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Relations between early family risk, children's behavioral regulation, and academic achievement

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Abstract

This study examined relations among early family risk, children's behavioral regulation at 54 months and kindergarten, and academic achievement in first grade using data on 1,298 children from the National Institute of Child Health and Human Development (NICHD) Study of Early Child Care and Youth Development. Family risk was indexed by ethnic minority status, low maternal education, low average family income from 1 – 54 months, and high maternal depressive symptoms from 1 - 54 months. Results of structural equation modeling indicated that minority status, low maternal education, and low family income had significant negative effects on reading, math, and vocabulary achievement in first grade. Modest indirect effects were also found from ethnicity, maternal education, and maternal depressive symptoms, through 54-month and kindergarten behavioral regulation to first-grade achievement. Discussion focuses on the importance of behavioral regulation for school success especially for children facing early risk.

The early years are crucial for the development of skills that help children succeed in school. Development of important cognitive, literacy, and language skills takes place early in life and large individual differences in children's skill levels are evident by preschool and school entry (Denton & West, 2002; Morrison, Bachman, & Connor, 2005). Consequently, many children enter school without the social and behavioral regulation skills necessary to be successful (McClelland, Morrison, & Holmes, 2000; Rimm-Kaufman, Pianta, & Cox, 2000). The development of early academic and behavioral regulation skills is not only important for a successful transition to school, but also for later academic achievement since trajectories for future educational attainment are formed and shaped during children's early educational experiences (Alexander & Entwisle, 1988; Chen, Lee, & Stevenson, 1996; Hamre & Pianta, 2001). For example, children who have difficulty during the first few years of school have more problems with later behavioral, emotional, academic, and social adjustment and are at increased risk of dropping out prior to the completion of formal schooling (Alexander, Entwisle, & Kabbani, 2001; Gutman, Sameroff, & Cole, 2003). In addition, academic shortfalls lead to lower lifetime earnings, poorer health, and higher incarceration rates as well as have a costly impact on the national economy (McKinsey & Company, 2009).

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In order to more fully understand children's development, attention must be given to specific aspects of the child's environment that can contribute to or threaten the successful mastery of early academic skills. In particular, children with socio-demographic risk factors, such as ethnic minority status, low maternal education, low family income, and mothers with depression, are more likely to suffer poor academic and developmental outcomes (Burchinal, Peisner-Feinberg, Pianta, & Howes, 2002; Huffman, Mehlinger, & Kerivan, 2000; Luster & McAdoo, 1994; McLoyd, 1998). It is also important to consider mechanisms by which these risks can be mediated by other developmental processes. In particular, children's behavioral regulation, or the ability to control, direct, and plan behavior, has been shown to be an important predictor of early academic achievement (McClelland, Cameron, Connor et al., 2007). The present study examined the relations among family risk factors (between 1 and 54 months), behavioral regulation during the transition to formal schooling, and children's achievement in first grade.

Family Risk Factors as Predictors of Academic Achievement

Children who experience risk factors during early childhood are more likely to start school unprepared, which can result in later school failure (Burchinal, Roberts, Zeisel, Hennon, & Hooper, 2006; Gutman et al., 2003; Luster & McAdoo, 1994; Raver, 2004). This is particularly evident for children who experience multiple family risk factors or risk factors over long periods of time (Huffman et al., 2000; Laucht, Esser, & Schmidt, 1997; Rutter, 1979; Wachs, 2000). Although a number of studies have illuminated links between proximal factors, such as parenting and the quality of the home environment, and children's academic outcomes (e.g., Morrison et al., 2005; NICHD Early Child Care Research Network [NICHD ECCRN], 2003a), less research has examined how more distal family risk factors such as ethnic minority status, low maternal education levels, low family income, and maternal depressive symptoms contribute to children's achievement directly and indirectly through their behavioral regulation. This study tested the hypothesis that children experiencing any of these factors may be deprived of stimulating resources and interactions which may have detrimental effects on their early behavioral regulation and achievement (Bradley, Corwyn, McAdoo, & Garcia Coll, 2001; Evans, 2004).

Risk is defined as an "elevated probability of a negative or undesirable outcome in the future" (Masten & Gewirtz, 2006, p. 24). In a developmental sense, risk implies a threat to a child's trajectory which can result in poor developmental outcomes. Minority status, maternal education level, family income, and maternal depressive symptoms are not by themselves risk factors and may be protective at certain levels (such as high education and income levels or low maternal depressive symptoms). When studying risk, researchers often either dichotomize status indicators of risk or use continuous scores. When risk is categorized, individuals are seen as being at risk if they are above or below a cut-off point (e.g., have less than so many years of education or live under the poverty threshold). This option, however, may be based on arbitrary cut-off points and also loses important variability (NICHD ECCRN, 2000). Thus, in the present study, we used continuous scores to conceptualize the risk factors of maternal education level, family income, and maternal depressive symptoms in order to retain variability and avoid arbitrary cut-off points.

For ethnic minority children, a significant gap has been documented in achievement when compared to their majority counterparts in early childhood as well as in later school years (Alexander et al., 2001; Chatterji, 2006; Denton & West, 2002; Huffman et al., 2000; Jencks & Phillips, 1998; McLoyd, 1998). Specifically, Black and Hispanic children have historically performed at significantly lower levels than White children starting in early elementary school and continuing throughout the elementary and secondary years (Humphreys, 1988; Stevenson, Chen, & Uttal, 1990). Recent research has found that Black and Hispanic students are academically an average of two to three years behind White children of the same age, with the

gap worsening the longer the child is in school (McKinsey & Company, 2009). The sources of the test score gap are difficult to isolate (Jencks & Phillips, 1998), but evidence suggests that minority children may experience a constellation of factors such as racism, residential, economic, and social segregation, unsafe neighborhoods, and schools with fewer resources and qualified teachers, all of which can negatively influence early achievement (Garcia Coll et al., 1996). In addition, socioeconomic status may account for a large part of the disparity in test scores among minority children (Magnuson & Duncan, 2006). Compared to White children, minority children are more likely to experience poverty, especially persistent poverty (Duncan, Brooks-Gunn, & Klebanov, 1994).

Maternal education and family income have also been closely associated with poor academic outcomes (Amato & Ochilree, 1986; Downer & Pianta, 2006; McLoyd, 1998). In one study, children whose mothers had lower educational attainment had substantially lower levels of cognitive development in the toddler and preschool years than peers of mothers with higher education (Petterson & Albers, 2001). In addition, children of mothers with lower education had significantly lower scores on reading, math, and vocabulary in the early elementary years (Luster & McAdoo, 1994). Research has also found that children living in poverty are at increased risk of poor achievement outcomes (Chatterji, 2006; Denton & West, 2002; Huffman et al., 2000). In particular, recent research by McKinsey & Company (2009) indicated that impoverished students are academically two years behind same-age students from higher income families. This achievement gap appears early and often persists through the school years. Moreover, children who experience poverty over longer periods of time have lower academic achievement than children who experience poverty infrequently or who have never been poor (McLoyd, 1998). In the present study, income was averaged over six time points from 1 to 54 months, reflecting the view that a child's development is the result of the accumulation of experiences that have occurred up to that point in time (Laucht et al., 1997; NICHD ECCRN, 2003b).

Research has documented that children who live in poverty tend to have significantly fewer educational materials and resources in the home and are exposed to fewer learning opportunities than children who are not poor, which can negatively affect achievement (Bradley & Corwyn, 2002; Bradley et al., 2001; Evans, 2004; Gershoff, Aber, Raver, & Lennon, 2007; McLoyd, 1998; Yeung, Linver, & Brooks-Gunn, 2002). This lack of cognitive enrichment and investment may lead to fewer opportunities to stimulate children's early learning and behavioral regulation. Poverty has also been linked with higher rates of birth complications and prematurity, increased exposure to health risks (such as lead), and reduced access to services that might otherwise buffer these negative conditions and promote achievement in young children (McLoyd, 1998). Taken together, research suggests that disadvantaged children, especially disadvantaged minority children, may be exposed to less stimulating materials in the home, face discrimination in their daily lives, live in dangerous neighborhoods, and attend subpar schools, all of which have been related to lower academic achievement.

Finally, the effects of maternal depressive symptoms on children's functioning and academic achievement are well-documented (Beardslee, Versage, & Gladstone, 1998; Downey & Coyne, 1990). In particular, children of depressed parents often have social and academic difficulties as well as internalizing and externalizing behavioral problems (Downey & Coyne, 1990). Research has found that depressed mothers are less emotionally available to children, which may deprive them of interactions that promote behavioral regulation and skills related to achievement in the preschool and early school years (Downey & Coyne, 1990; NICHD ECCRN, 1999). This is especially evident for children of mothers who have chronic depressive symptoms (Petterson & Albers, 2001). For example, children of mothers who experienced depressive symptoms chronically had significantly lower verbal comprehension and school

readiness skills at 36 months (NICHD ECCRN, 1999), lower cognitive and motor functioning from 28 to 50 months (Pettersen & Albers, 2001), and more academic problems at the end of first grade (Greenburg et al., 1999) than children of mothers who never reported experiencing depressive symptoms. In the present study, maternal depressive symptoms were compiled over six time points and used as an estimate of early childhood experience from 1 to 54 months.

Although a large body of research has shown that the presence of family risk factors throughout early childhood is related to children's early academic achievement, most studies have assessed characteristics of family risk at only one point in time. In addition, few studies have incorporated children's development in regulatory and academic arenas in a comprehensive model of the relation between risk and achievement. The present study examined relations between minority status, maternal education, family income, and maternal depressive symptoms during the children's first 54 months, children's behavioral regulation (as rated by parents and teachers), and achievement in the early school years.

Children's Behavioral Regulation, Family Risk, and Academic Achievement

Behavioral regulation falls under the broader self-regulation construct and is defined as the ability to apply cognitive skills such as attention, working memory, and inhibitory control, to behavior. Behavioral regulation includes skills such as focusing and maintaining attention on tasks, following instructions, and inhibiting inappropriate actions (McClelland, Cameron, Wanless, & Murray, 2007; Morrison, Ponitz, & McClelland, 2010). Other researchers have used terms such as executive function (e.g., Blair & Razza, 2007; Calkins, 2007) to refer to a similar set of skills, but the term behavioral regulation is used in this study in an attempt to specifically examine the integration of executive function processes into the regulation of behavior. Because recent research has pointed to inhibitory control and attention as particularly important for early academic success (Blair & Razza, 2007), these two aspects of behavioral regulation were the focus of the present study.

Children's regulatory skills depend on having opportunities to practice relevant behaviors, which may be absent in high-risk contexts, such as poverty or maternal depression (Evans & Rosenbaum, 2008; Sroufe, 1996). Although links between parenting and children's self-regulation have been more firmly established (e.g., Morrison et al., 2005; NICHD ECCRN, 2003a), less research has examined how distal risk factors influence children's behavioral regulation. For example, research documents that children from disadvantaged backgrounds have more difficulty on a number of school readiness indicators, including behavioral regulation, than their more advantaged peers (Dearing, Berry, & Zaslow, 2006; Raver, 2004). In one study, low family income and maternal education contributed to lower levels of attention and behavioral regulation skills prior to school entry and in the early school years (Howse, Lange, Farran, & Boyles, 2003). Another study found that children from disadvantaged Hispanic families entered preschool with significantly lower levels of behavioral regulation than their classmates (Wanless, Sektman, & McClelland, 2007). Research has also documented that risk factors such as minority status, single-parent status, and living in poverty predict lower self-regulation and achievement in young children (Evans & Rosenbaum, 2008). This research suggests that children who are exposed to family risk factors may have difficulty controlling, planning, and directing behavior.

One possible contributing factor is that children experiencing risk factors may have fewer resources to promote behavioral regulation and fewer opportunities to practice these skills. Recent research revealed that children in poverty are more likely to demonstrate difficulty in the cognitive processes underlying behavioral regulation (Kishiyama, Boyce, Jimenez, Perry, & Knight, 2009). Growing up with risk factors, such as being disadvantaged and of minority status, may create a set of behavioral strategies in children which may be adaptive in certain

contexts (e.g., unsafe neighborhoods), but maladaptive in classroom settings. Together, this research suggests that prolonged exposure to early risk factors makes it more difficult for children to learn to regulate their behavior in ways that contribute to being successful in academic contexts.

Aspects of children's behavioral regulation have also been found to predict early achievement throughout elementary school, even after controlling for IQ (Blair & Razza, 2007; McClelland, Acock, & Morrison, 2006; McClelland et al., 2000). To be successful in school settings, children must determine what is important to focus on, tune out irrelevant information, and inhibit the tendency to respond too quickly or to be distracted by other stimuli (NICHD ECCRN, 2003a). In one study, children's gains in behavioral regulation (including attention, inhibitory control, and working memory) over the preschool year predicted the gains they made in emergent literacy, math, and vocabulary (McClelland, Cameron, Connor et al., 2007). Another study found that behavioral regulation predicted children's reading, math, and vocabulary in kindergarten and gains made over the school year in math achievement (Ponitz, McClelland, Matthews, & Morrison, 2009). Other research found that behavioral regulation, as part of a learning-related skills construct (including behavioral regulation and social competence), significantly predicted children's academic skills between kindergarten and sixth grade (McClelland et al., 2006; McClelland et al., 2000). Moreover, aspects of attention have significantly predicted achievement from kindergarten to early adolescence (Duncan et al., 2007) and have predicted high school graduation rates (Vitaro, Brendgen, Larose, & Tremblay, 2005).

In general, it is likely that children in families with fewer resources, lower maternal education, more episodes of maternal depression, or of minority status have fewer opportunities to develop strong behavioral regulation which, in turn, hinders their ability to learn. Although recent research has found that sustained attention partially mediated the relation between the family environment and children's achievement outcomes in preschool (NICHD ECCRN, 2003a), and that children's self-regulation at 54 months mediated the relation between income and children's achievement in fifth grade (Evans & Rosenbaum, 2008), little research has considered the possible mediating role of behavioral regulation (including attention and inhibitory control) in preschool and kindergarten for early academic outcomes. In the present study, we examined how behavioral regulation in preschool and kindergarten mediated relations between indicators of risk and first-grade achievement.

It is clear that behavioral regulation is related to children's school success, but less research has examined the relationship between parent-rated behavioral regulation prior to school entry (54 months) and teacher-rated behavioral regulation in the kindergarten classroom and how this influences academic achievement in first grade. It may be that kindergarten behavioral regulation mediates the effect of 54-month behavioral regulation on achievement in first grade. In support of this notion, recent research suggests that behavioral regulation helps children be more successful in classroom learning environments, which in turn, helps children do better academically (McClelland, Cameron, Wanless et al., 2007).

Purpose and Hypotheses

The overall goal of this study was to chart direct and indirect pathways among early family risk factors, behavioral regulation, and first-grade academic achievement (see Figure 1). In particular, we sought to explore the individual contributions of minority status, maternal education, family income, and maternal depressive symptoms on children's behavioral regulation and early academic outcomes. In addition, the relations between behavioral regulation at 54 months and kindergarten, and first-grade academic achievement were explored.

It was anticipated that early family risk (indexed by Black and Hispanic minority status, low maternal education level, low income-to-needs ratio, and chronic maternal depressive symptoms) would have significant negative associations with children's 54-month and kindergarten behavioral regulation and first-grade academic achievement. We also predicted that low income and low maternal education would be particularly related to vocabulary skills based on research finding that disadvantaged and less educated parents tend to use less enriching language and speak fewer words to their children (Hart & Risley, 1995). In addition, we expected maternal depressive symptoms to have significant negative indirect effects on academic achievement through children's behavioral regulation. This was based on research finding that depressed mothers are less emotionally available, which may deprive children of interactions that promote behavioral regulation which would then lead to lower academic achievement (Downey & Coyne, 1990; NICHD ECCRN, 1999).

It was also hypothesized that strong behavioral regulation prior to school entry and in kindergarten would have significant positive effects on children's first-grade academic achievement. In particular, children who are able to pay attention, stay on task, and tune-out distractions are more likely to do well academically. We expected that children's behavioral regulation would significantly predict all academic outcomes, although relations were predicted to be stronger for behavioral regulation predicting math as children got older. This was based on recent research suggesting that aspects of behavioral regulation (such as attention and inhibitory control) are especially important for children's early math learning as they enter elementary school (Blair & Razza, 2007; Ponitz et al., 2009). Multiple measures and raters of behavioral regulation were used in order to more fully capture these skills in young children and explore the temporal stability of children's behavioral regulation between preschool and kindergarten as measured by parents and teachers. Thus, behavioral regulation at 54 months was measured via parent report and behavioral regulation in kindergarten was measured via teacher rating.

Finally, we expected to find indirect pathways from early family risk factors through behavioral regulation to first-grade achievement. It was anticipated that children with greater family risk would have significantly lower levels of behavioral regulation due to lack of resources, subpar living conditions, and lack of opportunities to practice skills. In turn, lower behavioral regulation in preschool and kindergarten would predict significantly lower levels of academic achievement in first grade. We also expected that lower behavioral regulation at 54 months would predict lower academic achievement in first grade in part through lower behavioral regulation in kindergarten.

Method

Study Design

The present study utilizes data from the National Institute of Child Health and Human Development (NICHD) Study of Early Child Care and Youth Development (see <http://secc.rti.org>). The NICHD study is a multi-site, prospective longitudinal study of 1,364 children and their families in the United States. The present analysis examined data from birth through first grade.

Participants

Children and families were recruited during the first 11 months of 1991 from hospitals in or near 10 locations across the United States (Little Rock, Arkansas; Irvine, California; Lawrence, Kansas; Boston, Massachusetts; Philadelphia, Pennsylvania; Pittsburg, Pennsylvania; Charlottesville, Virginia; Morganton, North Carolina; Seattle, Washington; and Madison, Wisconsin). Eligibility requirements at birth included that the mother was over the age of

eighteen, the mother spoke English, the mother was healthy, the baby was not a multiple birth or released for adoption, the family lived within one hour of the research site, and the family's neighborhood was safe. Of those eligible, 1,364 families with healthy newborns completed an interview when the child was one month old and were enrolled in the study, with approximately equal numbers of families at each site.

The enrolled families varied in ethnic background, family income, and family composition. Specifically, approximately 75% of participants identified themselves as White and Non-Hispanic, 13% Black and Non-Hispanic, 7% Hispanic, and approximately 5% identified themselves as Asian, Native American, or other ethnicities. In addition, the mean maternal education level was 14.2 years (10% completed less than 12th grade, 21% graduated high school, 33% had some college, 21% had a bachelor's degree, and 15% completed a graduate or professional degree). The mean household income of the sample when the children were one month old was \$37,781 (Median = \$30,000) with almost 19% of the families on public assistance and 14% of the mothers being single.

Although the sample was not a nationally-representative sample, families in the study represented a diverse range of socioeconomic and sociocultural backgrounds. Compared to US Census Bureau information for births during 1991, children in this sample were more likely to come from a family with lower mean household income (\$37,781 in sample vs. \$39,264 for census tract), and were more likely to receive public assistance than US families in general (18.8% vs. 6%) and had less educated mothers (68.5% vs. 52% had some college or higher) (NICHD ECCRN, 2001a). In addition, although the sample was considered ethnically diverse, it is important to note that White children were somewhat overrepresented in the sample compared to national patterns (75% vs. 64.9%) (NICHD ECCRN, 2001a).

The present analysis included 1,298 children and their families. Sixty-six children of Asian, Native American, or Other ethnicity were excluded from the present analysis due to small sample sizes. Compared to the original 1,364 sample, children in the present analysis did not differ on average maternal education, income, or percentage of families on public assistance. In addition, the sample from the present study ($N = 1,298$) represented a range of education and income across ethnic groups, with less variability within ethnic groups (see Table 1). For example, more White mothers had a college degree or higher (41%) compared to Black (6%) and Hispanic (14%) mothers. In addition, more Black and Hispanic families reported being in poverty over time (44% and 19% respectively) compared to White families (7%). Although Black and Hispanic families were more impoverished than Whites in this sample, Hispanic families were less likely to be poor compared to Black families (53% of Hispanic families were not poor compared to 33% of Black families).

Of the children in the sample, 973 had complete data for the first-grade child outcome variables in this study. Children from families who dropped from the study or who had data missing for academic outcomes differed from the initial sample in that they were more likely to be Black, $t(1296) = -3.15, p < .01$ and have a lower income-to-needs ratio ($M = 2.87, SD = .08$ vs. $M = 3.53, SD = .15$), $t(1287) = 3.91, p < .001$. In addition, mothers of those who dropped from the study were more likely to have lower education levels ($M = 13.61$ years of education, $SD = .14$ vs. $M = 14.44, SD = .08$), $t(1295) = 5.19, p < .001$. There was no significant difference between those leaving and staying in the study on children's inhibitory control, $t(1013) = 0.79, p > .10$; attention focusing, $t(977) = 1.09, p > .10$; cooperation, $t(947) = 1.94, p > .05$, or maternal depressive symptoms, $t(1295) = -1.68, p > .05$. Because the present study used the full information maximum likelihood estimation method in *Mplus*, available data on all 1,298 children and families were used in the analysis. This estimation utilizes all of the available information for each of the 1,298 cases (Kline, 2005) and has been shown to produce parameter

estimates and standard errors that are more accurate than listwise deletion, pairwise deletion, or mean imputation (Acock, 2005; Enders & Bandalos, 2001).

Measures

Family risk factors—Data for the present study were obtained during face-to-face interviews in home and laboratory settings when the children were 1, 6, 15, 24, 36, 54 months, in kindergarten, and in first grade. During home interviews at one month, mothers reported their own *education* in years of schooling completed and the *child's race or ethnicity*. Maternal education was reverse-coded so that higher scores indicated lower education or more educational risk. Two dummy variables were created to represent Black and Hispanic ethnic minorities.

Family income information was obtained during maternal interviews at 1, 6, 15, 24, 36, and 54 months. An *income-to-needs ratio* was computed for each assessment point by dividing total family income (including government assistance) by the appropriate yearly poverty threshold for household size and number of children under 18. Since family income often fluctuates over time, to more accurately represent a family's average financial situation over the first 54 months of the child's life, the income-to-needs ratios were averaged over the six time points (NICHD ECCRN, 2001a). Correlations between time points ranged from .53 to .83. The Cronbach's alpha coefficient for this variable was .94. In the present study, the mean income-to-needs ratio from 1 to 54 months was log transformed to normalize the distribution pattern (Kline, 2005, Research Triangle Institute [RTI], 1998a), and reversed to better capture risk. Thus, higher scores indicate more socioeconomic risk.

Maternal depressive symptoms were assessed using the Center for Epidemiological Studies Depression Scale (CES-D; Radloff, 1977) at 1, 6, 15, 24, 36, and 54 months. For this measure a general cutoff score of 16 is used to define potentially serious "clinical levels" of depression (Radloff, 1977). In the present study, binary variables indicating if the mother was above the 16-point cut off for depression at each time point from 1 to 54 months were created and then averaged. The average was then multiplied by six to create a scale ranging from 0 to 6, representing the average number of time points in which the mother was depressed. Mothers with higher scores had high levels of depressive symptoms over more time points during their children's first four-and-a-half-years of life. Correlations between maternal depression variables ranged from .39 to .58 over the six assessment periods. Cronbach's alphas for the CES-D scale ranged from .88 to .91 across the six time points and the alpha for the combined variable was .84 (NICHD ECCRN, 1999; RTI, 1998b).

Parent-rated behavioral regulation at 54 months—A latent variable for parent-rated behavioral regulation at 54 months was composed of the attentional focusing and inhibitory control subscales from the Child Behavior Questionnaire (CBQ; Rothbart, Ahadi, Hershey, & Fisher, 2001). *Attentional focusing* is the capacity to maintain attentional focus on task-related activities. The attentional focusing subscale includes eight items asking how well children complete a task or how easily they become distracted. The loading for this indicator variable was .76, $p < .001$. *Inhibitory control* is the capacity to plan and to suppress inappropriate approach responses under instructions or in novel or uncertain situations. The inhibitory control subscale includes 10 items asking how well children follow directions and can stop an activity when s/he is told to do so. The loading for this indicator variable was .70, $p < .001$. Cronbach's alphas were .75 for inhibitory control and .74 for attentional focusing (RTI, 1999). The two CBQ scales were correlated $r = .53$, $p < .001$. Higher scores indicated higher levels of parent-rated behavioral regulation.

Teacher-rated behavioral regulation at kindergarten—Children’s behavioral regulation at kindergarten was assessed using the mean score of the 10-item, teacher-rated Cooperation subscale of the Social Skills Rating System – Teacher Form (SSRS; Gresham & Elliott, 1990). Although often considered a component of social competence, examination of the items and correlations indicated that this subscale closely resembled the attention and inhibitory control aspects of behavioral regulation. SSRS items tapping attention include paying attention to the teacher’s instructions and finishing classroom assignments within time limits. Items tapping inhibitory control include following directions, using time appropriately, and making transitions without being disruptive (Gresham & Elliott, 1990). Items in the Cooperation subscale at kindergarten were also positively correlated to the items in the CBQ inhibitory control ($r = .28, p < .001$) and attentional focusing ($r = .23, p < .001$) subscales rated by parents at 54 months, which provides evidence of construct validity and stability over time. Cronbach’s alpha for items on the cooperation subscale was .92 (RTI, 2000a). Higher scores indicated higher levels of perceived behavioral regulation in the classroom.

Academic achievement in first grade—Achievement in first grade was measured using subtests from the Woodcock-Johnson Psycho-Educational Battery – Revised (WJ-R; Woodcock & Johnson, 1989) administered during the spring of the child’s first grade year. *Reading* achievement at first grade was assessed with the Letter-Word Identification subtest, which involves the child’s ability to match a pictographic representation of a word with an actual picture of the object and identify isolated letters and words. *Math* achievement was assessed through the Applied Problems subtest, which measures the child’s skill in analyzing and solving practical problems in math. *Vocabulary* was assessed through the Picture Vocabulary subtest, which measures the ability to recognize and name pictured objects. Cronbach’s alpha coefficients for the study sample were: Letter-Word Identification = .92, Applied Problems = .83, Picture Vocabulary = .72 (RTI, 2000b). Raw scores on all three academic outcomes were converted into standard scores ($M = 100, SD = 15$) for use in this model.

Results

Descriptive statistics are listed in Tables 2 and 3. As expected, early family risk factors (including Black ethnicity, maternal education, income-to-needs ratio, and maternal depressive symptoms) were significantly correlated with reading, math, and vocabulary, with higher risk indicating lower achievement. In addition, family risk factors were significantly correlated with behavioral regulation at 54 months and in kindergarten in that higher risk was related to lower skill levels. Aspects of behavioral regulation at 54 months and in kindergarten were positively correlated with achievement in first grade.

Structural Equation Modeling (SEM) was used to examine the relationships among early family risk factors from 1 to 54 months, behavioral regulation at 54 months and in kindergarten, and first-grade achievement. Structural equation modeling employs a simultaneous method of modeling whereby all proposed direct and indirect parameters, or paths, between the predictor and outcome variables are computed at the same time. Therefore, one structural equation model was tested using Mplus (Muthén & Muthén, 2006; see Figure 1). To account for intercorrelations among risk factors, all exogenous variables were allowed to be correlated and disturbance terms for outcome variables (reading, math, and vocabulary) were also allowed to be correlated. Standardized coefficients (betas, β) are reported for all outcomes. According to Durlak (2009), standardized path coefficients can be used as an effect size for structural equation modeling. Since the extent to which the outcomes varied by site were minimal, site was not included as a cluster variable. The intraclass correlations between the predictors and outcomes ranged from 0.00 and 0.02 for the behavioral regulation variables, and from 0.00 and 0.06 for the academic outcomes.

Mplus analysis provides the direct and indirect effect coefficients and performs tests of significance for each separate path in the model as well as assesses how well the hypothesized model fits the data. In this analysis, multiple goodness-of-fit statistics were reported in addition to the chi-square statistic because the overall chi-square statistic was affected by the large sample size. The chi-square value for the model was statistically significant ($\chi^2(8) = 39.22$, $p < .001$). Other measures of fit, including the comparative fit index (CFI = .98) and the standardized root mean square residual (SRMR = .02), indicated a good model fit. The root mean square error of approximation (RMSEA) in this analysis indicated a close approximate fit at .06, with a 90% confidence interval of .04 – .07. Thus, despite the significant chi-square, fit indices indicated an excellent fit of the model to the data (Hu & Bentler, 1999; Kline, 2005).

Based on the structural equation model tested, early family risk factors, including minority status, maternal education, income-to-needs ratio, and maternal depressive symptoms, explained 18% of the variance in 54-month behavioral regulation and 15% of the variance in behavioral regulation at kindergarten. Early family risk factors, behavioral regulation at 54 months, and behavioral regulation in kindergarten accounted for 17% of the variance in first-grade reading achievement, 26% of the variance in first-grade math achievement, and 28% of the variance in first-grade vocabulary achievement.

Relations among Family Risk, Behavioral Regulation, and Academic Achievement

Family risk and behavioral regulation—A number of direct relations were observed between the early family risk factors and behavioral regulation at 54 months and in kindergarten (see Table 4). For the most part, a child's ethnicity did not significantly contribute to his or her behavioral regulation, although Black children were more likely to have lower behavioral regulation as rated by teachers in kindergarten ($\beta = -.09$, $p < .05$). Lower maternal education was associated with lower parent-rated behavioral regulation at 54 months ($\beta = -.21$, $p < .001$), but not lower teacher-rated behavioral regulation at kindergarten. Likewise, children in families with a lower income-to-needs ratio from 1 to 54 months had lower behavioral regulation skills at 54 months ($\beta = -.11$, $p < .05$), but not in kindergarten. More time points of high maternal depressive symptoms predicted lower parent-rated 54-month behavioral regulation ($\beta = -.20$, $p < .001$), but did not predict teacher-rated behavioral regulation in kindergarten. In addition, higher parent-rated behavioral regulation at 54 months significantly predicted higher teacher-rated behavioral regulation in kindergarten ($\beta = .30$, $p < .001$).

We also considered the possibility that mothers who reported high depressive symptoms at 54 months may have rated their children lower on behavioral regulation. Follow-up analyses found that children of mothers who were depressed at 54 months had significantly lower behavioral regulation scores than did children of mothers who were not depressed at 54 months, although the difference in means was fairly small (for inhibitory control: $M = 4.41$, $SD = .79$ (depressed mothers) vs. $M = 4.73$, $SD = .76$ (non-depressed mothers), $t = 5.66$, $p < .001$; for attention focusing: $M = 4.47$, $SD = .85$ (depressed mothers) vs. $M = 4.77$, $SD = .84$ (non-depressed mothers), $t = 4.60$, $p < .001$). In addition, maternal depressive symptoms between 1 and 36 months and maternal depressive symptoms at 54 months were both equally related to children's lower behavioral regulation at 54 months. We also found that having a depressed mother at 54 months was related to children's lower behavioral regulation as rated by kindergarten teachers although the difference in means was also small ($M = 1.52$, $SD = .44$ (depressed mothers) vs. $M = 1.62$, $SD = .39$ (non-depressed mothers), $t = 3.15$, $p < .01$).

Reading—As Table 4 indicates, Black children were more likely to have lower reading achievement scores at first grade ($\beta = -.10$, $p < .01$) with Black children scoring approximately five points lower than White children on reading ($B = -4.65$). In addition, lower maternal

education and lower average income-to-needs ratio were significantly related to lower reading achievement in first grade ($\beta = -.10, p < .05$; $\beta = -.10, p < .05$). No significant direct path to first-grade reading achievement was found for Hispanic children or for children of mothers with depressive symptoms. Children's behavioral regulation at 54 months and in kindergarten were significant predictors of first-grade reading achievement ($\beta = .16, p < .001$; $\beta = .14, p < .001$) with higher behavioral regulation related to higher reading achievement.

Math—The direct effects for math achievement were similar to those for reading (see Table 4). Ethnicity was related to math achievement where both Black and Hispanic children had significantly lower math performance, although the effect was stronger for Black children ($\beta = -.19, p < .001$) than for Hispanic children ($\beta = -.08, p < .05$). Black children scored approximately 10 points lower than White children ($B = -9.54$) and Hispanic children scored approximately five points lower than White children on mathematics ($B = -5.23$). Lower maternal education and lower income-to-needs ratio were negatively associated with children's math achievement ($\beta = -.16, p < .001$; $\beta = -.12, p < .01$), but the path between maternal depressive symptoms and math did not reach significance. Stronger behavioral regulation at 54 months and in kindergarten was related to higher math achievement ($\beta = .11, p < .01$; $\beta = .18, p < .001$).

Vocabulary—As Table 4 indicates, Black children were more likely to demonstrate lower vocabulary performance in first grade ($\beta = -.19, p < .001$) with Black children scoring approximately nine points lower than White children on vocabulary ($B = -9.01$). In addition, having a mother with lower education was negatively linked to children's vocabulary achievement in first grade ($\beta = -.21, p < .001$), with the effect being stronger for vocabulary than for reading or math. Similarly, lower family income-to-needs ratio from 1 to 54 months significantly predicted lower vocabulary performance ($\beta = -.15, p < .001$). Identification as Hispanic or having a mother with depressive symptoms had no significant effect on first-grade vocabulary. Stronger behavioral regulation at 54 months and in kindergarten was associated with higher vocabulary achievement in first grade ($\beta = .15, p < .001$; $\beta = .09, p < .01$).

Indirect Effects between Family Risk, Behavioral Regulation, and Academic Achievement

There was also evidence that a child's behavioral regulation at 54 months and in kindergarten mediated the relationship between family risk and academic achievement, although the strength of the indirect effects were relatively small (see Table 5). An indirect pathway was found through behavioral regulation at 54 months for Black children, with Black ethnicity being associated with lower first-grade reading and math achievement, in part, through its association with lower behavioral regulation at 54 months. Lower maternal education was also associated with lower first-grade reading, math, and vocabulary performance, through relations to lower behavioral regulation skills at 54 months. An additional indirect path indicated that low maternal education was related to reading, math, and vocabulary achievement through both 54-month and kindergarten behavioral regulation. Finally, more periods of maternal depressive symptoms were associated with lower reading, mathematics, and vocabulary achievement indirectly through lower behavioral regulation at 54 months and lower behavioral regulation at both 54 months and in kindergarten.

In addition to the paths from family risk to achievement, an indirect pathway was found from behavioral regulation at 54 months through behavioral regulation in kindergarten to first-grade achievement (see Table 5). Higher behavioral regulation at 54 months was associated with better behavioral regulation in kindergarten, which, in turn, predicted higher reading, math, and vocabulary achievement in first grade.

Patterns of Risk, Behavioral Regulation, and Achievement

To further examine results between early family risk and achievement, we explored how different patterns of risk and behavioral regulation were related to achievement. In this analysis, we averaged the two 54-month behavioral regulation scales together to create one variable since the factors loaded fairly equally on the latent variable (.70 and .76). Therefore, behavioral regulation was coded as high or low if children scored one standard deviation above or below the mean of the combined attentional focusing and inhibitory control subscales at 54 months and the cooperation subscale at kindergarten. Education risk included mothers who were one standard deviation below the mean on maternal education and socioeconomic risk included families who had an average income-to-needs ratio one standard deviation below the mean income-to-needs ratio. Minority status risk included Black and Hispanic children and maternal depressive symptoms were considered a risk if a mother was one standard deviation higher on the number of time points in which clinically significant levels of symptoms (CES-D > 16) were present.

Using an additive model, predicted scores were computed for each academic outcome based on the presence of each risk factor and the level of behavioral regulation. Results indicated that regardless of the presence of a risk factor, children with strong behavioral regulation scored about one-half a standard deviation higher in reading and math, and over a third of a standard deviation higher in vocabulary than children low in behavioral regulation (.49, .51, .37 respectively). For example, the estimated score on reading for Black children with high behavioral regulation was 111.59 compared to 103.90 for Black children with lower behavioral regulation. For all outcomes, higher behavioral regulation was related to higher reading, math, and vocabulary, regardless of which risk factor was present.

In addition, for any combination of risk factors, children with high behavioral regulation scored higher on all academic outcomes than children with low behavioral regulation who had the same risk factors. For example, Hispanic children from low-income families who had high behavioral regulation scored approximately six points higher on mathematics than Hispanic children from low income families who had low behavioral regulation (104.36 vs. 98.63). This was found for all combinations of risk factors on all academic outcomes. Taken together, these results suggest that behavioral regulation was an important factor for children's achievement in the context of early family risk. Children with high behavioral regulation had stronger achievement than children with low behavioral regulation, regardless of the presence or combination of risk factors.

Discussion

Findings from the present study demonstrated that Black and Hispanic ethnic minority status, low maternal education, low family income, and longer periods of high maternal depressive symptoms were negatively related to achievement in first grade directly and indirectly through a child's behavioral regulation in preschool and kindergarten. In addition, the link between behavioral regulation at 54 months and children's first-grade academic achievement was through children's kindergarten behavioral regulation. Finally, children with high behavioral regulation also performed better academically than children with low behavioral regulation, regardless of the presence of a risk factor.

Relations between Family Risk, Behavioral Regulation, and Academic Achievement

Children who were Black were significantly more likely to have lower academic performance, although results were stronger for math and vocabulary than for reading. Being Hispanic was significantly related to lower math, but not to reading or vocabulary performance in first grade. Overall, these results are consistent with previous research finding that children belonging to

racial minorities often score below average on academics (Chatterji, 2006; Denton & West, 2002; Jencks & Phillips, 1998; McKinsey & Company, 2009). However, when interpreting these results, it is important to consider the demographic characteristics of minority children in the sample. In the present study, Black and Hispanic families are over-represented in low income and low education demographic groups. That is, the majority of Black families and half of Hispanic families averaged below or near the poverty line during their child's first four-and-a-half-years of life. This lack of variability in income and education suggests that results of the present study can only be generalized to disadvantaged Black and Hispanic families.

Based on this, these results support research finding that low-income minority children face a plethora of detrimental conditions including fewer resources in the home, unsafe neighborhoods and schools, and social and economic segregation (Garcia Coll et al., 1996). This supports the notion that disadvantaged minority children have less exposure to learning materials that can support achievement, contexts that promote behavioral regulation, and opportunities to practice these skills. Results between minority status (Black or Hispanic) and achievement were especially strong for math, which could be due to a lack of opportunities to acquire a strong foundation in math at home and in school where math is not typically a focus of instruction compared to literacy (Connor, Morrison, & Slominski, 2006; NICHD ECCRN, 2002).

In the present study, Hispanic children were more likely to score higher on reading, math, and vocabulary than Black children. This could be related to the higher percentage of Hispanic families (53%) that were not poor compared to Black families (33%). In addition, Hispanic children and their mothers had to speak English to be enrolled and participate in this study, which could have limited the variability of the sample. These factors suggest that future research should include Hispanic families with a greater range of education and income to further explore the relations between ethnicity, behavioral regulation, and achievement. Moreover, to further tease out the effects of ethnicity, research would benefit from the use of multiple group analyses to determine if relations between the risk factors, behavioral regulation, and achievement were similar for different ethnic groups in the sample. This was not feasible with this sample because children were predominately White (75%) with much smaller numbers of Blacks and Hispanics (13% and 7%). These extremely unequal sample sizes make it likely that effects for the White children would have overshadowed effects for Blacks and Hispanics, and there would have been little power to detect a substantively important difference (L. K. Muthen, personal communication, March 9, 2009). Studies including samples with similar numbers of ethnic group participants would enable a better examination of this issue. In addition, future research should include sufficient samples of middle- and upper-income, well-educated Black and Hispanic children and families to better examine how demographic characteristics are related to behavioral regulation and academic achievement.

In addition to ethnic minority status, lower maternal education and income-to-needs ratio were related to lower behavioral regulation and academic achievement in first grade. These findings are congruent with previous research showing that children had more advanced receptive language, math, and reading skills from preschool to second grade if mothers were more educated (Burchinal et al., 2002) and also research indicating that low parental education is related to low behavioral regulation skills in preschool (McClelland, Cameron, Connor et al., 2007). Comparable results were found with income-to-needs ratio and match research finding that a family's income directly contributes to academic achievement (Chen et al., 1996; Denton & West, 2002; Huffman et al., 2000; Sameroff & Seifer, 1983) and behavioral regulation (Evans & Rosenbaum, 2008; Howse et al., 2003). Taken together, these findings suggest that children living in poverty may be at increased risk for poor behavioral regulation and achievement outcomes because they have less access to the resources, materials, and contexts

that promote behavioral regulation and achievement. Indirect paths were also found from maternal education to 54-month and kindergarten behavioral regulation, and academic achievement in first grade, but effects were small, which limited firm conclusions about the practical significance of the results.

Unlike the other family risk factors, maternal depressive symptoms were not directly related to first-grade academic achievement. Instead, mothers reporting more time points of serious depressive symptoms rated children as having lower behavioral regulation at 54 months. Lower 54-month behavioral regulation then contributed to lower behavioral regulation at kindergarten and achievement in first grade. Although previous research has found evidence for complex relations between maternal depression and early academic skills (Downey & Coyne, 1990; Greenburg, et al., 1999; NICHD ECCRN, 1999), little research has examined the effects of having a mother who reported being depressed over multiple time points on children's early regulatory and academic skills. In the present study, mothers reporting depressive symptoms at multiple time points may have been less emotionally available and able to provide interactions that encouraged strong behavioral regulation and achievement in children.

It is also important to consider that maternal depressive symptoms at 54 months could have influenced a parent's ratings of their child (NICHD ECCRN, 2003b). However, follow-up analyses indicated that maternal depressive symptoms between 1 and 36 months and maternal depressive symptoms at 54 months were both equally negatively related to children's behavioral regulation at 54 months. In addition, children with a depressed mother at 54 months were rated significantly lower on behavioral regulation by their teachers in kindergarten. Moreover, other research has found that although an association may exist between maternal depression and rating of behaviors, a substantive association also exists between depression and child behavior (Boyle & Pickles, 1997). These results make it is less likely that concurrent maternal depressive symptoms influenced ratings of children's behavioral regulation at 54 months, but future research should use additional measures of children's behavioral regulation to better examine this issue.

Although each of the family risk factors had a unique impact on early academic achievement, maternal education, family income, ethnicity, and maternal depressive symptoms were also interrelated. For example, studies have found that African-American and Hispanic populations were over-represented in low income groups (Duncan et al., 1994; NICHD ECCRN, 2001b). In addition, children living in poverty were more likely to have mothers with lower education levels and were more likely to be cared for by intermittently or chronically depressed mothers (Brody & Flor, 1997; NICHD ECCRN, 2001b; Petterson & Albers, 2001). Each risk factor not only influences the presence and intensity of other risk factors, but also affects the impact of the other risk factors on the outcomes. Although the present study correlated these predictors in the model, minority status, low maternal education, and low income each had a unique effect on early academic achievement. Moreover, although being Black was moderately correlated with income-to-needs ratio ($r = .39$), it is lower than is often found in studies (Magnuson & Duncan, 2006). Thus, by using an additive model it is possible that Black minority status was somewhat disentangled from low income-to-needs ratio. This coincides with recent research suggesting that the racial and income achievement gaps may be independent (McKinsey & Company, 2009). Results of the present study suggest that being Black or of low income were each uniquely related to lower behavioral regulation and academic achievement. In other words, each factor influenced behavioral regulation and academic achievement above and beyond the effects of the other[0] variable. However, it is also possible that other unmeasured family and demographic variables aside from income may account for reasons that Black performed lower on academic achievement. Future research should include a broader array of relevant variables to further tease apart the possible confounds among risk factors.

The Role of Behavioral Regulation

Higher parent-rated behavioral regulation at 54 months and teacher-rated behavioral regulation in kindergarten significantly predicted higher reading, math, and vocabulary skills in first grade. These results support previous research finding that behavioral regulation (including attention, working memory, and inhibitory control) significantly predicts early academic achievement in preschool and elementary school (McClelland et al., 2006; McClelland, Cameron, Wanless et al., 2007; McClelland et al., 2000; Ponitz et al., 2009). Children with higher behavioral regulation are likely better able to attend to specific cues, remember instruction, stay on task, tune out irrelevant information, and process information necessary to complete tasks, all of which contributes to their ability to succeed in school settings and perform well academically. In addition, recent research has found that attentional aspects of behavioral regulation significantly predict achievement from kindergarten to adolescence and into young adulthood (Duncan et al., 2007; Vitaro et al., 2005). Although we did not measure working memory in the present study, results suggest that the attention and inhibitory control aspects of behavioral regulation are important for children's academic success in first grade.

Although behavioral regulation at 54 months and in kindergarten predicted all academic outcomes, small differences in predictability emerged based on the rater of behavioral regulation and time point in which it was rated. Parent-rated behavioral regulation at 54 months was a somewhat stronger predictor of first-grade vocabulary compared to teacher-ratings of these skills in kindergarten. In addition, teacher-rated behavioral regulation in kindergarten was somewhat more strongly related to math skills in first grade compared to parent-ratings of behavioral regulation. These patterns could suggest that parent ratings of paying attention and inhibiting inappropriate behaviors at 54 months may be especially important for vocabulary development compared to the skills being rated by teachers in classroom settings. Similarly, teacher-ratings of behavioral regulation in kindergarten may reflect the skills needed to do well in math in first grade, which is not typically emphasized in classroom instruction compared to the instructional emphasis on reading (Connor et al., 2006; NICHD ECCRN, 2002). It also suggests that as children enter kindergarten, attention and inhibitory control aspects of behavioral regulation may become increasingly important for math, which has been found in recent research (Blair & Razza, 2007; Ponitz et al., 2009).

In addition, parent-rated behavioral regulation at 54 months significantly predicted teacher-rated behavioral regulation in kindergarten. Parent and teacher measures of behavioral regulation were used in order to better capture these skills over time. Moreover, despite being rated at different points in time, by different raters, and on different measures, behavioral regulation at 54 months was a moderate predictor of behavioral regulation in kindergarten ($\beta = .30, p < .001$). This shows stability over time and supports the construct validity of the measures used to assess behavioral regulation. In addition, when controlling for all other variables in the model, kindergarten behavioral regulation mediated the influence of behavioral regulation at 54 months on children's achievement in first grade. This supports previous research suggesting that children's early behavioral regulation is related to the skills needed to be successful in classroom learning contexts and also to children's early achievement (McClelland, Cameron, Wanless et al., 2007).

Patterns of Risk, Behavioral Regulation, and Achievement

Findings also illuminated patterns of risk and behavioral regulation that contribute to children's achievement. Behavioral regulation emerged as an important factor for children's achievement in the context of early family risk. For example, regardless of having a risk factor present (minority status, low maternal education, low income-to-needs ratio, or high maternal depressive symptoms) children with strong behavioral regulation scored about one-half a standard deviation higher in reading and math and over a third of a standard deviation higher

in vocabulary than children low in behavioral regulation. In addition, for children with the same number of risk factors, those with high behavioral regulation did better academically than children with low behavioral regulation. These results can be tied to previous research finding that behavioral regulation is a significant predictor of children's academic achievement (McClelland et al., 2006; McClelland, Cameron, Wanless et al., 2007; Ponitz et al., 2009). In addition, the present study adds to the growing body of literature on the importance of behavioral regulation for academic achievement by finding that children who are better able to regulate their behavior perform better academically regardless of the presence and combination of risk factors the children experience. Since behavioral regulation is amendable to change, this provides significant implications for intervention work in this area (Diamond, Barnett, Thomas, & Munro, 2007; Tominey & McClelland, 2010).

Practical Implications

This study extends previous research by illuminating mechanisms through which early risk influences academic achievement and results point to a number of practical implications. First, as found in many other studies, children of mothers with low education and children living in low-income households are important populations to target for intervention given direct relations between these risk factors and academic achievement. Moreover, results support efforts to increase the availability of resources, learning materials, and contexts that promote early achievement and behavioral regulation for disadvantaged children.

Second, this study emphasizes the role that early behavioral regulation plays in children's academic development. Behavioral regulation at 54 months and in kindergarten directly contributed to academic achievement in first grade after controlling for family risk factors. In addition, children with high behavioral regulation had stronger reading, math, and vocabulary than children with low behavioral regulation, regardless of the presence of risk. These results suggest that early behavioral regulation (as measured by attention and inhibitory control) is an important area to focus intervention efforts, and may be an effective way to promote early achievement, especially for children who are disadvantaged and who have mothers with high levels of depressive symptoms.

Interventions targeting behavioral regulation can include providing emotional support and verbal feedback when a child is having difficulty regulating his or her behavior, creating opportunities to engage in challenging socio-dramatic roles requiring behavioral regulation skills, and playing games that integrate attention and inhibitory control (McClelland, Cameron, Wanless et al., 2007; Tominey & McClelland, 2010). In particular, several interventions in the classroom setting have been found to be successful in enhancing children's behavioral regulation. The *Tools of the Mind* curriculum, which includes socio-dramatic play, encouraging children to use private speech, and teaching children to draw pictures, has been found to significantly increase preschooler's attention and inhibitory control (Diamond et al., 2007). Such interventions, especially during preschool and the early school years, can strengthen children's ability to successfully navigate classroom settings including the skills that help children stay on-task, inhibit impulses, and persist through difficulty. Because the foundation of behavioral regulation is formed during early childhood, interventions during this time that focus on families and children would be particularly crucial for supporting early academic success.

Limitations and Future Directions

Although this study provides important information about pathways from early risk factors to academic achievement in first grade, there were several limitations. First, the nature of the recruited sample suggests that families with multiple or severe risk factors were under-represented. The NICHD study aimed to assess normative development, therefore, the sample

enrolled in the study did not include children who were unhealthy at birth, children of adolescent or non-English-speaking mothers, or those that lived in neighborhoods deemed unsafe. In addition, those who left the study or had missing data were more likely to be Black, have lower income-to-needs ratios, and low maternal education. Therefore, the sample does not represent a large number of at-risk children and families, which could have restricted the ability to detect associations and contributed to small effect sizes. However, it is notable that significant results were found given this limited variability. Future research would benefit from samples with a wider range of demographic and socioeconomic backgrounds to further explore the relation between early risk factors and academic achievement and tease out the confound between risk factors. A related limitation was that information on maternal education not assessed over time as was done with family income, which would be important to include in future research.

Second, children's behavioral regulation at 54 months was based on maternal report and behavioral regulation at kindergarten was rated by teachers. Although the best measures available were used at each time point, these parent and teacher ratings may be influenced by perceptions and well-being, rather than reflecting actual child behavior (McClelland, Cameron, Connor et al., 2007; McClelland & Morrison, 2003). Future studies would benefit from exploring direct methods of assessing behavioral regulation skills (McClelland, Cameron, Connor et al., 2007; Ponitz et al., 2008; Ponitz et al., 2009).

Finally, this study does not account for all of the influences affecting a child's early academic trajectory and focused on distal socio-demographic factors rather than proximal factors such as parenting and the home environment. Although research has examined these proximal processes more comprehensively than distal factors in relation to behavioral regulation and achievement (e.g., Morrison et al., 2005; NICHD ECCRN, 2003b), future research should include both proximal and distal factors in models to capture a more complete understanding of children's early academic trajectories. Despite these limitations, however, this study contributes to the growing body of literature on the complex relations between early family risk, children's behavioral regulation during the transition to kindergarten, and early academic achievement.

Conclusion

The present study found that a number of family risk factors shaped a child's first-grade academic achievement and highlights the importance of behavioral regulation for early school success. Minority status, low maternal education, and low family income had significant negative effects on reading, math, and vocabulary achievement in first grade. In contrast, longer periods of high maternal depressive symptoms had a small but significant negative indirect effect on achievement through behavioral regulation. Modest negative indirect effects were also found from minority status and low maternal education through poor behavioral regulation to lower first-grade achievement. Finally, behavioral regulation at 54 months and in kindergarten significantly contributed to a child's achievement after controlling for the effects of early family risk factors and served to boost children's academic achievement. Results shed light on the factors that shape children's early regulatory and achievement trajectories which are essential for promoting academic success in the transition to school and beyond.

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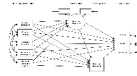


Figure 1.
Model of first-grade academic achievement

Table 1

Education and Income of Families in the Sample, by Ethnicity N = 1,298

Risk Factors	Hispanic		Black		White		Total	
	n	%	n	%	n	%	n	%
Maternal education								
< 12 th grade	17	20	29	17	84	8	130	
High school graduate	23	28	59	34	192	18	274	
Some college	29	35	74	43	332	32	435	
Bachelor's degree	9	11	7	4	255	24	271	
Postgraduate work	5	6	4	2	178	17	187	
Income-to-needs ratio ^a								
Poor	16	19	76	44	76	7	168	
Near Poor	22	27	40	23	140	13	202	
Not Poor	44	53	57	33	818	79	919	

Note. Due to missing data, all numbers do not add up to 100%

^aIncome-to-needs ratio averaged over six time points from 1 to 54 months. Poor equals averaging below the poverty line, Near poor equals averaging from the poverty line to 180% of poverty, Not poor equals averaging over 180% of the poverty line.

Table 2

Means, Standard Deviations, and Range of Predictor, Mediator, and Outcome Variables (N = 1,298)

Variables	M	SD	Range
Predictor variables			
Hispanic child ^a	.06	.24	0–1.00
Black child ^b	.13	.34	0–1.00
Maternal education ^c	14.23	2.50	7.00–21.00
Income-to-needs ratio ^d	3.36	2.63	.13–23.79
Maternal depressive symptoms ^e	1.19	1.68	0–6.00
Mediator variables at 54 months			
CBQ: Inhibitory control ^f	4.64	.78	2.00–6.70
CBQ: Attention focusing ^f	4.68	.85	1.63–6.88
Mediator Variable at kindergarten			
SSRS: Cooperation ^g	1.58	.40	0–2.00
Outcome variables at first grade			
Reading: WJ-R letter-word identification ^h	111.39	15.73	51–152
Math: WJ-R applied problems ^h	109.95	17.28	46–163
Vocabulary: WJ-R picture vocabulary ^h	104.48	15.77	44–151

^aChild Ethnicity: 0 = Non-Hispanic, 1 = Hispanic.

^bChild Ethnicity: 0 = Non-Black, 1 = Black.

^cMaternal education, prior to reverse coding.

^dIncome-to-needs ratio averaged over the six time points from 1 to 54 months, prior to log transformation. Score of 1.00 indicates income at poverty threshold.

^eMaternal depressive symptoms represents the average number of time points in which the mother was depressed from 1 through 54 months.

^fCBQ = Child Behavior Questionnaire, average of eight items (attention) and 10 items (inhibitory control) on a scale from 1 – 7.

^gSSRS = Social Skills Rating System –Teacher Form, average of 10 items on a scale from 0 – 2.

^hWJR = Woodcock-Johnson Psycho-Educational Battery – Revised.

Table 3

Correlations between Predictor, Mediator, and Outcome Variables (N = 1,298)

Variables	1	2	3	4	5	6	7	8	9	10	11
1. Hispanic child	–										
2. Black child	-.10*	–									
3. Maternal education ^a	.13*	.21*	–								
4. Income-to-needs ratio: 1–54 mo. ^b	.10*	.39*	.61*	–							
5. Maternal depressive symptoms: 1–54 mo.	.03	.18*	.27*	.35*	–						
6. CBQ: Inhibitory control	-.03	-.08*	-.20*	-.22*	-.26*	–					
7. CBQ: Attention focusing	-.04	-.18*	-.29*	-.26*	-.19*	.53*	–				
8. SSRS: Cooperation	.00	-.19*	-.21*	-.23*	-.12*	.28*	.23*	–			
9. WJ-R: Reading	-.05	-.22*	-.28*	-.30*	-.16*	.19*	.25*	.26*	–		
10. WJ-R: Math	-.09*	-.32*	-.36*	-.38*	-.18*	.19*	.25*	.31*	.57*	–	
11. WJ-R: Vocabulary	-.06	-.33*	-.41*	-.42*	-.18*	.18*	.29*	.25*	.39*	.48*	–

^aMaternal education reversed.^bAverage income-to-needs ratio reversed and log transformed.* $p < .05$.

Table 4

Direct Paths Between Family Risk, Behavioral Regulation, and Achievement

Direct Paths	Behavioral regulation (54 months)		Behavioral regulation (Kindergarten)		Reading (Grade 1)	
	B(SE)	β	B(SE)	β	B(SE)	β
Hispanic child	-.02(.08)	-.01	.04(.05)	-.02	-1.83(1.96)	-.03
Black child	-.10(.07)	-.07	-.11(.04)	-.09*	-4.65(1.59)	-.10*
Maternal education ^a	-.05(.01)	-.21*	-.01(.01)	-.05	-.63(.25)	-.10*
Income-to-needs ratio: 1 – 54 mo. ^b	-.07(.04)	-.11*	-.04(.02)	-.08	-1.96(.86)	-.10*
Maternal depressive symptoms: 1 – 54 mo.	-.06(.02)	-.20*	.01(.01)	.03	-.12(.33)	-.01
Behavioral regulation: 54 months			.22(.03)	.30*	4.71(1.32)	.16*
Behavioral regulation: Kindergarten					5.52(1.34)	.14*

Direct Paths	Math (Grade 1)		Vocabulary (Grade 1)	
	B(SE)	β	B(SE)	β
Hispanic child	-5.23(2.03)	-.08*	-1.92(1.83)	-.03
Black child	-9.54(1.63)	-.19*	-9.01(1.49)	-.19*
Maternal education ^a	-1.13(.25)	-.16*	-1.32(.23)	-.21*
Income-to-needs ratio: 1 – 54 mo. ^b	-2.50(.88)	-.12*	-2.98(.80)	-.15*
Maternal depressive symptoms: 1 – 54 mo.	-.03(.34)	-.00	.18(.31)	.02
Behavioral regulation: 54 months	3.58(1.32)	.11*	4.22(1.24)	.15*
Behavioral regulation: Kindergarten	7.45(1.37)	.18*	3.34(1.26)	.09*

^aMaternal education reversed.

^b Average income-to-needs ratio reversed and log transformed.

* $p < .05$.

Table 5

Significant Indirect Paths Between Family Risk, Behavioral Regulation, and Achievement

Indirect Paths	Reading (Grade 1)		Math (Grade 1)		Vocabulary (Grade 1)	
	B(SE)	β	B(SE)	β	B(SE)	β
Through behavioral regulation at 54 months						
Black child	-.60(.28)	-.01*	-.80(.36)	-.02*		
Maternal education ^a	-.22(.08)	-.03*	-.16(.07)	-.02*	-.19(.07)	-.03*
Maternal depressive symptoms	-.30(.10)	-.03*	-.23(.10)	-.02*	-.27(.09)	-.03*
Through behavioral regulation at 54 months and at kindergarten						
Maternal education ^a	-.06(.02)	-.01*	-.08(.02)	-.01*	-.03(.02)	-.01*
Maternal depressive symptoms	-.08(.03)	-.01*	-.11(.03)	-.01*	-.05(.02)	-.01*
Through behavioral regulation at kindergarten						
Behavioral regulation at 54 months	1.22(.34)	.04*	1.65(.38)	.05*	.74(.29)	.03*

^aMaternal education reversed.

* $p < .05$.