical issues in early childhood professional development* (pp. 203–224). Paul H. Brookes Publising Co.

Bohlmann, N. L., & Downer, J. T. (2016). Self-regulation and task engagement as predictors of emergent language and literacy skills. *Early Education and Development*, *27*(1), 18–37. https://doi.org/10.1080/10409289.2015.1046784

Brimo, D., Lund, E., & Sapp, A. (2018). Syntax and reading comprehension: A meta-analysis of different spoken-syntax assessments. *International Journal of Language & Communication Disorders*, *53*(3), 431–445. https://doi.org/10.1111/1460-6984.12362

Buek, K. W. (2019). Early growth trajectories of children's approaches to learning: The contribution of parent and family characteristics. *Psychology in the Schools*, *56*(6), 1053–1072. https://doi.org/10.1002/pits.22224

Cadima, J., Barros, S., Ferreira, T., Serra-Lemos, M., Leal, T., & Verschueren, K. (2019). Bidirectional associations between vocabulary and self-regulation in preschool and their interplay with teacher–child closeness and autonomy support. *Early Childhood Research Quarterly*, *46*, 75–86. https://doi.org/10.1016/j.ecresq.2018.04.004

Cadima, J., Ferreira, T., Guedes, C., Vieira, J., Leal, T., & Matos, P. M. (2016). Risco e regulação emocional em idade pré-escolar: A qualidade das interações dos educadores de infância como potencial moderador. *Análise Psicológica*, *34*(3), 235–248. https://doi.org/10.14417/ap.1079

Cadima, J., Gamelas, A. M., McClelland, M., & Peixoto, C. (2015). Associations between early family risk, children's behavioral regulation, and academic achievement in Portugal. *Early Education and Development*, *26*(5-6), 708–728. https://doi.org/10.1080/10409289.2015.1005729

Chen, F. F. (2007). Sensitivity of goodness of fit indexes to lack of measurement invariance. *Structural Equation Modeling: A Multidisciplinary Journal*, *14*(3), 464–504. https://doi.org/10.1080/10705510701301834

Clark, L. A., & Watson, D. (2019). Constructing validity: New developments in creating objective measuring instruments. *Psychological Assessment*, *31*(12), 1412–1427. https://doi.org/10.1037/pas0000626

Curenton, S. M., & Justice, L. M. (2004). African american and caucasian preschoolers' use of decontextualized language. *Language, Speech, and Hearing Services in Schools*, *35*(3), 240–253. https://doi.org/10.1044/0161-1461(2004/023)

Dealy, J., Mudrick, H., & Robinson, J. (2019). Children's narrative story stem responses: Contributions of executive functioning and language proficiency to relationship representations. *Social Development*, *28*(1), 168–185. https://doi.org/10.1111/sode.12335

Denham, S. A. (2006). Social-emotional competence as support for school readiness: What is it and how do we assess it? *Early Education & Development*, *17*(1), 57–89. https://doi.org/10.1207/s15566935eed1701_4

Denham, S. A., & Bassett, H. H. (2020). You hit me! That's not nice and it makes me sad!!': Relations of young children's social information processing and early school success. *Early Child Development and Care*, *190*(6), 791–805. https://doi.org/10.1080/03004430.2018.1491562

Denham, S. A., Bassett, H., Mincic, M., Kalb, S., Way, E., Wyatt, T., & Segal, Y. (2012). Social-emotional learning profiles of preschoolers' early school success: A person-centered approach. *Learning and Individual Differences*, *22*(2), 178–189. https://doi.org/10.1016/j.lindif.2011.05.001

Denham, S. A., Bassett, H. H., Way, E., Kalb, S., Warren-Khot, H., & Zinsser, K. (2014). "How would you feel? What would you do?" Development and underpinnings of preschoolers' social information processing?" *Journal of Research in Childhood Education: JRCE*, *28*(2), 182–202. https://doi.org/10.1080/02568543.2014.883558

Denham, S. A., Bassett, H. H., Zinsser, K., & Wyatt, T. M. (2014). How preschoolers' social-emotional learning predicts their early school success: Developing theory-promoting, competency-based assessments. *Infant and Child Development*, *23*(4), 426–454. https://doi.org/10.1002/icd.1840

Denham, S. A., Blair, K. A., DeMulder, E., Levitas, J., Sawyer, K., Auerbach-Major, S., & Queenan, P. (2003). Preschool emotional competence: Pathway to social competence? *Child Development*, *74*(1), 238–256. https://doi.org/10.1111/1467-8624.00533

Denham, S. A., Zoller, D., & Couchoud, E. A. (1994). Socialization of preschoolers' emotion understanding. *Developmental Psychology*, *30*(6), 928–936. https://doi.org/10.1037/0012-1649.30.6.928

Di Norcia, A., Pecora, G., Bombi, A. S., Baumgartner, E., & Laghi, F. (2015). Hot and cool inhibitory control in italian toddlers: Associations with social competence and behavioral problems. *Journal of Child and Family Studies*, *24*(4), 909–914. https://doi.org/10.1007/s10826-014-9901-z

Dickinson, D. K., & Snow, C. E. (1987). Interrelationships among prereading and oral language skills in kindergartners from two social classes. *Early Childhood Research Quarterly*, *2*(1), 1–25. https://doi.org/10.1016/0885-2006(87)90010-X

Duncan, G. J., Dowsett, C. J., Claessens, A., Magnuson, K., Huston, A. C., Klebanov, P., Pagani, L. S., Feinstein, L., Engel, M., Brooks-Gunn, J., Sexton, H., Duckworth, K., & Japel, C. (2007). School readiness and later achievement. *Developmental Psychology*, *43*(6), 1428–1446. https://doi.org/10.1037/0012-1649.43.6.1428

Dunn, L. M. (1986). *Test de vocabulario en imagénes Peabody: Adaptación española [Peabody picture vocabulary test: Spanish version] (S. Pereda, Trans.)*. MEPSA.

Edossa, A. K., Schroeders, U., Weinert, S., & Artelt, C. (2018). The development of emotional and behavioral self-regulation and their effects on academic achievement in childhood. *International Journal of Behavioral*

*Development*, *42*(2), 192–202. https://doi.org/10.1177/0165025416687412

Enders, C., & Bandalos, D. (2001). The relative performance of full information maximum likelihood estimation for missing data in structural equation models. *Structural Equation Modeling: A Multidisciplinary Journal*, *8*(3), 430–457. https://doi.org/10.1207/S15328007SEM0803_5

Engel, S. (2012). *The stories children tell: Making sense of the narratives of childhood*. Henry Holt and Co.

Engle, J. M., McElwain, N. L., & Lasky, N. (2011). Presence and quality of kindergarten children's friendships: Concurrent and longitudinal associations with child adjustment in the early school years. *Infant and Child Development*, *20*(4), 365–386. https://doi.org/10.1002/icd.706

European Commission/EACEA/Eurydice. (2019). *Key Data on Early Childhood Education and Care in Europe* – 2019 Edition. Eurydice Report. Publications Office of the European Union.

Friend, M., & Bates, R. P. (2014). The union of narrative and executive function: Different but complementary. *Frontiers in Psychology*, *5*, 469. https://doi.org/10.3389/fpsyg.2014.00469

Fuhs, M. W., Farran, D. C., & Nesbitt, K. T. (2013). Preschool classroom processes as predictors of children's cognitive self-regulation skills development. *School Psychology Quarterly*, *28*(4), 347–359. https://doi.org/10.1037/spq0000031

Fuhs, M. W., Nesbitt, K. T., Farran, D. C., & Dong, N. (2014). Longitudinal associations between executive functioning and academic skills across content areas. *Developmental Psychology*, *50*(6), 1698–1709. https://doi.org/10.1037/a0036633

Fung, W-k., Chung, K. K-h., & Cheng, R. W-y. (2019). Gender differences in social mastery motivation and its relationships to vocabulary knowledge, behavioral self-regulation, and socioemotional skills. *Early Education and Development*, *30*(2), 280–293. https://doi.org/10.1080/10409289.2018.1544004

Gestsdottir, S., von Suchodoletz, A., Wanless, S. B., Hubert, B., Guimard, P., Birgisdottir, F., Gunzenhauser, C., & McClelland, M. (2014). Early behavioral self-regulation, academic achievement, and gender: Longitudinal findings from France, Germany, and Iceland. *Applied Developmental Science*, *18*(2), 90–109. https://doi.org/10.1080/10888691.2014.894870

Graziano, P. A., Reavis, R. D., Keane, S. P., & Calkins, S. D. (2007). The role of emotion regulation and Children's Early Academic Success. *Journal of School Psychology*, *45*(1), 3–19. https://doi.org/10.1016/j.jsp.2006.09.002

Harrington, E. M., Trevino, S. D., Lopez, S., & Giuliani, N. R. (2020). Emotion regulation in early childhood: Implications for socioemotional and academic components of school readiness. *Emotion (Washington, D.C.)*, *20*(1), 48–53. https://doi.org/10.1037/emo0000667

Howse, R. B., Calkins, S. D., Anastopoulos, A. D., Keane, S. P., & Shelton, T. L. (2003). Regulatory contributors to children's kindergarten achievement. *Early Education and Development*, *14*(1), 101–119. https://doi.org/10.1207/s15566935eed1401_7

Jones, S. M., Bailey, R., Barnes, S. P., & Partee, A. (2016). *Executive function mapping project: Untangling the terms and skills related to executive function and self- regulation in early childhood (OPRE Report # 2016–88)*. Washington DC: Office of Planning, Research and Evaluation, Administration for Children and Families, U.S. Department of Health and Human Services.

Kim, S., Nordling, J. K., Yoon, J. E., Boldt, L. J., & Kochanska, G. (2013). Effortful control in "hot" and "cool" tasks differentially predicts children's behavior problems and academic performance. *Journal of Abnormal Child Psychology*, *41*(1), 43–56. https://doi.org/10.1007/s10802-012-9661-4

Korucu, I., Selcuk, B., & Harma, M. (2017). Self-regulation: Relations with theory of mind and social behaviour. *Infant and Child Development*, *26*(3), e1988. https://doi.org/10.1002/icd.1988

Lonigan, C. J., Allan, D. M., & Phillips, B. M. (2017). Examining the predictive relations between two aspects of self-regulation and growth in preschool children's early literacy skills. *Developmental Psychology*, *53*(1), 63–76. https://doi.org/10.1037/dev0000247

Lonigan, C. J., Phillips, B. M., Clancy, J. L., Landry, S. H., Swank, P. R., Assel, M., Taylor, H. B., Klein, A., Starkey, P., Domitrovich, C. E., Eisenberg, N., de Villiers, J., de Villiers, P., & Barnes, M., School Readiness Consortium. (2015). Impacts of a comprehensive school readiness curriculum for preschool children at risk for educational difficulties. *Child Development*, *86*(6), 1773–1793. https://doi.org/10.1111/cdev.12460

Lonigan, C. J., Schatschneider, C., & Westberg,., National Early Literacy Panel. (2008). Identification of children's skills and abilities linked to later outcomes in reading, writing, and spelling. In *Developing early literacy: Report of the National Early Literacy Panel* (pp. 55–106). National Institute for Literacy.

Lugo-Gil, J., & Tamis-LeMonda, C. S. (2008). Family resources and parenting quality: Links to children's cognitive development across the first 3 years. *Child Development*, *79*(4), 1065–1085. https://doi.org/10.1111/j.1467-8624.2008.01176.x

Matthews, J. S., Ponitz, C. C., & Morrison, F. J. (2009). Early gender differences in self-regulation and academic achievement. *Journal of Educational Psychology*, *101*(3), 689–704. https://doi.org/10.1037/a0014240

McClelland, M. M., & Cameron, C. E. (2012). Self-regulation in early childhood: Improving conceptual clarity and developing ecologically valid measures. *Child Development Perspectives*, *6*(2), 136–142. https://doi.org/10.1111/j.1750-8606.2011.00191.x

McClelland, M. M., Cameron, C. E., Duncan, R., Bowles, R. P., Acock, A. C., Miao, A., & Pratt, M. E. (2014). Predictors of early growth in academic achievement: The head-toes-knees-shoulders task. *Frontiers in Psychology*, *5*, 599. https://doi.org/10.3389/fpsyg.2014.00599

McClelland, M. M., Ponitz, C. C., Messersmith, E. E., & Tominey, S. (2010). Self-regulation: Integration of cognition and emotion. In W. F. Overton & R. M. Lerner (Eds.), *The handbook of life-span development* (Vol. 1, pp. 509–553). Wiley.

Melo, A. I. (2005). *Emoções no período escolar: Estratégias parentais face à expressão emocional e sintomas de internalização e externalização da criança* [Master, University of Minho].

Montroy, J. J., Bowles, R. P., Skibbe, L. E., & Foster, T. D. (2014). Social skills and problem behaviors as mediators of the relationship between behavioral self-regulation and academic achievement. *Early Childhood Research Quarterly*, *29*(3), 298–309. https://doi.org/10.1016/j.ecresq.2014.03.002

Murray, D. W., Rosanbalm, K., Christopoulos, C., & Hamoudi, A. (2015). *Self-regulation and toxic stress: Foundations for understanding self-regulation from an applied developmental perspective* (OPRE Report #2015-21). Office of Planning, Research and Evaluation, Administration for Children and Families, U.S. Department of Health and Human Services. https://www.acf.hhs.gov/opre/resource/self-regulation-and-toxic-stress-foundations-for-understanding-self-regulation-from-an-applied-developmental-perspective

Muthén, L. K., & Muthén, B. O. (1998–2012). *Mplus user's guide* (7th ed.). Muthén & Muthén.

NICHD Early Childhood Research Network. (2005). Pathways to reading: The role of oral language in the transition to reading. *Developmental Psychology*, *41*(2), 428–442. https://doi.org/10.1037/0012-1649.41.2.428

O'Toole, S. E., Monks, C. P., Tsermentseli, S., & Rix, K. (2020). The contribution of cool and hot executive function to academic achievement, learning-related behaviours, and classroom behaviour. *Early Child Development and Care*, *190*(6), 806–821. https://doi.org/10.1080/03004430.2018.1494595

OECD. (2019). TALIS Starting Strong (2018). Technical Report. OECD Publishing.

Payton, J. W., Wardlaw, D. M., Graczyk, P. A., Bloodworth, M. R., Tompsett, C. J., & Weissberg, R. P. (2000). Social and emotional learning: A framework for promoting mental health and reducing risk behavior in children and youth. *Journal of School Health*, *70*(5), 179–185. https://doi.org/10.1111/j.1746-1561.2000.tb06468.x

Ponitz, C. C., McClelland, M. M., Matthews, J. S., & Morrison, F. J. (2009). A structured observation of behavioral self-regulation and its contribution to kindergarten outcomes. *Developmental Psychology*, *45*(3), 605–619. https://doi.org/10.1037/a0015365

Ready, D. D., LoGerfo, L. F., Burkam, D. T., & Lee, V. E. (2005). Explaining girls' advantage in kindergarten literacy learning: Do classroom behaviors make a difference? *The Elementary School Journal*, *106*(1), 21–38. https://doi.org/10.1086/496905

Robson, D. A., Allen, M. S., & Howard, S. J. (2020). Self-regulation in childhood as a predictor of future outcomes: A meta-analytic review. *Psychological Bulletin*, *146*(4), 324–354. https://doi.org/10.1037/bul0000227

Roth, F. P., Speece, D. L., & Cooper, D. H. (2002). A longitudinal analysis of the connection between oral language and early reading. *The Journal of Educational Research*, *95*(5), 259–272. https://doi.org/10.1080/00220670209596600

Satorra, A., & Bentler, P. M. (2010). Ensuring positiveness of the scaled difference chi-square test statistic. *Psychometrika*, *75*(2), 243–248. https://doi.org/10.1007/s11336-009-9135-y

Schick, A., & Melzi, G. (2010). The development of children's oral narratives across contexts. *Early Education & Development*, *21*(3), 293–317. https://doi.org/10.1080/10409281003680578

Sektnan, M., McClelland, M. M., Acock, A., & Morrison, F. J. (2010). Relations between early family risk, children's behavioral regulation, and academic achievement. *Early Childhood Research Quarterly*, *25*(4), 464–479. https://doi.org/10.1016/j.ecresq.2010.02.005

Shields, A., & Cicchetti, D. (1997). Emotion regulation among school-age children: The development and validation of a new criterion Q-sort scale. *Developmental Psychology*, *33*(6), 906–916. https://doi.org/10.1037/0012-1649.33.6.906

Sim-Sim, I. (2014). *Avaliação da linguagem oral: Um contributo para o conhecimento do desenvolvimento linguístico das crianças portuguesas [Oral language assessment: contributing to kowledge about portuguese children linguistic development]*. Fundação Calouste Gulbenkian.

Slot, P. L., & von Suchodoletz, A. (2018). Bidirectionality in preschool children's executive functions and language skills: Is one developing skill the better predictor of the other? *Early Childhood Research Quarterly*, *42*, 205–214. https://doi.org/10.1016/j.ecresq.2017.10.005

Son, S.-H., Lee, K., & Sung, M. (2013). Links between preschoolers' behavioral regulation and school readiness skills: The role of child gender. *Early Education & Development*, *24*(4), 468–490. https://doi.org/10.1080/10409289.2012.675548

Storch, S. A., & Whitehurst, G. J. (2002). Oral language and code-related precursors to reading: Evidence from a longitudinal structural model. *Developmental Psychology*, *38*(6), 934–947. https://doi.org/10.1037/0012-1649.38.6.934

Suggate, S., Schaughency, E., McAnally, H., & Reese, E. (2018). From infancy to adolescence: The longitudinal links between vocabulary, early literacy skills, oral narrative, and reading comprehension. *Cognitive Development*, *47*, 82–95. https://doi.org/10.1016/j.cogdev.2018.04.005

ten Braak, D., Størksen, I., Idsoe, T., & McClelland, M. (2019). Bidirectionality in self-regulation and academic skills in play-based early childhood education. *Journal of Applied Developmental Psychology*, *65*, 101064. https://doi.org/10.1016/j.appdev.2019.101064

Ursache, A., Blair, C., & Raver, C. C. (2012). The promotion of self-regulation as a means of enhancing school readiness and early achievement in children at risk for school failure. *Child Development Perspectives*, *6*(2), 122–128. https://doi.org/10.1111/j.1750-8606.2011.00209.x

Verhagen, J., & Leseman, P. (2016). How do verbal short-term memory and working memory relate to the acquisition of vocabulary and grammar? A comparison between first and second language learners. *Journal of Experimental Child Psychology*, *141*, 65–82. https://doi.org/10.1016/j.jecp.2015.06.015

von Suchodoletz, A., Gestsdottir, S., Wanless, S. B., McClelland, M. M., Birgisdottir, F., Gunzenhauser, C., & Ragnarsdottir, H. (2013). Behavioral self-regulation and relations to emergent academic skills among children in Germany and Iceland. *Early Childhood Research Quarterly*, *28*(1), 62–73. https://doi.org/10.1016/j.ecresq.2012.05.003

Wanless, S. B., McClelland, M. M., Acock, A. C., Ponitz, C. C., Son, S.-H., Lan, X., Morrison, F. J., Chen, J.-L.,

Chen, F.-M., Lee, K., Sung, M., & Li, S. (2011). Measuring behavioral regulation in four societies. *Psychological Assessment*, *23*(2), 364–378. https://doi.org/10.1037/a0021768

Wanless, S. B., McClelland, M. M., Lan, X., Son, S.-H., Cameron, C. E., Morrison, F. J., Chen, F.-M., Chen, J.-L., Li, S., Lee, K., & Sung, M. (2013). Gender differences in behavioral regulation in four societies: The United States, Taiwan, South Korea, and China. *Early Childhood Research Quarterly*, *28*(3), 621–633. https://doi.org/10.1016/j.ecresq.2013.04.002

Wechsler, D. (2003). *Escala de inteligência de Wechsler para a idade pré-escolar eprimária (edição revista) [Wechsler preschool and primary intelligence scale forchildren-revised version]*. Cegoc, Investigação e PublicaçõesPsicológicas.

Wechsler, D. (2010). *Escala de inteligência de wechsler para a idade pré-escolar eprimária: Adaptação portuguesa [Wechsler preschool and primary scale ofintelligence: Portuguese adaptation]*. Cegoc, Investigação ePublicações Psicológicas.

Whitehurst, G. J., & Lonigan, C. J. (1998). Child development and emergent literacy. *Child Development*, *69*(3), 848–872. https://doi.org/10.1111/j.1467-8624.1998.tb06247.x

Williams, R. L. (2000). A note on robust variance estimation for cluster-correlated data. *Biometrics*, *56*(2), 645–646. https://doi.org/10.1111/j.0006-341x.2000.00645.x

Willoughby, M., Kupersmidt, J., Voegler-Lee, M., & Bryant, D. (2011). Contributions of hot and cool self-regulation to preschool disruptive behavior and academic achievement. *Developmental Neuropsychology*, *36*(2), 162–180. https://doi.org/10.1080/87565641.2010.549980

Zelazo, P. D., & Carlson, S. M. (2012). Hot and cool executive function in childhood and adolescence: Development and plasticity. *Child Development Perspectives,* *6*(4), 354–360. https://doi.org/10.1111/j.1750-8606.2012.00246.x

Zelazo, P. D., & Müller, U. (2011). Executive function in typical and atypical development. In U. Goswami (Ed.), *Handbook of childhood cognitive development* (pp. 574–603). Wiley-Blackwell.