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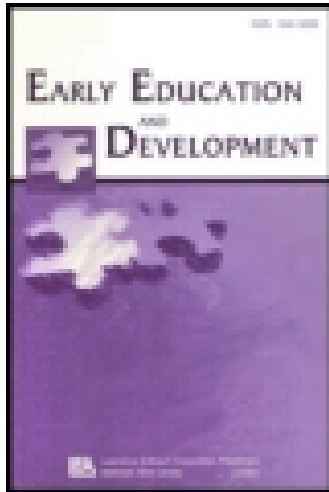
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# Associations Between Early Family Risk, Children's Behavioral Regulation, and Academic Achievement in Portugal

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*Research Findings:* This study examined concurrent associations between family sociodemographic risk, self-regulation, and early literacy and mathematics in young children from Azores, Portugal ( $N = 186$ ). Family sociodemographic risk was indexed by low maternal education, low family income, and low occupational status. Behavioral aspects of self-regulation were assessed using a direct measure called the Head–Toes–Knees–Shoulders task. Results of structural equation modeling revealed that family sociodemographic risk had significant negative effects on behavioral regulation and academic achievement. Behavioral regulation was positively associated with academic achievement when we adjusted for the influence of family sociodemographic risk and child verbal IQ. Furthermore, behavioral regulation mediated the association between family sociodemographic risk and mathematics achievement. *Practice or Policy:* The results suggest the detrimental effect of family socioeconomic risk in Portugal and the potential importance of behavioral regulation for school success for Portuguese children.

In many Western societies, large numbers of young children move from early child care settings into increasingly structured schooling environments. As they make this transition, they are expected to demonstrate the ability to regulate their thoughts, feelings, and behavior in order to adjust to classroom demands and benefit from learning activities (Morrison, Cameron Ponitz, & McClelland, 2010). Self-regulation skills, such as maintaining focus on a task in the face of distractions, remembering instructions, inhibiting a dominant response, or regulating strong emotions, help children to respond to complex classroom settings in a deliberate, adaptive manner that helps predict positive outcomes (Blair, 2002; Cameron Ponitz, McClelland, Matthews, & Morrison, 2009; Morrison et al., 2010; Wanless, McClelland, Acock, et al., 2011). The

potential role of these skills for early school success is supported by international research showing that self-regulation uniquely predicts academic competence in early childhood (Blair & Razza, 2007; McClelland et al., 2007; von Suchodoletz et al., 2013; Wanless, McClelland, Acock, et al., 2011). Given this research, it seems critical to understand early contextual influences on self-regulation and academic achievement, particularly in cultural contexts in which research is still scarce. In this study, we examine concurrent associations between behavioral aspects of self-regulation, family sociodemographic risk, and early literacy and mathematics in a sample of young children in Azores, Portugal.

## SELF-REGULATION AND ITS IMPORTANCE FOR SCHOOL SUCCESS

Self-regulation has been defined as a broad, multidimensional construct that refers to children's deliberate attempts to modulate attention, thoughts, emotions, and behavior in response to a given situation (Liew, 2012; McClelland & Cameron Ponitz, 2012; McClelland, Cameron Ponitz, Messersmith, & Tominey, 2010; Olson & Sameroff, 2009). A growing literature indicates that aspects of self-regulation and related constructs, including effortful control, inhibition, executive functions, behavioral regulation, and emotion-related regulation, are associated with academic competence (Blair & Razza, 2007; McClelland et al., 2007; Valiente, Lemery-Chalfant, & Swanson, 2010). The current study focuses only on behavioral regulation as assessed with a widely utilized measure, the Head-Toes-Knees-Shoulders task (HTKS; McClelland et al., 2014). In this study, behavioral regulation is understood as the ability to integrate attention, working memory, and inhibitory control in the regulation of overt behavior (Cameron Ponitz et al., 2009; McClelland et al., 2007; Sektnan, McClelland, Acock, & Morrison, 2010; Wanless, McClelland, Acock, et al., 2011). This subset of skills is particularly important in the classroom setting, where children are often asked to shift attention and ignore irrelevant, distracting information (attention); remember instructions while responding (working memory); and stop inappropriate responses that could otherwise disrupt classroom activities (inhibitory control; McClelland et al., 2007; Wanless, McClelland, Acock, et al., 2011).

A large body of research now suggests that over and above the effects of important academic skills and demographic factors, behavioral regulation is associated with higher scores in language, mathematics, and literacy skills (Blair & Razza, 2007; Graziano, Reavis, Keane, & Calkins, 2007; Howse, Calkins, Anastopoulos, Keane, & Shelton, 2003; Liew, Chen, & Hughes, 2010; McClelland et al., 2007; Valiente et al., 2010). Findings of numerous studies show that behavioral regulation and related constructs correlate significantly with academic achievement in preschool and elementary school (Blair & Razza, 2007; Cameron Ponitz et al., 2009; McClelland et al., 2007). For example, Blair and Razza (2007) found that effortful control contributed to early mathematics and literacy skills in the United States. Similarly, Valiente et al. (2010) found that effortful control was positively related to achievement in kindergarten. In one study examining children's behavioral regulation skills using a direct measure (the HTKS) in Taiwan, South Korea, China, and the United States, results indicated that children with higher behavioral regulation scores were more likely to show higher early mathematics, vocabulary, and literacy skills after important demographic variables were controlled (Wanless, McClelland, Acock, et al., 2011). In another study conducted in the United States using the same direct measure, gains in behavioral regulation predicted gains in mathematics skills over the kindergarten

year (Cameron Ponitz et al., 2009). von Suchodoletz and colleagues (2013) also found positive associations among behavioral regulation and academic skills in Germany and Iceland. Together, these studies show the critical role of behavioral regulation on children's achievement.

In addition, these studies support the validity of the HTKS in several countries (von Suchodoletz et al., 2013; Wanless, McClelland, Acock, et al., 2011). The HTKS was designed to assess the integrative nature of behavioral regulation in an ecologically valid manner (Cameron Ponitz et al., 2009). This measure taps aspects of behavioral regulation similar to the behaviors required from children in the classroom context and was designed to be used in school settings (McClelland & Cameron Ponitz, 2012). The usefulness of a direct measure such as the HTKS can be even greater when one is assessing behavioral regulation in different sociocultural contexts. For instance, although teacher and parent reports can provide valid information on behavioral regulation, they can also be biased because they rely on expectations for children's behavior (von Suchodoletz et al., 2013; Wanless, McClelland, Acock, et al., 2011). Teacher and parent expectations can be particularly susceptible to cultural values and thus reflect culture-specific definitions for child behavior. For this reason, in this study, we used a direct measure, the HTKS, to examine relations between behavioral regulation and academic achievement in Portugal, taking into account important socioeconomic characteristics of children's families.

### SOCIOECONOMIC RISK, ACADEMIC ACHIEVEMENT, AND BEHAVIORAL REGULATION

Research has consistently pointed out the negative associations between socioeconomic risk and child development. Multiple family and social risk factors, including low income, low maternal education, and low occupational skills, have been shown to adversely predict children's achievement (Ackerman, Brown, & Izard, 2004; Burchinal, Roberts, Zeisel, Hennon, & Hooper, 2006; Lipina, Martelli, Vuelta, & Colombo, 2005; McLoyd, 1998). Although it has been less extensively examined, a number of studies also suggest the adverse effects of socioeconomic disadvantage on children's behavioral regulation skills (Evans & Rosenbaum, 2008; Lengua, Honorado, & Bush, 2007; Mezzacappa, 2004; Noble, Norman, & Farah, 2005; Wanless, McClelland, Tominey, & Acock, 2011). In one study examining the effects of socioeconomic status (using a composite of income, occupational status, and educational status), results suggested that socially disadvantaged children performed less proficiently in behavioral regulation than their more advantaged peers (Mezzacappa, 2004). Findings from another study showed that children from low-income families began prekindergarten with significantly lower behavioral regulation than their peers (Wanless, McClelland, Tominey, et al., 2011). Other research suggested that family socioeconomic risk, indexed by ethnic minority status, low maternal education, low family income, and high maternal depressive symptoms, had significant negative effects on both parent- and teacher-rated behavioral regulation in preschool and kindergarten (Sektnan et al., 2010).

To document family risk, researchers have used either a categorical approach or continuous scores of risk indicators (Burchinal, Roberts, Hooper, & Zeisel, 2000; National Institute of Child Health and Human Development Early Child Care Research Network [NICHD ECCRN], 2002; Sektnan et al., 2010). In the categorical approach, each risk indicator is dichotomized into two groups representing the presence or absence of risk (Gutman, Sameroff, & Cole, 2003).

Although this approach is useful, cutoffs may be arbitrary, and important variability is often discarded (NICHD ECCRN, 2002; Sektan et al., 2010). Thus, to avoid arbitrary cutoff points, we used continuous scores of three risk factors: maternal education level, family income, and low occupational status.

Several pathways have been investigated to explain links between sociodemographic risk and behavioral regulation, including how risk is related to adverse parenting and to children's stress levels (Evans & Kim, 2013; Sarsour et al., 2011). For example, parents with low education, income, and occupational status are more likely to have fewer resources and higher levels of distress (Blair & Raver, 2012; Evans & Kim, 2013). This can lead to lower parent warmth/responsiveness and less cognitive stimulating experiences for children (e.g., fewer educational materials and learning opportunities; Evans & Rosenbaum, 2008; Mistry, Benner, Biesanz, Clark, & Howes, 2010; Sarsour et al., 2011). Sociodemographic risk can also lead to higher stress levels in children, as indicated by higher levels of physiological dysregulation (Evans & Schamberg, 2009). Chronic stress in the form of chronic activation of the hypothalamic–pituitary–adrenal axis can result in downstream effects on cortical structures important for the development of behavioral regulation (Blair, 2010; Evans & Kim, 2013; Kiss, Fechete, Pop, & Susa, 2014).

In addition to there being pathways between sociodemographic risk and behavioral regulation in children, longitudinal research also suggests that behavioral regulation mediates relations between the family environment and children's achievement (Evans & Rosenbaum, 2008; NICHD ECCRN, 2003; Sektan et al., 2010). Evans and Rosenbaum (2008) found, for example, that family income during early childhood (age 2 to Grade 3) positively predicted behavioral regulation, which in turn was related to cognitive development in fifth graders. Sektan et al. (2010) also found that kindergarten behavioral regulation significantly mediated relations between family risk (e.g., low maternal education, and chronic poverty between birth and 54 months) and first-grade achievement. These longitudinal studies suggest that establishing the mediating role of behavioral regulation can be especially important for prevention efforts (Raver et al., 2011).

Research is relatively scarce outside of the United States, however. In particular, in order to contribute to a culturally sensitive understanding of the factors influencing child outcomes in different cultures, it is important to consider the broader social and cultural contexts that frame behavioral regulation and family characteristics. Most studies have been conducted in the United States, where ethnicity and language status are often intertwined with low levels of maternal education and family income. For example, it has been shown that in the United States African American children are disproportionately more likely to live in poverty than Caucasian children (DeNavas-Walt, Proctor, & Smith, 2011; Duncan, Brooks-Gunn, & Klebanov, 1994). In Portugal, however, the population is relatively homogeneous regarding ethnicity, language, and religion. Conducting studies in different sociocultural contexts can thus provide a clearer understanding of the respective roles of income, maternal education, and race or ethnicity on behavioral regulation.

## CONSIDERING SOCIOCULTURAL CONTEXTS: THE PORTUGUESE CONTEXT

Over the past few years, many countries have experienced high levels of income inequality (e.g., Organisation for Economic Co-operation and Development [OECD], 2013a). In addition,

as a result of the recent economic crisis that started in 2008 in Europe, poverty has increased considerably among children and youth (Council of Europe, 2014; Forster & Richardson, 2011; OECD, 2013a). This is especially relevant in Portugal, which has one of the highest percentages of children living in poverty in Europe (21%). For example, in 2009, nearly 1 in 5 Portuguese households with a child younger than the age of 6 lived under the threshold for poverty, whereas the mean percentage in Europe was 1 in 7 (Eurydice, 2009). Several reports on household income inequality have also shown that Portugal is one of the most unequal countries in Europe, showing large disparities in incomes between the richest and the poorest (Carmo, Cantante, & Carvalho, 2012; OECD, 2013a).

Given the present economic situation in Portugal, there is no indication of an improvement in living conditions for young children. In fact, the economic crisis has severely affected the employment and welfare systems (Council of Europe, 2014). Austerity measures in Portugal included cuts to public funding for social transfers, family benefits, health care, and education (Eurochild, 2014). In addition, the Portuguese social transfer system is relatively ineffective compared to those in other European countries, with state policies having little impact in reducing the risk of poverty among children (Save the Children, 2014). This is particularly worrisome because poverty is associated with other risk factors for child development (Eurydice, 2009).

In the case of Portugal, low income and unemployment are concentrated among less educated parents (Carneiro, 2007; OECD, 2013a). Low parental education has been shown to be a strong predictor of poverty and low work status. In addition to the large disparities in rates for educational attainment among the population, Portugal has one of the largest proportions of adults without a high school degree among developed countries (65% in contrast to the average of 25% for OECD countries; OECD, 2013a). Furthermore, analyses of intergenerational persistence in Europe have indicated that the transmission of low levels of education from parents to children in Portugal is nearly 70%, which clearly contrasts with the mean of 35% for European countries (Grundiza & Vilaplana, 2013). This suggests that in Portugal low parent education affects not only parents' current economic and occupational status but also the likelihood of their children having low levels of education. It has been shown that the experiences children have in early childhood lay the foundation for lifelong learning and development (Shonkoff & Phillips, 2000). It is thus very important, within the application of a prevention framework, to understand whether family socioeconomic risk predicts child behavior and achievement starting early in life. To date, however, examination of the effects of low education and other socioeconomic risks in early childhood is still limited in Portugal.

In one study that was conducted in Portugal, examining links between family socioeconomic risk (e.g., low maternal education, large households, low income) and children's literacy skills at school entry, results indicated large disparities among 5-years-olds and provided evidence of the negative impact of family risks on child literacy development in Portugal (Cadima, McWilliam, & Leal, 2010). Specifically, findings suggested that at the end of preschool, at-risk children had significantly lower literacy skills than their not-at-risk peers and that the differences between at-risk and not-at-risk children tended to increase throughout first grade. These early disparities highlight the need to better understand specific aspects that can contribute to or inhibit the development of children's academic skills in Portugal. Given that behavioral regulation can be a key component of school success, this study examined patterns among behavioral regulation and children's achievement in the context of family risk for young Portuguese children.

## THE PRESENT STUDY

The present study examines concurrent associations between family sociodemographic risk, behavioral regulation, and early literacy and mathematics in young children in Portugal. Three objectives are addressed. First, we investigate relations between family sociodemographic risk (low maternal education, low income, and low occupational skills) and children's behavioral regulation and achievement in preschool. We are particularly interested in examining this influence in the Portuguese context in order to contribute to a culturally informed understanding of the factors influencing child outcomes. Second, we investigate the extent to which child behavioral regulation is associated with early literacy and mathematics after we take into account important variables, namely, child verbal IQ and family sociodemographic risk (low maternal education, low income, and low occupational skills). Third, we test the extent to which the influence of family sociodemographic risk on early literacy and mathematics is mediated through children's behavioral regulation.

Considering the particular context of Portugal, we expect that maternal education will influence the capacity of families to foster their children's skills by showing high associations with the other socioeconomic risk factors. Because of the intergenerational persistence of social disadvantage in Portugal, we expect that family risk will have a strong negative impact on child outcomes. Based on previous research findings in other countries (Mezzacappa, 2004; Wanless, McClelland, Tominey, et al., 2011), we expect that family sociodemographic risk will be negatively associated with children's behavioral regulation and academic achievement. We also expect that behavioral regulation will be significantly related to literacy and mathematics skills (von Suchodoletz et al., 2013; Wanless, McClelland, Acock, et al., 2011). In addition, we anticipate a negative indirect effect of family sociodemographic risk on child achievement through children's behavioral regulation (Sektan et al., 2010).

This study extends prior research in two important ways. First, it examines family sociodemographic risk factors in a population relatively homogeneous with respect to language, racial, and ethnic status, contributing to a better understanding of the respective roles of maternal education, income, and occupation in behavioral regulation and academic achievement. Second, it examines the utility of a direct measure of behavioral regulation that has not previously been used with Portuguese children. Thus, the study aims to place behavioral regulation and family characteristics in their social and cultural contexts (Raver, 2004).

## METHOD

### Participants

Participants were 186 Portuguese children (86 girls and 100 boys), their families, and their preschool teachers participating in the study Risk Factors in Child Development in Azores. This research project was designed to describe the family environment of preschool children and to investigate its associations with children's skills in children from a small urban area of the Terceira island in the Azores archipelago, Portugal. In Portugal, children ages 3 to 5 attend preschool, which is not compulsory. Compulsory school starts at age 6 (first grade) in elementary school. However, preschool attendance rate is relatively high—74% (Instituto

Nacional de Estatística, 2012). In this study, all of the preschool classrooms from two school groups were recruited, for a total of 17 classrooms. In each participating classroom, teachers sent consent forms describing the study to all parents of children who met the following criteria for participation: (a) were 4 or 5 years old and (b) did not have an individualized education plan. The average rate of parent consent was 65%.

Children's mean age was 5 years and 1 month ( $SD=6.7$  months). All children were Caucasian, and all parents were of Portuguese nationality. Mothers' average level of education was 8 years ( $SD=3.5$ ; see Table 1 for descriptive statistics). The percentages of mothers attending basic education (9 years), secondary school (12 years), and university were, respectively, 73.9%, 15.9%, and 10.2%. The percentages of fathers were, respectively, 79.6%, 13.6%, and 6.8%. These percentages were similar to Azores educational levels of completing high school (24%) and somewhat lower than national educational levels, with 32% of adults having at least the equivalent of a high school degree (Instituto Nacional de Estatística, 2012; OECD, 2013b). It is worth noting that in the United States, the percentage of adults with a high school degree is 89% (OECD, 2013b). Mothers' and fathers' levels of education were strongly related ( $r=.59$ ). The average household monthly income for participants in the study was €1,000–€1,499 (which is equivalent to about \$1,364 USD–\$2,044 USD a month or \$16,369 USD–\$24,537 USD a year), with monthly incomes ranging from less than €499 (7.9%) to more than €2,000 (4.5%). This sample income average was comparable to the national average of \$19,366 USD a year, which is less than the OECD average of \$23,047 USD and half of the average in the United States of \$38,001 USD a year (OECD, 2013a).

With respect to the mother's current job and occupation status, based on the European Union variant of the International Standard Classification of Occupations (Elias & Birch, 1994; Eurostat, 1988), 45% of the mothers were unemployed or nonactive (see Table 1).

TABLE 1  
Descriptive Statistics for Family Risk Variables

Variable	<i>N</i>	%	<i>M</i>	<i>SD</i>	Range
Mother's education	176		8.45	3.57	0–16
Elementary school ( $\leq 6$ years)		46			
Compulsory school ( $\leq 9$ years)		28			
High school ( $\leq 12$ years)		16			
College/university		10			
Mother's occupation status	181				
Unemployed/nonactive		45			
Elementary occupations		29			
Skilled agricultural craft workers		11			
Service workers or clerks		8			
Technicians or associate professionals		4			
Managers and professionals		3			
Family income	177				
<€499		8			
€500–€999		38			
€1,000–€1,499		45			
€1,500–€1,999		4			
€2,000–€2,499		3			
>€2,500		1			

## Measures

**Behavioral regulation.** The HTKS directly assesses children's behavioral regulation and requires 5–7 min to administer. It measures the executive function processes of attentional or cognitive flexibility, working memory, and inhibitory control (McClelland & Cameron Ponitz, 2012). In the task, children are asked to first touch their head and then touch their toes and then are asked to do the opposite and touch their head instead of their toes. There are three parts to the task involving paired rules: a head–toes section (four practice items and 10 test items), a knees–shoulders section (four practice items), and a section with four types of paired commands (10 test items). There are a total of 20 test items given in a consistent order with scores of 0 (incorrect), 1 (self-correct), or 2 (correct) for each item. A *self-correct* is defined as any motion to the incorrect response that is self-correcting and ends with the correct action. Self-corrections must occur without verbal cues. Scores range from 0 to 40, and higher scores indicate higher levels of behavioral regulation. The task is available in English and Spanish and has been found to be reliable and to significantly predict academic outcomes in diverse samples (McClelland et al., 2014; McClelland & Cameron Ponitz, 2012; McClelland et al., 2007). The task has also been found to be reliable and predict academic outcomes in samples in Asia (Taiwan, South Korea, and China; Wanless, McClelland, Acock, et al., 2011) and Europe (Germany, Iceland, and France; Gestsdottir et al., 2014; von Suchodoletz et al., 2013). In the current study, Cronbach's alpha was .94. Although not a focus of the current study, preliminary validity for the HTKS was determined through inspecting correlations with another measure of behavioral regulation, the teacher-rated Child Behavior Rating Scale (CBRS; Bronson, Tivnan, & Seppanen, 1995). The CBRS assesses behavioral regulation in the classroom, and its reliability has been shown in several studies (cf. McClelland et al., 2007). For this sample, higher scores on the HTKS were correlated with higher teacher ratings on CBRS behavioral regulation ( $r = .25, p < .001$ ). The magnitude of association between HTKS scores and teacher-reported scores was comparable to that found in previous research in the United States and Asia (Wanless, McClelland, Acock, et al., 2011).

**Letter identification.** Children's ability to identify letters was assessed using a subscale of the Portuguese test the Cross-Linguistic Assessment of Foundation Level (Castro, Cary, & Gomes, 1998). Two lists of 21 randomly sorted letters are presented; the Portuguese alphabet has 23 letters, but *h* and *q* are not part of the list because of idiosyncrasies in the Portuguese language, in which *h* serves different purposes and *q* is always taught as *qu*. The child is asked to say the name or the sound of each letter. A total score with the number of correct responses was created and used in the present analyses. In the current study, internal consistency was very good ( $\alpha = .96$ ).

**Mathematics skills.** Preschool math ability was assessed with the Portuguese translation of the Test of Early Mathematics Ability–3 (Ginsburg & Baroody, 2003). This test measures both informal and formal concepts and mathematics skills across different domains of number sense, such as numbering skills, calculation skills, and understanding of concepts. Several questions of increasing difficulty are presented to the child (e.g., “I'm going to tell you some numbers, and I'd like you to write them down on the worksheet here. The first number is 24”). The assessment is untimed, and the assessor starts at the entry point established for each age group. The

floor (five consecutive correct responses) and ceiling (five consecutive incorrect items) rules are the same in the Portuguese version as in the original version. This test has been used in Portugal, demonstrating good validity and reliability (Cadima et al., 2008). The validity and reliability studies of the Test of Early Mathematics Ability–3 for Portuguese children involved 281 children ages 4 to 7. Internal consistency coefficients were reported to be above .90; test–retest reliability was adequate, with a correlation coefficient of .90; and scores were demonstrated to be highly correlated with scores on the Arithmetic subtest of the Wechsler Intelligence Scale for Children–III ( $r = .62$ ; Cadima et al., 2008). In this study, the sum of correct responses was used, with a possible maximum score of 72. Cronbach’s alpha was .95.

*Child verbal IQ.* Children’s verbal IQ was assessed with the vocabulary subtest of the Wechsler Preschool and Primary Scale of Intelligence (Wechsler, 2010). The Wechsler Preschool and Primary Scale of Intelligence is a widely used, well-validated test that assesses the intelligence of children between 3 and 7 years of age. It has been shown to be a highly reliable and valid measure across diverse populations, with its validity being established for Portuguese children as well (Wechsler, 2003). The test reports good reliability estimates for all subtests and composite scores for Portuguese children, which range from .79 to .94 (Wechsler, 2010). The vocabulary subtest was used for analysis in the current study, consisting of 21 items asking children to give definitions of a particular word. The item’s score could vary from 0 to 2. The subtest total was obtained by summing across the items. In the current study, Cronbach’s alpha was .87.

*Family sociodemographic risk.* A background measure was used to gather family sociodemographic risk data. Items included the mother’s education level, the mother’s current job and employment status, and family income. For maternal education, the total years of education was reverse coded so that higher scores indicated lower education and more family risk. Regarding maternal occupation status, mothers’ current jobs were classified by two research assistants using the European Union variant of the International Standard Classification of Occupations (Elias & Birch, 1994). Double coding for agreement was conducted on all cases. Mothers’ jobs were coded so that higher scores represented more socioeconomic risk. Categories included (a) unemployed or elementary occupations (simple and routine tasks that mainly require the use of handheld tools and require skills at the first primary school skill level), (b) plant and machine operators, (c) skilled agricultural and fishery workers or craft workers (e.g., farmers, carpenters, plumbers), (d) service workers or clerks (e.g., restaurant service workers, personal care workers, secretaries, typists), (e) technicians and associate professionals, and (f) managers and professionals. Categories for family monthly income were (a) less than €499, (b) €500–€999, (c) €1,000–€1,499, (d) €1,500–€1,999, (e) €2,000–€2,499, and (f) more than €2,500 (see Table 1).

## Procedure

Children’s skills were measured in the spring of the preschool year. Research assistants administered the battery of tests individually at the child’s preschool center in a quiet room. Information regarding family characteristics was collected in preschool. Mothers completed the background questionnaire in the spring with the help of research assistants.

## Analytic Strategy

To answer our research questions, we analyzed data using structural equation modeling with Mplus software (Muthén & Muthén, 1998–2010). A latent factor representing family sociodemographic risk was created with three indicators: maternal education, income, and occupation. A series of models were then estimated to examine the concurrent relationships among family sociodemographic risk factors, behavioral regulation, and children's school readiness outcomes. To test for mediation, we tested a final model in which the direct and indirect effect coefficients were modeled simultaneously. In this model, all proposed direct and indirect paths were computed at the same time and significance tests for each separate path were obtained. To account for the influence of child characteristics, the models estimated direct effects on behavioral regulation from child age and gender as well as the covariation between behavioral regulation and child IQ. Direct effects on letter identification and mathematics from child age, gender, and verbal IQ were also estimated. Sobel's (1982) test was used to test the significance of the indirect effects. The following fit indices were used to evaluate the fit between the data and the models: the comparative fit index (CFI) and the root mean square error of approximation (RMSEA). The fit of a model is considered adequate if the CFI exceeds .95 and the RMSEA is less than .06 (Hu & Bentler, 1999; Kline, 2005). To address the nesting of children in classrooms, we estimated the models using the special feature for complex survey data available in Mplus software (Muthén & Muthén, 1998–2010). This feature uses the maximum likelihood with robust standard errors to take into account the nonindependence of observations and corrects the standard errors that otherwise would be underestimated.

Complete data were available for all 186 children for child age and gender. Family income and maternal occupational status had less than 5% missing data, and maternal education had 16% missing data. In addition, 6% of the sample was missing data on the HTKS, 8% was missing on letters, and 21% was missing on child verbal IQ and mathematics. The reasons for missing data for child verbal IQ and mathematics related primarily to child absence, as these measures were administered at the end of the battery and frequently during a second visit to the setting. To examine patterns of missing data, for those variables with greater than 5% missing data we conducted *t* tests using dummy variables indicating whether data were missing or not and examined differences on the variables for which we had complete information, namely, child age and sex. Missingness on these variables did not predict any of the other variables, with the exception that participants missing mathematics data were more likely to be older. Little's missing completely at random test,  $\chi^2(151, N = 186) = 179.35, ns$ , suggested that data were missing completely at random. Missing data were handled using full information maximum likelihood estimation (FIML) to prevent sample size reduction and subsequent loss of statistical power (Enders, 2001). FIML estimates model parameters and standard errors directly from all available data, including cases with incomplete data, without imputing missing values (Buhi, Goodson, & Neilands, 2008). FIML parameter estimates have advantages over traditional techniques, such as listwise and pairwise deletion and mean substitution, in that they provide less biased estimates (Baraldi & Enders, 2010; Enders, 2001). Regarding effect sizes, we present the standardized path coefficients assessing the direct effects that can be used as effect sizes (Durlak, 2009).

RESULTS

Descriptive Statistics and Correlations

Descriptive statistics and correlations are provided in Table 2. Children’s behavioral regulation scores showed considerable variability, covering the entire range of the task. Relatively few children scored at ceiling level ( $n = 7$ ; 4%), but nearly 20% ( $n = 34$ ) scored at floor level, which supports other studies with children at this age (Cameron Ponitz et al., 2009). Skewness and kurtosis values were nevertheless within an acceptable range, suggesting no severe deviations from an expected normal distribution (Kline, 2005). Pearson correlations indicated that early family sociodemographic risk factors (including maternal education, income, and job status) were statistically significantly and modestly related to behavioral regulation, early literacy, and mathematics in the expected directions, with higher risk associated with lower skill levels. In addition, family sociodemographic risk factors were moderately intercorrelated with one another, and behavioral regulation was positively related to both literacy and mathematics skills. Child’s age was also positively correlated with higher skill levels.

Next we performed analyses testing the direct and indirect pathways among family sociodemographic risk factors, behavioral regulation, and academic achievement. Figure 1 presents the standardized coefficients and the factor loadings for the latent construct family sociodemographic risk for the overall model. The overall model provided adequate model fit,  $\chi^2(14, N = 186) = 20.42, p = .117, RMSEA = .050, CFI = .990$ . The model explained 19% of the variance in behavioral regulation, 38% of the variance in letter identification, and 57% of the variance in mathematics skills.

Is Family Socioeconomic Risk Associated With Behavioral Regulation, Letter Identification, and Mathematics?

The first research question addressed the extent to which the latent construct family sociodemographic risk is associated with child behavioral regulation, letter identification, and mathematics (see Figure 1). Consistent with our expectations, family sociodemographic risk was negatively

TABLE 2  
Descriptive Statistics and Correlations for the Observed Variables

Variable	1	2	3	4	5	6	7	8	9	M	SD
1. Maternal education (reversed)	—										
2. Family income (reversed)	.57**	—									
3. Mother’s job status	.68**	.66**	—								
4. Child age	-.01	-.17*	-.19*	—						0.46	
5. Child gender <sup>a</sup> (% female)	-.02	-.05	-.04	.01	—					4.21	0.65
6. Self-regulation	-.19*	-.23*	-.20*	.43**	.11	—				19.51	14.14
7. Child IQ (vocabulary)	-.26**	-.31**	-.25**	.39**	.06	.55**	—			17.63	7.38
8. Letter identification	-.28**	-.33**	-.33**	.37**	.06	.50**	.53**	—		7.34	7.03
9. Mathematics	-.37**	-.35**	-.35**	.47**	.13	.58**	.64**	.70**	—	13.86	8.18

<sup>a</sup>1 = female.  
\* $p < .05$ . \*\* $p < .01$ .

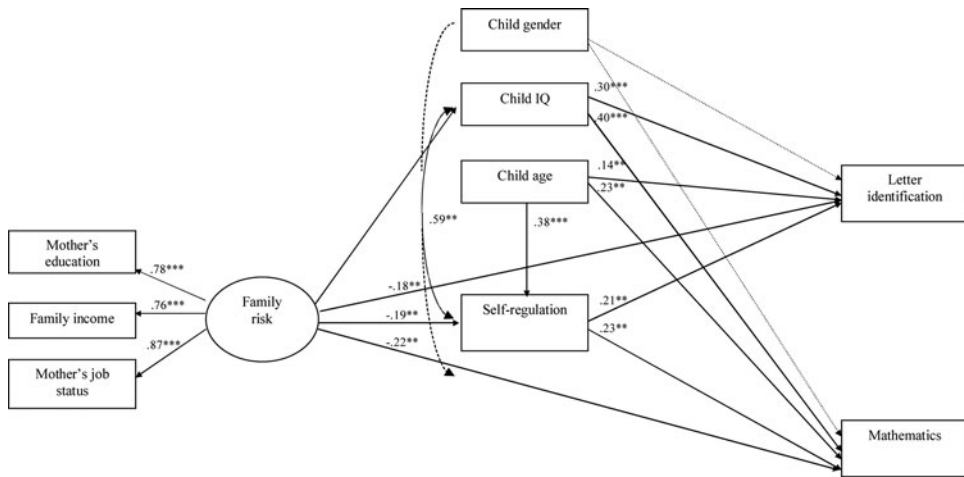


FIGURE 1 Standardized coefficients for the model of the influence of family risk on children's self-regulation and achievement, with self-regulation as a mediating pathway. Dotted lines represent nonsignificant paths. Model fit statistics:  $\chi^2(14, N = 186) = 20.42, p = .117$ , root mean square error of approximation = .050, comparative fit index = .990. \*\* $p < .01$ . \*\*\* $p < .001$ .

and modestly associated with lower levels of behavioral regulation ( $\beta = -.19, SE = .06, p = .002$ ) and letter knowledge and mathematics skills in the spring of preschool ( $\beta = -.18, SE = .06, p = .002$ ; and  $\beta = -.22, SE = .08, p = .005$ , respectively) after we took into account child age, gender, and IQ. Children experiencing higher levels of family sociodemographic risk scored lower in behavioral regulation, letters, and mathematics than children exposed to low levels of family sociodemographic risk. Specifically, an increase of 1 *SD* in family sociodemographic risk was associated with a decrease of about one fifth of a standard deviation in behavioral regulation, letters, and mathematics.

#### Is Behavioral Regulation Associated With Letter Identification and Mathematics After Family Sociodemographic Risk and Child Verbal IQ Are Taken Into Account?

Also consistent with our expectations, in the spring of the preschool year, behavioral regulation was modestly associated with higher levels of both letter identification and mathematics ( $\beta = .23, SE = .09, p = .007$ ; and  $\beta = .21, SE = .07, p = .003$ , respectively) after we controlled for child verbal IQ, age, and gender and family sociodemographic risk (see Figure 1). Children with high scores on behavioral regulation scored higher in letters and mathematics than children low in behavioral regulation. Specifically, a 1 *SD* increase in behavioral regulation was associated with a one fifth of a standard deviation increase in letters and mathematics scores (.23 and .21, respectively).

#### Does Behavioral Regulation Mediate the Relation Between Family Sociodemographic Risk and Children's Letter Identification and Mathematics?

To test whether the associations between family sociodemographic risk and children's letter identification and mathematics skills were mediated through behavioral regulation in the spring

TABLE 3  
Summary of Tests of Mediation for Path Analysis

Path	Total effect		Direct effect		Indirect effect	
	Unstandardized B	SE	Unstandardized B	SE	Unstandardized B	SE
Family risk → mathematics	-4.03**	0.87	-2.29**	0.77	-0.42*	0.16
Family risk → letter identification	-2.91**	0.69	-1.65**	0.54	-0.41	0.21

\* $p < .05$ . \*\* $p < .01$ .

of the preschool year, we simultaneously computed indirect paths in the overall model. Table 3 presents total effects, direct effects, and indirect effects. As shown, the results indicated that the association between family sociodemographic risk and children's mathematical skills in the spring of preschool was significantly mediated by children's behavioral regulation (unstandardized indirect effect =  $-.42$  [.0.12, 0.72]). Children with higher levels of family sociodemographic risk tended to have lower levels of behavioral regulation. In turn, children with lower levels of behavioral regulation tended to have lower levels of mathematics skills. The effect was somewhat modest in size, with a standardized regression coefficient of  $-.04$ . No evidence of mediation was found for literacy skills. Although higher levels of family sociodemographic risk were related to lower levels of letter identification, the indirect effect of family sociodemographic risk through behavioral regulation only reached marginal levels of statistical significance in the overall model.

## DISCUSSION

The present study examined the direct and indirect pathways between family sociodemographic risk, behavioral regulation, and early literacy and mathematics in young children in Portugal. Findings demonstrated that family sociodemographic risk, indexed by low maternal education, low family income, and low maternal occupational status, was negatively related to behavioral regulation and academic achievement. Consistent with earlier studies (Mezzacappa, 2004; Mistry et al., 2010; Wanless, McClelland, Tominey, et al., 2011), children who experienced higher levels of family sociodemographic risk showed poorer behavioral regulation skills and lower levels of letter identification and mathematics compared to children who experienced lower levels of risk. In addition, higher levels of behavioral regulation were associated with higher levels of letter identification and mathematics skills after we adjusted for the influence of family sociodemographic risk and child verbal IQ. Finally, family sociodemographic risk was negatively related to mathematics indirectly through children's behavioral regulation.

### Relations Between Family Sociodemographic Risk, Academic Achievement, and Behavioral Regulation

Our findings showed that lower maternal education, family income, and maternal occupational status were related to lower behavioral regulation and academic achievement for young

Portuguese children. Previous research has also shown that the family socioeconomic risk factors examined in this study individually or jointly predicted achievement and behavioral regulation. Family income has been shown to negatively predict numerous academic outcomes (Burchinal et al., 2006; Krishnakumar & Black, 2002; McLoyd, 1998) and, more recently, behavioral regulation (Evans & Rosenbaum, 2008; Mistry et al., 2010; Raver, McCoy, Lowenstein, & Pess, 2013; Sektnan et al., 2010; Wanless, McClelland, Tominey, et al., 2011). It has also been established that children whose mothers have low levels of education are more likely to perform poorly on achievement and behavioral regulation tasks (Ardila, Rosselli, Matute, & Guajardo, 2005).

Comparable evidence has also indicated that socioeconomic status, as assessed from parents' occupations, adversely affects cognitive development (Bradley & Corwyn, 2002) and behavioral regulation (Mezzacappa, 2004; Noble et al., 2005; Sarsour et al., 2011). Our results provide further evidence for the negative effects of family sociodemographic risk on behavioral regulation and achievement outcomes for Portuguese children, until now found primarily for North American children. Of note is that the negative effects of family sociodemographic risk on behavioral regulation and academic achievement could be found for children as early as the age of 4. These findings highlight that variations among children emerge early in development.

It has been shown that children from families experiencing higher levels of risk may have fewer opportunities to experience supportive and cognitive stimulating family environments and may have less access to the kind of resources and interactions that promote behavioral regulation and achievement (Mistry et al., 2010; Rhoades, Greenberg, Lanza, & Blair, 2011). It has also been suggested that family risk affects children's stress levels, which can interfere with the development of behavioral regulation (Evans & Kim, 2013). Potential mechanisms linking risk to behavioral regulation should continue to be examined in future work.

In support of our expectations, maternal education, family income, and maternal work status were strongly correlated with one another. Mothers with low educational levels were likely to have low incomes and be in low-skill occupations. These findings are consistent with prior research conducted in other countries showing that family risk factors are likely to be correlated (Burchinal, Roberts, Hooper, et al., 2000; McLoyd, 1998). Research has suggested that the actual effects of each risk factor should be understood in the context of the others (Kraemer, Stice, Kazdin, Offord, & Kupfer, 2001). In the particular case of Portugal, it is possible that the high associations between family factors are a result of the detrimental effects of low maternal education on professional status and wage (Carneiro, 2007). It has been demonstrated that in Portugal, education is an important source of income inequality and directly affects work status (Carneiro, 2007). Moreover, the odds of school failure due to low parental education for Portuguese children are extremely high compared to in other European countries (Grundiza & Vilaplana, 2013). The high variability in educational levels among parents in Portugal, combined with a high percentage of mothers with low education, may place Portuguese children at increased risk for poor outcomes. Findings from this study provide some support for this contention by showing that, even before starting compulsory school, children exposed to low levels of maternal education, income, and occupational status already are at increased risk for poor behavioral regulation and achievement outcomes. Our results are limited by the concurrent nature of the data, and further longitudinal research is needed to investigate family socioeconomic effects in early childhood in countries such as Portugal.

## The Role of Behavioral Regulation in Early Academic Achievement

Findings from this study indicated that children with higher behavioral regulation skills performed better on the letter identification and mathematics tasks. These findings support previous research showing that behavioral regulation is positively related to early academic achievement in preschool (Cameron Ponitz et al., 2009; McClelland et al., 2007; von Suchodoletz et al., 2013; Wanless, McClelland, Acock, et al., 2011). Children with strong behavioral regulation are likely better able to shift attention and ignore irrelevant cues, remember instruction, and stop inappropriate behavior, which can facilitate learning and help children succeed academically (McClelland et al., 2007). In other words, it seems that early behavioral regulation is associated with skills needed to be successful in the classroom, providing the basis for academic competence (Blair, 2002). Of note is the finding that behavioral regulation was associated with letter knowledge and mathematics when we controlled for the effects of family sociodemographic risk. Regardless of family risk levels, children with high behavioral regulation scored higher on the academic tasks than children with low behavioral regulation. Furthermore, the relations between behavioral regulation and academic skills were robust after we controlled for child verbal IQ. Findings from this study contribute to the growing body of research on the importance of behavioral regulation for achievement in the context of family sociodemographic risk and suggest that success in school depends on cognitive and socioemotional processes that are likely to be intertwined rather than merely on academic skills (Evans & Rosenbaum, 2008).

Findings also support the utility of the HTKS as a measure of behavioral regulation associated with achievement for young children in Portugal. The HTKS showed significant variability among children, and scores on the HTKS correlated with achievement in the expected directions. Moreover, the effect sizes of the HTKS for letters and mathematics were similar to the effect sizes of socioeconomic risk and child age. Our findings are consistent with those of other studies using the HTKS among children from different countries. For example, Wanless, McClelland, Acock, et al. (2011) reported that higher HTKS scores significantly predict higher achievement in the United States, Taiwan, South Korea, and China. The magnitude of the associations between the HTKS and achievement found in our study (ranging from .50 to .58) was in line with previous studies in the United States, South Korea, and China (ranging from .30 to .59; Cameron Ponitz et al., 2009; Wanless, McClelland, Acock, et al., 2011). Moreover, although we could not test the statistical significance of the difference, the mean scores in our sample were comparable to those found in Germany and in the United States for kindergarten children, although somewhat lower. Possible reasons for these differences can be the large disparities among maternal education levels between Portugal and the other countries, although more research on the HTKS is clearly needed. Taken together with previous research, the present findings suggest that the HTKS may be an adequate, ecologically valid measure for assessing behavioral regulation among young children in different countries.

## The Mediating Role of Behavioral Regulation

In this study, we elaborated on previous findings on family and early achievement by examining whether associations between family sociodemographic risk and achievement were mediated by observed behavioral regulation. We examined one possible mechanism, behavioral regulation,

given that it has been demonstrated that behavioral regulation is amenable to intervention (Raver et al., 2011; Sanford Derosie & Bierman, 2012). The results indicated that behavioral regulation mediated the relation between family sociodemographic risk and mathematics but not between family sociodemographic risk and letter identification. This finding matches previous research, which has found stronger associations between behavioral regulation and mathematics than for literacy (Blair & Razza, 2007; Cameron Ponitz et al., 2009; Sektan et al., 2010). One possible reason is that the components of behavioral regulation are more directly linked to mathematics learning (Blair & Razza, 2007). When solving mathematics problems, children are required to reason actively, attend to specific cues, process information, and shift attention appropriately. Literacy skills, and in particular letter identification, are likely to make less demands of behavioral regulation. Mathematics seems therefore more effortful compared to letter identification (Blair & Razza, 2007). It is also possible that other mediators, namely, language skills, have a more substantial role in the relation between family risk and literacy (Burchinal et al., 2006; Sarsour et al., 2011). Language is an important skill underlying academic achievement that is negatively affected by early exposure to risk (Krishnakumar & Black, 2002). For example, Burchinal et al. (2006) reported that a child's language skills at school entry mediated associations between family sociodemographic risk and achievement outcomes. It is very likely that multiple mediators contribute simultaneously to explain the detrimental effects of risk on early achievement.

The present findings provide preliminary support for the mediation role of behavioral regulation in the influence of family sociodemographic risk on mathematics achievement. One possible explanation is that children experiencing higher levels of family sociodemographic risk are likely to face several stressors and simultaneously have less access to enriching resources that foster behavioral regulation (Blair & Raver, 2012). Mothers' education, in particular, may reflect less awareness on the part of the mothers of the importance of providing enriching environments, limiting opportunities to practice these skills (Dilworth-Bart, 2012; Sektan et al., 2010). Furthermore, low levels of education, along with other family sociodemographic risk factors, are likely to reflect less responsive, consistent forms of caregiving and limit setting, which influence children's regulation of attention and behavior (Blair & Raver, 2012). Lower levels of behavioral regulation are in turn associated with a decreased ability to plan, pay attention, and complete mathematics activities (Blair & Razza, 2007; Dilworth-Bart, 2012). It is also possible that children in families with lower maternal education have fewer opportunities to learn mathematics at home and rely heavily on the classroom context. Because of their difficulties in regulating their behavior in ways that contribute to their learning, they may miss opportunities to learn mathematics in the classroom context.

Our findings offer the promise that promoting the development of behavioral regulation may be an effective way to help Portuguese children who face socioeconomic risk to succeed early in mathematics, although we are not able to make causal claims. Recent research has provided evidence of the benefits of intervention programs for later academic success through supporting children's behavioral regulation skills. For example, Raver and colleagues (2011) have shown that children enrolled in a classroom-based program designed to support behavioral regulation substantially improve their behavioral regulation and academic skills. It seems that helping children in being better able to stay on task, ignore irrelevant cues, and follow through on teachers' instructions can support them in being able to take the most advantage of learning and improve their academic skills. This seems an important line of inquiry, and more

investigation on the mediating role of behavioral regulation may shed light on potential targets for interventions efforts aimed at promoting school success.

Taken together, the present findings, in conjunction with previous research, underscore the relevance of behavioral skills for school success in young children. It needs to be emphasized, though, that these findings are preliminary and need to be examined further. Next we present some suggestions for future research.

### Limitations and Future Directions

When interpreting our findings, some limitations should be noted. First, a key limitation is that the results of this study are based on cross-sectional data, and therefore the causal roles of family sociodemographic risk and behavioral regulation cannot be determined. Longitudinal studies are needed to provide further evidence of the potential mediating role of behavioral regulation skills. In spite of this limitation, however, this study is one of the first to investigate these research questions and can be used as a foundation from which to extend further research.

Second, to further understand cultural nuances, research would benefit from multiple group analyses in cross-cultural studies. Future research is needed to compare the equivalence of the measures, namely, the HTKS, across countries so that meaningful cross-cultural comparisons can be made. It is important to note that this measure has been used in several European and Asian countries. Findings from this study also support the utility of the HTKS in Portugal and extend its adequacy to a new country.

Third, although we included in this study the most widely used indicators of socioeconomic risk, consistent with an ecological systems framework (Bronfenbrenner, 1986), other distal and proximal family factors should be included in future research. For instance, in addition to other risk factors that have been shown to negatively predict child development (e.g., being a single parent, having negative life events), it would be important to further examine the quality of the home environment, including parenting quality and type of activities and materials. Similarly, future studies would benefit from examining potential mechanisms linking family risk to behavioral regulation, including the potential role of chronic stress in behavioral regulation in children from different countries and cultural backgrounds. Cross-cultural studies could be particularly helpful in understanding whether there are universal patterns linking family conditions to behavioral regulation. Considering that national education policies are increasingly affected by international and European factors, understanding the extent to which studies conducted in different regions and countries report similar and comparable results seems crucial.

An additional limitation that requires mention is that we were not able to address classroom effects. An important body of research has documented the critical role of high-quality child care for children's development (Burchinal, Roberts, Riggins, et al., 2000; Mashburn et al., 2008). There is evidence suggesting that high-quality early childhood programs promote children's cognitive, language, and socioemotional development (Bierman et al., 2008; Raver et al., 2011), but there is limited research on the associations between child care quality and behavioral regulation. An important line of inquiry would be to examine the associations between child care quality and children's behavioral regulation skills. In addition, in the present study, classrooms in the sample were drawn from a region in Portugal, the Terceira island in Azores. It is important to replicate these findings in other regions of Portugal to account

for possible variations within the country with respect to the associations between family risk factors, behavioral regulation, and academic achievement. A final point that requires mention is that data on income were collected using ordinal categories.

Despite these limitations, this study contributes to the growing body of literature on the complex relations between early family sociodemographic risk, children's behavioral regulation, and early achievement. It provides important information on an understudied population, Portuguese children, and demonstrates the negative effects of family sociodemographic risk on behavioral regulation and achievement. It also highlights the critical role that behavioral regulation skills may have for early achievement, particularly for mathematics for young Portuguese children.

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