

**Associations among Family Environment, Attention, and School Readiness
for At-Risk Children**

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Abstract

This study examined the developmental pathways from children's family environment to school readiness within an at-risk sample ($N = 1,701$). Measures of the family environment (maternal parenting behaviors and maternal mental health) across early childhood were related to children's observed sustained attention as well as to academic and behavioral outcomes at age 5 years. Results suggest specificity in the associations among attention and its correlates. Maternal parenting behaviors but not mental health explained individual differences in sustained attention, which in turn were associated with variability in children's academic school readiness. Mediation tests confirmed that sustained attention partially accounted for the link between parenting behaviors and academic school readiness. While maternal mental health was associated with children's behavioral school readiness, sustained attention did not play a mediating role. Findings indicate sustained attention as a potential target for efforts aimed at enhancing academic school readiness among predominantly poor and minority children.

Associations among Family Environment, Attention, and School Readiness for At-Risk Children

Attention generally refers to a complex set of physiological and behavioral responses that are driven by stimuli in the environment or consciously controlled by the individual (Rueda, Posner, & Rothbart, 2005). One aspect of attention that has received increased interest in recent years is sustained attention. Sustained attention (also referred to as focused attention; Ruff, 1986; Eisenberg et al., 2004) describes a fundamental component of attention characterized by the ability to direct cognitive resources to a stimulus and process information associated with the stimulus (Ruff & Rothbart, 1996; Sarter, Givens, & Bruno, 2001). Specifically, sustained attention allows children to intentionally focus attention on a particular target in the environment and avoid distraction over time (Derryberry & Rothbart, 1997).

The voluntary control of attention emerges during a child's first year of life and continues to develop across the early childhood years (Ruff & Rothbart, 1996). Extant literature suggests that an important influence on the development of sustained attention is the family environment (Dilworth-Bart, Khurshid, & Vandell, 2007; Groot, de Sonnevill, Stins, & Boomsa, 2004; NICHD Early Child Care Research Network [ECCRN], 2003, 2005). Collectively, the above studies support both negative and positive associations between a variety of maternal and home environment characteristics and individual differences in children's sustained attention across early childhood. These findings have important implications for children's school readiness, as there is accumulating research to suggest that sustained attention is associated with both academic and behavioral outcomes and may be a key mechanism underlying the association between family environment and children's school readiness (Belsky, Fearon, & Bell, 2007; Miech, Essex, & Goldsmith, 2001; NICHD ECCRN, 2003).

Despite the growing interest in children's sustained attention, the majority of research in this area has been conducted with European American and socioeconomic-advantaged families (e.g., Davies, Woitach, Winter, & Cummings, 2008), as well as with a select dataset - the NICHD Study of Early Child Care and Youth Development (SECCYD; Belsky et al., 2007; Dilworth-Bart et al., 2007; NICHD ECCRN, 2003, 2005). Of interest is whether the associations among family environment, sustained attention, and school readiness would generalize to children from low-income or minority backgrounds, particularly given that family environments vary across socioeconomic and cultural contexts (Bradley, Corwyn, McAdoo, & García Coll, 2001; Brooks-Gunn & Markman, 2005; Hart & Risely, 1995; Lareau, 2000). For example, poor and minority children typically experience less stimulation and routine in their homes (Bradley et al., 2001; Brody & Flor, 1997), which could adversely affect the development of their self-regulatory mechanisms, including attention. Indeed, the limited research in this area shows that poor and minority children score lower than their peers on sustained attention (Dilworth-Bart et al., 2007; Mezzacappa, 2004; Miech et al., 2001), but it is unknown whether or to what degree their poorer sustained attention explains their lower school readiness. Thus, the purpose of this study is to examine associations among the family environment, sustained attention, and school readiness within a national dataset representing at-risk children and families. Understanding the factors that promote school readiness is especially important for such children, as they are at increased risk for school failure (Klebanov, Brooks-Gunn, McCarton, & McCormick, 1998; McLoyd, 1998) and behavior problems (Buckner, Mezzacappa, & Beardslee, 2003; Lengua, 2002).

The Association Between Family Environment and Sustained Attention

The family environment plays a critical role in the development of sustained attention according to Bronfenbrenner's bioecological model of human development, which views lives in context and considers person-environment interactions key to understanding development (Bronfenbrenner, 1979; Bronfenbrenner & Morris, 2006). Specifically, voluntary aspects of attention, including sustained attention, are thought to emerge in the social context of the early family environment and are believed to be shaped by the continuing interaction between the child and his/her environment (Ruff & Rothbart, 1996).

Research on associations between family context and sustained attention has focused almost exclusively on aspects of the mother-child relationship, such as parenting style and attachment status. For example, maternal responsiveness is consistently associated with higher levels of both concurrent and later attention (Belsky et al., 2007; Bornstein & Tamis-LeMonda, 1989; Findji, 1993). In contrast, negative aspects of the mother-child relationship, such as intrusiveness and insecure child-mother attachment, have been linked to poorer attention outcomes (Fearon & Belsky, 2004; Hubbs-Tait, McDonald Culp, Culp, & Miller, 2002). Thus, it appears that supportive parenting helps children sustain attention during activities and gradually assume responsibility for their cognitive monitoring, while unsupportive parenting limits children's practice with attention regulation (Jacobvitz & Sroufe, 1987; Smith, Landry, Miller-Loncar, & Swank, 1997). Collectively, these studies demonstrate the responsiveness of attention to early socialization practices and highlight the importance of early mother-child interaction as a key context for the development of children's attentional processes.

The effects of family environmental factors aside from mother-child interaction, such as stimulating learning materials, family routines, and maternal mental health, are well-documented with respect to young children's academic and behavioral status (for a review, see Bradley &

Corwyn, 2006). The influence of these aspects of the broader family context on children's attention has received less consideration. The few studies that do exist, however, suggest that family processes beyond the mother-child relationship have implications for sustained attention. For example, maternal depression was negatively associated with focused attention in early childhood (Breznitz & Friedman, 1988; Gartstein & Fagot, 2003). Maternal stress has also been linked to attention problems, although in middle-childhood (Barry, Dunlap, Cotten, Lochman, & Wells, 2005). Moreover, the quality of the home environment, as indexed by a composite of the Home Observation for Measurement of the Environment (HOME; Caldwell & Bradley, 1984) and ratings of maternal sensitivity and cognitive stimulation, was positively associated with children's sustained attention (NICHD ECCRN, 2003).

Although the above-cited studies contribute to our understanding of how the family environment influences children's sustained attention, they are limited in that they either focus exclusively on one factor or they examine a multifaceted composite without disentangling its components. Thus, the present study examines two distinct factors in the family environment (maternal parenting and maternal mental health), individually and simultaneously to assess their relative explanatory power. Identifying these processes should inform prevention and intervention efforts, given that different family processes suggest different courses of action.

The Association Between Sustained Attention and School Readiness

Attentional processes are thought to be fundamental to controlled cognitive activities and social behavior (Calkins & Fox, 2002; Eisenberg et al., 2005; Lawson & Ruff, 2004). Sustained attention, in particular, is thought to underlie higher aspects of attention and cognitive competence in general (Sarter et al., 2001). A growing body of evidence supports these claims, as sustained attention has been associated with both cognitive performance (Carter & Swanson,

1995; Choudhury & Gorman, 2000) and behavioral regulation (Eisenberg et al., 2005; NICHD ECCRN, 2003) across early childhood. Furthermore, deficits in sustained attention have been linked with disorders such as ADHD (Barkley, 1997; Rothbart, Posner, & Hershey, 1995) and are believed to be closely associated with executive function skills that underlie planning and goal-directed behavior, such as working memory (Levy & Hobbes, 1989; Silver & Feldman, 2005) and inhibitory control (Shoda, Mischel, & Peake, 1990). Thus, it is not surprising that difficulties in sustained attention are associated with both concurrent levels of school adjustment and decreases in school adjustment over time (Davies et al., 2008).

In addition to its direct implications for children's school readiness, sustained attention may also mediate the established association between the family environment and school readiness (e.g., Bornstein & Tamis-LeMonda, 1989; Bradley & Caldwell, 1984; Shonkoff & Phillips, 2000). For example, the NICHD SECCYD found that children's attention skills at 54 months partially mediated associations between the quality of their family environment from ages 6 to 54 months and their academic and behavioral competence at 54 months and first grade (NICHD ECCRN, 2003). More recently, Belsky et al. (2007) reported that attention control in the 1st grade partially mediated both the effect of maternal sensitivity at 54 months on externalizing behavior in 3rd grade and the effect of maternal sensitivity in 1st grade on externalizing behavior in 5th grade.

If sustained attention is a key mechanism underlying the link between children's early home environment and their school readiness, it may serve as an additional target for prevention and intervention programs remediating poor school performance and problem behavior in early childhood. Additional research in this area is needed, however, as the existing literature has been limited to a single dataset (the NICHD SECCYD). Thus, the present study examines the

association between sustained attention and both academic and behavioral competence during early childhood in an at-risk sample. In addition, we explore sustained attention as a mediator of the association between the family environment and children's school readiness.

Attention and At-Risk Families

Despite the increased interest in sustained attention, most research to date has been conducted with a select population. Specifically, we know about sustained attention and its correlates primarily through work with European American, middle- and upper-income samples (e.g., Belsky et al. 2007; Davies et al, 2008; NICHD ECCRN, 2003, 2005). This trend has begun to change in recent years, however, as the investigation has extended to ethnic minorities and children living in poverty. For example, research suggests that children from low SES backgrounds enter school with lower levels of sustained attention compared to their more advantaged peers (Levy & Hobbes, 1979; Norman & Breznitz, 1992). Moreover, research with ethnically diverse children suggests that attentional skills vary across European American, African American, and Hispanic children, independent of SES (Mezzacappa, 2004).

Such findings likely reflect the vast differences in life experiences between poor and non-poor children, and between European-American and minority children (Duncan & Brooks-Gunn, 1997). One consequence of these differences may be that certain environmental factors may moderate or mediate risk in some subgroups but not others. In other words, even if we observe the same associations between the family environment and school readiness across multiple subgroups, it is possible that different mechanisms are responsible for those observed associations. For example, although the family environment predicted sustained attention in the predominantly European American NICHD SECCYD dataset (NICHD ECCRN, 2003), subsequent analyses suggest that one measure of the family environment (the HOME) predicted

inattention among European Americans but not among African Americans (Dilworth-Bart et al., 2007). This difference points to the need for research on developmental processes within diverse samples of ethnic minorities (García Coll et al., 1996).

Understanding the associations between the family environment, attention, and school readiness within at-risk samples is of particular importance. Both poor and minority children enter school with poorer academic skills than other children (Denton & West, 2002), and they are more likely to develop behavior problems over the grade school years (NICHD ECCRN, 2004; Schmitz, 2003). Thus, school readiness deficits are potentially more severe for these children and are therefore a critical target for early intervention.

The Current Study

The main objective of this study was to increase our understanding of sustained attention and its correlates across early childhood among at-risk children. As discussed previously, children from minority and low SES backgrounds are at heightened risk for cognitive and behavioral problems (Klebanov et al., 1998; McLoyd, 1998; Lengua, 2002; Schmitz, 2003). Thus, it is imperative that we identify the factors associated with, as well as the consequences of, individual differences in children's sustained attention. The first aim was to examine the longitudinal association between the family environment and children's sustained attention. Particular attention is paid to the possibility of differential effects on attention of maternal parenting behaviors and mental health, both of which are known predictors of children's cognitive and behavioral status at school entry (e.g., Anhalt, Telzrow, & Brown, 2007; Estrada, Arsenio, Hess, & Holloway, 1987; McDonald Culp, Hubbs-Tait, Culp, & Starost, 2000; NICHD ECCRN, 1999, 2004; Yeung, Linver, & Brooks-Gunn, 2002). The second aim of the study was to explore the concurrent link between sustained attention and both academic and behavioral

competence in early childhood. Finally, the third aim was to explore the associations among the family environment, sustained attention, and school readiness within a single model, with a specific interest in examining sustained attention as a mediator of the link between family environment and school readiness.

Method

Participants

The Fragile Families and Child Wellbeing Study follows a birth cohort of approximately 4,900 children in 20 cities across the U. S. By design, children born to unmarried parents were oversampled ($n = 3,712$ versus $n = 1,186$ born to married parents). The cities were selected to be representative of all U. S. cities with populations of 200,000 or more (for further information on sample selection see Reichman, Teitler, Garfinkel, & McLanahan, 2001). Hospitals were sampled within cities, and births were sampled within hospitals. Mothers were first interviewed in the hospital within 48 hours of giving birth, and fathers were interviewed as soon as possible thereafter. Both mothers and fathers were interviewed by phone at child ages 1, 3, and 5 as part of the core study.

We draw on data from a substudy of the core called the In-Home Longitudinal Study of Preschool Aged Children. At the age 3 and age 5 phone surveys, mothers were invited to take part in an in-home data collection substudy. Mothers who agreed to participate (79% at age 3 and 91% at age 5) were visited by data collectors in their homes. During the home visit at both timepoints, mothers were interviewed, the home environment was observed and children were directly assessed. Families who had moved out of the area were eligible to complete the interview by phone. At 18 of the 20 cities, an additional module called Child Care and Parental

Employment (CCPE) in Fragile Families was administered. Children's attention was assessed as part of this module.

Of the 2,848 families who participated in the CCPE module at the age 3 wave, 2,216 (78%) were eligible for inclusion in our analytic sample because they had complete information on their family environment. The most common reason for incomplete information was mode of data collection; phone participants lacked observational items that contributed to the home environment scale. Eligible cases tended to be more socioeconomically disadvantaged than ineligible cases. It is possible that families who moved out of the area did so due to improving economic circumstances. Eligible cases were also more likely to be African American than ineligible cases (55% versus 37%).

Of the 2,216 cases with family environment information, approximately one-quarter ($n = 515$) were excluded because they were missing data on child attention or school readiness at age 5. Missingness was due to attrition in approximately half these cases, and to participation by phone (which prevented direct assessment of the child) in the other half. Cases without child attention or school readiness data tended to be more socioeconomically advantaged, thus correcting much of the bias introduced by dropping cases without family environment data. As a result, the final analytic sample ($n = 1,701$) closely resembled the original CCPE sample, although it contains more African American mothers and female children than the original sample (54% and 50%, respectively, compared to 51% and 48%).

In sum, members of the analytic sample were generally socioeconomically disadvantaged. Forty-three percent of mothers met the federal definition of poverty at baseline, and 50% lived without a spouse or partner. One-third of mothers did not complete high school, another one-third completed high school or obtained a GED, and another one-third attended

some college. The mean age at first birth was 21. Approximately half the mothers (54%) were African American; 22% were Hispanic; and 21% were European American. All but a negligible number of mothers coresided with their children at ages 3 and 5 and were the primary caregivers.

Procedure

Data on the children's family environment were collected at ages 3 and 5, and data on children's attention and school readiness were collected at age 5. The home visits at ages 3 and 5 were conducted by data collectors who were trained on both interviews and direct child assessments. The maternal interview covered family routines and parenting behaviors, the child's health and safety, the child's behavior problems, child care arrangements, and maternal employment. Data collectors made observations on the mother and child's interaction, the child's hygiene, the interior of the residence and features of the environment immediately outside. Data collectors also measured the child's attention, academic ability, and height and weight.

Measures

Family environment. The family environment consists of two composites, the first of which taps maternal parenting behaviors and the second of which taps maternal mental health. Both composites comprise measures gathered at child ages 3, 5, or both. The first measure in the maternal parenting composite assessed the quality of the home environment and included items from the maternal interview and data collector observation from the home visits at ages 3 and 5. Items drawn from the HOME Inventory (Caldwell & Bradley, 1984) were supplemented with items measuring the interior and exterior environment from the Homelife Interview (Leventhal, Selner-O'Hagan, Brooks-Gunn, Bingenheimer, & Earls, 2004). At age 3, there were 39 items ($\alpha = .84$) falling into the following subscales: emotional and verbal responsiveness, avoidance of punishment, appropriate play materials, interior, and exterior. At age 5, there were 35 items ($\alpha =$

.82) falling into the following subscales: learning stimulation, language stimulation, academic stimulation, warmth/acceptance, variety of experience, acceptance/lack of hostility, interior, and exterior. Scores at ages 3 and 5 were standardized and then averaged.

The second measure in the parenting composite assessed maternal engagement in parenting, which was measured at age 3 only. During the core study phone interview, mothers were asked to report the number of days last week in which they had engaged in the following five activities with their child: play games like “peek-a-book” or “gotcha,” play inside with toys, sing songs or nursery rhymes, read stories, and tell stories. These items are similar to those found in other large datasets, including the Panel Study of Income Dynamics-Child Development Study and the Early Child Longitudinal Study-Birth Cohort (Carlson & McClanahan, 2006). Responses across items ($\alpha = .73$) were averaged and then standardized. Because the engagement items were similar to some of the items capturing language and learning stimulation in the measure of home environment quality, the two were averaged into a composite measure of parenting ($r = .16, p < .001$).

The first measure of maternal mental health assessed maternal parenting stress using items drawn from the Parenting Stress Index (Abidin, 1995). At both the age 3 and age 5 home visit, mothers were asked to endorse 11 items describing stress on a 5-point scale (0 = strongly disagree, 4 = strongly agree). Sample items include “You feel trapped by your responsibilities as a parent” and “You feel alone and without friends.” At each age, items were summed (age 3 $\alpha = .86$; age 5 $\alpha = .87$), as done in other studies (e.g., Taylor, Guterman, Lee, & Rathouz, 2009). Scores at ages 3 and 5 were standardized and then averaged.

The second measure of maternal mental health captured maternal depression. During the phone interviews for the core sample at ages 3 and 5, mothers were administered the Composite

International Diagnostic Interview – Short Form (CIDI-SF) Section A (Kessler et al., 1998). Responses were used to generate an indicator variable denoting whether the mother met the criteria from the Diagnostic and Statistical Manual of Mental Disorders-IV for a major depressive episode (American Psychiatric Association, 1994). Additional information on the scoring of this measure can be found in the Fragile Families Three-Year Core Scales Documentation

(http://www.fragilefamilies.princeton.edu/documentation/core/scales/ff_3yr_scales.pdf). Scores from ages 3 and 5 were standardized and then averaged. Following Malik et al. (2007), scores on parenting stress and depression were averaged ($r = .27, p < .001$) into a single measure of maternal mental health. Higher scores indicate poorer mental health.

Sustained attention. Children's attention was measured during the age 5 home visit. The Sustained Attention task from the Leiter International Performance Scale-Revised assessed children's ability to maintain attention to a specific stimulus (Roid & Miller, 1997). Children were shown a picture of a variety of objects scattered throughout the page. There was a target object at the top of the page and children were asked to put a line through as many of the objects matching the target as possible without accidentally crossing out any other objects. Children completed four timed trials. The adjusted total correct scale score reflects the total number of correct marks adjusted for the total number of incorrect marks. Scores are standardized against a national norming sample with a mean of 10 ($SD = 3$). The task has high internal reliability ($\alpha = .83$) for children ages 4 to 5 years and good test-retest reliability ($r = .85$).

School readiness. There are four measures of school readiness that capture its academic and socioemotional dimensions, as defined by the National Education Goals Panel (Kagan, Moore, & Bredekamp, 1995). The first measure is the Peabody Picture Vocabulary Test-III

(PPVT; Dunn & Dunn, 1997), which assesses children's receptive vocabulary. During the age 5 home visit, children were read words out loud and asked to point to one of four pictures that corresponded to the word spoken by the interviewer (e.g., "Point to dog"). Raw scores were converted to age-based standardized scores ($M = 100$, $SD = 15$). The PPVT-III has high internal reliability ($\alpha = .94$) for children ages 3 to 6 years and strong validity (Williams & Wang, 1997).

The second measure of school readiness is the Woodcock-Johnson Tests of Achievement Letter-Word Identification subtest (W-J; Woodcock & Johnson, 1990), also administered at the age 5 home visit. This test assesses the child's ability to identify letters and words presented in large type in a test booklet. The W-J is nationally normed by age, with a standard score of $M = 100$ ($SD = 15$). The internal reliability for preschoolers is .92 (Woodcock & Mather, 1989).

The third measure of school readiness assessed children's externalizing behavior problems. At child age 5, mothers reported on all but 3 items from the Externalizing subscale of the Child Behavior Checklist/4-18 (CBCL; Achenbach, 1991a). For each item describing a behavior problem, mothers rated whether it was not true (0), sometimes true (1), or very true (2) of her child. Sample items include "child argues a lot" and "child has temper tantrums or hot temper." There were 30 items in all ($\alpha = .86$), which were summed. Higher values indicate more externalizing behaviors.

The fourth measure of school readiness assessed children's prosocial behaviors. Mothers reported on their child's prosocial behaviors at age 5 using the Express subscale from the Adaptive Social Behavior Inventory (ASBI; Hogan, Scott, & Bauer, 1992). There were 13 items describing prosocial behaviors such as "child will join a group of children playing" and "child is sympathetic to other children's distress." For each item describing a prosocial behavior, mothers

rated whether it was not true (0), sometimes true (1) or very true (2) of her child. Items were summed ($\alpha = .80$).

Control variables. Characteristics of the child and his or her family were included as controls in all multivariate models. These characteristics were selected based on previous literature showing their associations with family environment, sustained attention, and school readiness. Except where noted, all were captured at baseline; in a few instances, characteristics were measured at the timepoint closest to measurement of the family environment.

Indicators were created to reflect when the child was female or born low birth weight (<2500 g). The child's temperament as an infant was captured at the age 1 phone interview using the mean of three items ($\alpha = .60$) drawn from the Emotionality scale of the EAS Temperament Survey for Children (Buss & Plomin, 1984). Mothers were asked to rate how well three items described their child (often fusses and cries, gets upset easily, reacts intensely when upset) on a 5-point scale (1 = not at all like my child, 5 = very much like my child). Maternal age at first birth was also reported at the age 1 phone interview.

Race was coded according to maternal self-report as European American non-Hispanic, African American non-Hispanic, Hispanic or other. Maternal education was coded as less than high school, high school graduation or GED, or some college or more. Maternal marital status as of the in-home visit at age 3 was coded as married/cohabiting or single. A variable indicating whether the family was in poverty as of the age 3 in-home visit was coded affirmatively if the household income fell below the poverty threshold established by the U. S. Census Bureau for the preceding calendar year. A ratio of children to adults living in the household at the age 3 visit was calculated based on a household roster.

Results

Table 1 presents the means, standard deviations, and sample sizes for the predictor, mediator, and outcome variables. All variables were normally distributed with adequate skew and kurtosis. Zero-order correlations among the variables are displayed in Table 2. As expected, significant associations were found among all variables, suggesting that family environment, sustained attention, and children's school readiness outcomes are interrelated.

Analytic Approach

Data analysis involved a two-stage process. In the first stage, we identified associations between the family environment and sustained attention, which was the first aim of our study. In the second stage, we regressed school readiness outcomes on the family environment and sustained attention. This analysis addressed the second and third aims of our study, namely to identify associations between attention and school readiness, and test whether attention mediated associations between the family environment and school readiness. Separate hierarchical regression models were run for each school readiness outcome (receptive vocabulary, letter-word identification, externalizing behaviors, and prosocial behaviors). In step 1 of the model, the school readiness outcome was regressed on the two measures of family environment and all controls. In step 2, child sustained attention was added as a predictor. If the coefficient for a family environment measure decreased from step 1 to step 2, a Sobel test was conducted to determine whether attention mediated the association between that measure of family environment and that outcome. Formal mediation tests were conducted in STATA using *sgmediation*, which uses bootstrap analyses to estimate the indirect effect of the predictor variable on the dependent variable through the mediator variable. Bootstrap analysis involves drawing a large number of samples (with replacement) from a data set, computing the indirect effect for each sample, and then generating an average indirect effect across all samples.

As previously noted, all regression models included controls for city, child sex, infant temperament, low birth weight, maternal race, maternal education, marital status, maternal age at first birth, poverty status, and household adult:child ratio. The number of cases with valid values on each school readiness outcome varies; *N*s are presented in tables.

The Association Between Family Environment and Sustained Attention

Ordinary Least Squares (OLS) regression was conducted to explore the longitudinal association between the family environment across ages 3 and 5 years and children's sustained attention at age 5 years in an at-risk sample. Of particular interest was whether two key facets of the family environment (maternal parenting behaviors and maternal mental health) would be independent predictors of sustained attention. Thus, sustained attention was regressed simultaneously on maternal parenting behaviors and maternal mental health (with all controls listed above). Results support maternal parenting behaviors ($\beta = .09, p < .001$) as an independent predictor of children's sustained attention (see Table 3). A similar association was not found for maternal mental health ($\beta = -.01, ns$).

Associations Among Family Environment, Sustained Attention, and Academic School Readiness Outcomes

Hierarchical regressions were conducted to determine whether children's family environment from ages 3 to 5 and sustained attention at age 5 were associated with academic school readiness outcomes (receptive vocabulary and letter-word identification) at age 5. As shown in step 1 of Table 4, maternal parenting behaviors were strongly associated with both receptive vocabulary ($\beta = .19, p < .001$) and letter-word identification ($\beta = .13, p < .001$). In step 2, sustained attention was itself strongly associated with both receptive vocabulary and letter-word identification ($\beta = .30, p < .001$ and $\beta = .28, p < .001$, respectively). Sustained attention

accounted for 8% of the unique variance in children's receptive vocabulary, $F(1, 1648) = 209.49$, $p < .001$. Further, the coefficient for maternal parenting behaviors was somewhat reduced ($\beta = .16$, $p < .001$), suggesting partial mediation. Sustained attention also accounted for 7% of the unique variance in children's letter-word identification, $F(1, 1657) = 144.49$, $p < .001$, and decreased the standardized regression coefficient for maternal parenting ($\beta = .10$, $p < .001$), which suggests partial mediation.

A Sobel test that formally tested whether sustained attention mediated the association between maternal parenting behaviors and children's receptive vocabulary was significant ($z = 3.30$, $p < .001$; results not shown). It indicated that sustained attention mediated 14.22% of the total effect of maternal parenting behaviors on children's receptive vocabulary. Similarly, a Sobel test conducted for letter-word identification was significant ($z = 3.35$, $p < .001$), and indicated that sustained attention mediated 19.31% of the total effect of maternal parenting behaviors on children's letter-word identification.

Maternal mental health was weakly associated with receptive vocabulary, but was not associated at all with letter-word identification. Children whose mothers were in poorer mental health tended to score lower on receptive vocabulary ($\beta = -.05$, $p < .05$). However, the addition in step 2 of sustained attention to the model of receptive vocabulary did not change the coefficient for maternal mental health. Therefore, there was no evidence that sustained attention mediated the association between maternal mental health and receptive vocabulary.

Associations Among Family Environment, Sustained Attention, and Behavioral School Readiness Outcomes

The results from hierarchical regression models predicting behavioral school readiness outcomes (externalizing behaviors and prosocial behaviors) from family environment and

sustained attention are displayed in Table 5. The results from step 1 show that maternal parenting behaviors strongly predicted both externalizing behaviors and prosocial behaviors, such that children with higher-scoring mothers had fewer externalizing behaviors ($\beta = -.11, p < .001$) and more prosocial behaviors ($\beta = .20, p < .001$). Maternal mental health also strongly predicted both outcomes, such that children whose mothers were in poorer mental health had more externalizing behaviors ($\beta = .26, p < .001$) and fewer prosocial behaviors ($\beta = -.10, p < .001$).

In step 2, sustained attention was weakly associated with externalizing behaviors and prosocial behaviors. Specifically, sustained attention accounted for less than 1% of unique variance in both externalizing behaviors, $F(1, 1648) = 5.39, p < .05$, and prosocial behaviors, $F(1, 1647) = 5.95, p < .05$. Also, for both outcomes, the addition of sustained attention in step 2 failed to decrease the regression coefficient for either maternal parenting behaviors or maternal mental health. Thus, results suggest that sustained attention does not mediate the longitudinal association between the family environment and children's behavioral school readiness.

Discussion

The primary aim of this study was to examine the interrelations among the family environment, sustained attention, and school readiness in at-risk children. As expected, support was found for associations among all three constructs, suggesting that sustained attention and its correlates are important for poor and ethnically diverse children and their families. In particular, this study made three significant contributions to the attention literature. First, the present study increased our understanding of the specificity of the longitudinal association between the family environment and sustained attention. Specifically, results suggest that maternal parenting behaviors (i. e., quality of the home environment and maternal engagement in parenting), but not maternal mental health (i. e., maternal depression and stress), predict children's sustained

attention during early childhood. Second, this study furthered our understanding of the specific role of sustained attention in children's school readiness. Although sustained attention was associated with both academic competence (i.e., receptive vocabulary and letter-word identification) and behavioral competence (i.e., externalizing behaviors and prosocial behaviors), findings indicated that the former link was considerably stronger than the latter. Third, the current study extended the examination of sustained attention as a mechanism underlying associations between the family environment and school readiness outcomes to at-risk children. Results supported sustained attention as a partial mediator of the association between early maternal parenting behaviors and children's academic but not behavioral school readiness. Overall, the results suggest that the proposed associations between sustained attention and its correlates are not unique to more advantaged European Americans, but rather have important implications for promoting school readiness outcomes among children from predominantly low-income and minority backgrounds.

Developmental Pathways to School Readiness for At-Risk Children

The present study extends our understanding of the developmental pathways to school readiness for at-risk children by highlighting the role of sustained attention in this process. As expected, individual differences in sustained attention were both attributed to the family environment and responsible for variability in children's school readiness outcomes. Interestingly, however, the findings indicate specificity in the associations between attention and its correlates for these children. That is, differential associations were found between maternal parenting behaviors and maternal mental health and children's sustained attention. The positive link between maternal parenting behaviors and sustained attention is consistent with other studies (Belsky et al., 2007; NICHD ECCRN, 2003) and provides further support for the role of

developmentally-appropriate practices and materials in the development of children's self-regulatory behaviors. For example, maternal engagement and stimulating learning materials, which are characteristic of high-quality home environments, are believed to promote sustained attention by facilitating joint attention episodes with objects/people and providing children opportunities to exercise attention regulation (Saxon, Frick, & Colombo, 1997; Smith et al., 1997).

Contrary to our expectations, however, maternal mental health did not predict children's sustained attention. Although this is inconsistent with previous literature on maternal depression (Brenitz & Friedman, 1988; Garstein & Fagot, 2003), a similar lack of association has been reported between maternal stress and sustained attention (Dilworth-Bart, et al., 2007) as well as between maternal psychological wellbeing and other indices of children's self-regulation, such as executive control or executive function (Li-Grining, 2007; Rhoades, Greenberg, & Lanza, 2009). While it is possible that maternal mental health does not in fact influence children's sustained attention, an alternative explanation is that maternal mental health plays an indirect role in children's sustained attention through its documented negative effect on maternal parenting behaviors (Pett, Vaughan-Cole, Wampold, 1994; Webster-Stratton & Hammond, 1988). Moreover, it is possible that the lack of an association in this study was due to measurement variation across the two components of the family environment. Specifically, it is possible that because it relied on observation as well as self-report, the maternal parenting behaviors measure was more robust than the maternal mental health measure, thus allowing it more predictive power in analyses.

Further support for specificity in the developmental pathways was reflected by the direct and indirect effects of the family environment on children's school readiness. With respect to

direct effects, the associations between family environment and both the academic and behavioral dimensions of school readiness are consistent with previously reported findings. Maternal parenting behaviors predicted academic outcomes and prosocial behavior more strongly than did maternal mental health, while the reverse was true of externalizing behaviors. One likely reason for the strong association between parenting and the academic outcomes is the centrality of learning stimulation to the parenting measure. A greater number of items in the measure of the home environment assessed learning materials and activities than affective behaviors such as demonstrations of warmth. Past research on the home environment suggests that stimulation may be more predictive than warmth of academic outcomes among young children (Bradley, Corwyn, Burchinal, Pipes McAdoo, & García Coll, 2001; Leventhal, Martin, & Brooks-Gunn, 2004).

Maternal mental health was more strongly predictive of externalizing behaviors than academic outcomes. This finding emerged even controlling for maternal parenting behaviors, which are themselves adversely affected by poor maternal mental health, particularly with respect to greater hostility and disengagement (Lovejoy, Graczyk, O'Hare, & Neuman, 2000). Maternal stress and depression are each associated with insecure child-parent attachment (Atkinson et al., 2000), which has important implications for children's peer relations and classroom behavior (Berlin, Cassidy, & Appleyard, 2008). In addition to parenting behaviors, social learning is also thought to explain the association between poor maternal mental health and children's behavior problems. Specifically, distressed mothers role model negative cognitions, poor emotional regulation, and ineffective problem solving (Goodman, 2007).

Moreover, maternal mental health was more strongly associated with externalizing behaviors than with prosocial behaviors. Although unexpected, this finding supports the notion

that prosocial behavior is conceptually distinct from the absence of externalizing behavior (Hogan et al., 1992; Patterson, DeBaryshe, & Ramsey, 1989). Maternal mental health may have had stronger associations with children's externalizing behaviors than with their prosocial behaviors if there are few or no direct effects of maternal mental health net of parenting behaviors on prosocial behavior. According to Eisenberg and colleagues (Eisenberg, Spinrad, & Sadovsky, 2006), prosocial behavior requires empathy, which is fostered by warm, responsive parenting. Further research is needed to clarify whether there are direct effects of maternal mental health on prosocial behavior in addition to indirect effects via parenting behaviors.

The pattern of differential associations between predictors and outcomes extended to the link between sustained attention and school readiness as well. As expected, sustained attention had significant implications for children's academic competence. This finding adds to a growing body of literature that demonstrates the importance of attentional skills for children's cognitive performance (Carter & Swanson, 1995; Choudhury & Gorman, 2000), which was directly assessed here by vocabulary and early-reading assessments. Specifically, the ability to intentionally focus attention and avoid distraction is believed to be especially critical for reading and language competencies (Tamis-LeMonda & Bornstein, 1989; Velting & Whitehurst, 1997). Moreover, sustained attention emerged as an important mechanism underlying the effect of maternal parenting behaviors on children's academic outcomes. This finding is consistent with the NICHD SECCYD results (NICHD ECCRN, 2003), which supported sustained attention as a partial mediator of the association between the early family environment and children's achievement and language outcomes, and offers a specific focus for future interventions aimed at improving academic outcomes for at-risk children.

In our sample of at-risk children, sustained attention was not strongly associated with concurrent externalizing problems or prosocial behaviors. Although it has been speculated that attention skills contribute more to achievement than to behavior (Ponitz, McClelland, Matthews, & Morrison, 2009), our findings nevertheless contradict those yielded by the NICHD SECCYD (NICHD ECCRN, 2003; Belsky et al., 2007) and Eisenberg et al. (2005). If the difference in findings between this study and the NICHD SECCYD is due to the current sample's greater representation of ethnic minorities and poor children, it suggests that that attention may be more closely associated with behavior (both adaptive and maladaptive) at school entry among more advantaged children than among less advantaged children. Another possible source of this difference is that our measure of attention differs slightly from that of the NICHD study in that our task was administered by paper and theirs was administered by computer. More importantly, the NICHD study's measure of attention isolated sustained attention (correct answers) from impulse control (incorrect answers), whereas our measure represented attention as a single construct based on correct minus incorrect answers. Interestingly, in the NICHD study, impulse control was more strongly associated with child behavior than sustained attention was. Moreover, impulse control, but not sustained attention, mediated the effect of the family environment on behavior. Thus, there may be a stronger link between impulsivity and behavior than between sustained attention and behavior

An alternative explanation for the lack of an association between sustained attention and behavioral outcomes relates to the measurement of the latter constructs. First, it is possible that the link between attention and behavior was stronger in the NICHD SECCYD because it relied on teacher reports of behavior whereas we relied on maternal reports of behavior (NICHD ECCRN, 2003; Belsky et al., 2007). Past studies show modest rates of correspondence between

parent and teacher reports of preschoolers' behavior problems, likely because different behaviors are elicited across various social contexts and by differing types of demands (Achenbach, Edelbrock, & Howell, 1987; Achenbach & Rescorla, 2000). It is possible that children's ability to pay sustained attention to stimuli is more relevant to behavior in the classroom than it is to behavior at home. Although Einsenberg et al. (2005) also used parental report of behavior, their measure of attention was parent-reported, which might have inflated associations between attention and behavior due to shared method variance.

Second, it is possible that the link between attention and prosocial behavior was stronger in the NICHD SECCYD because it employed a comprehensive measure of social competence whereas our study used a more restrictive measure. Specifically, the NICHD SECCYD used the California Preschool Social Competency Scale (CPSC; Levine, Elzey, & Lewis, 1969), a 30-item questionnaire that taps a range of peer interaction skills as well as the child's ability to follow instructions and communicate effectively (NICHD ECCRN, 2003). In contrast, our study used the Express subscale of the ASBI, which is only one of three subscales; the other two subscales are Comply and Disrupt (Hogan et al., 1992). Thus our measure captured peer interactions but not compliance. It is possible that the limited scope of our measure was responsible for the smaller association between attention and prosocial behavior in our sample.

Finally, it is possible that low variability in our measure of prosocial behavior limited our ability to detect significant associations with sustained attention. The children in this sample had a relatively high rate of prosocial behaviors ($M = 22.19$; possible range 0 – 26), which may have created a ceiling effect. Thus, there was relatively little variance in this outcome that attention could account for, especially after entering a comprehensive list of control variables.

Conclusions and Limitations

Although the current study adds to our understanding of sustained attention and its correlates among at-risk children, it is not without limitations. First, the method of measurement used in this study could have influenced the findings. For example, there were measurement differences between our two indices of the family environment because maternal parenting behaviors were assessed using both self-report and observational methods, whereas maternal mental health was assessed solely via self-report. As previously mentioned, it is possible that the inclusion of multiple methods in the assessment of maternal parenting behavior resulted in a more robust indicator compared to maternal mental health. In addition, the two areas of children's school readiness were assessed via different methods of measurement. Specifically, academic outcomes were tapped via direct child assessment while behavioral outcomes were tapped using maternal reports. Thus, it is possible that a different pattern of results could have emerged had academic competence been rated by parents or teachers, or had children's behavioral competence been directly assessed.

A second limitation of the current study is that the sustained attention and school readiness were obtained at the same point in time. Thus, although we can use analytic methods to help model directionality among these constructs, we cannot establish a causal link between our mediator and outcomes. Rather, our results indicate that sustained attention accounted for unique variance in concurrent assessments of children's academic competence. Additional research is needed to determine whether individual differences in early attention have implications for children's later academic achievement and behavioral competence. For example, it is possible that the implications of sustained attention are more immediate for academic outcomes, while the implications for behavioral outcomes develop over time. However, it is also feasible that the association between attention and behavior is strongest during early childhood, as evidence

suggests that the direct and mediational effects of attention on behavior problems decreases across the elementary years (Belsky et al., 2007). Future research should address such issues by allowing for repeated measurement of these constructs across the preschool and elementary years.

Finally, a third limitation of the current study is its exclusive focus on sustained attention as a mechanism through which family environment influences school readiness. Although sustained attention is an important mediator of this link, it is only one of several key self-regulatory processes that could fulfill this role. For example, executive function and effortful control are two additional facets of self-regulation that deserve consideration, as both are influenced by the family environment and have important consequences for children's school readiness (Blair, 2002; Kochanska, Murray, & Harlan, 2000; Li-Grining, 2007). Moreover, although there is overlap among various aspects of self-regulation, the limited research addressing this issue supports specificity in the family environmental predictors of the different self-regulatory processes (Li-Grining, 2007) and suggests that each can make unique contributions to school readiness outcomes (Blair & Razza, 2007; NICHD ECCRN, 2003).

In conclusion, this study is the first to examine specific associations among the family environment, sustained attention, and school readiness within a predominantly poor and minority sample. Results indicated that the links among sustained attention and its correlates are important for at-risk children and that these pathways deserve future study. Moreover, these findings provide additional support for the increasing call to target self-regulatory mechanisms in the promotion of school readiness (Blair, 2002; Blair & Diamond, 2008). An important first step is the development and dissemination of assessment tools for children's self-regulation in the classroom. Such efforts could help identify children with self-regulatory deficits who may be at

risk for subsequent academic and behavior problems. A comprehensive battery tapping the emotional, attentional, and behavioral domains of self-regulation was recently developed and validated for low-income preschoolers (Smith-Donald, Raver, Hayes & Richardson, 2007). Additional tests for measuring the individual and collective components of self-regulation should be piloted in diverse samples.

A second area for future research concerns sustained attention per se as a potential target for intervention to alleviate poor school performance and problem behavior. The results of the current study support two different, yet complimentary, strategies for promoting children's sustained attention. The first strategy focuses on promoting attention directly via targeted intervention. Results from preliminary work in this area are promising. For example, research suggests that a computer-based program can enhance young children's attention in as little as five days of training (Rueda, Rothbart, McCandliss, Saccomanno, & Posner, 2005). Moreover, a packaged curriculum focusing on the promotion of self-regulation for preschool- and kindergarten-aged children, Tools of the Mind (Bodrova & Leong, 2007), has proven effective in improving children's executive functions (Diamond, Barnett, Thomas, & Munro, 2007) and academic outcomes (Barnett et al., 2008). The second strategy to promote sustained attention may operate indirectly via programs aimed at enhancing the family environment. Specifically, the results of this study indicate maternal parenting behaviors as a plausible target for such interventions. Home visiting programs may be particularly well-suited for the delivery of services aimed at parenting and the home environment (Kendrick et al., 2000). Together, increased assessment and promotion of children's sustained attention should prove fruitful for efforts to increase school readiness among at-risk children.

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Table 1

Means, Standard Deviations, and Sample Size for Predictor, Mediator, and Outcome Variables

Variable	Across 3 and 5 years			5 years		
	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>
Predictors						
Maternal parenting behaviors	.04	.71	1,701			
Maternal mental health	.00	.66	1,701			
Mediator						
Sustained attention				12.43	3.37	1,701
Outcomes						
Receptive vocabulary (PPVT)				94.26	14.94	1,687
Letter-word identification (WJ)				100.59	14.76	1,696
Externalizing behaviors				11.18	6.50	1,687
Prosocial behaviors				22.19	3.44	1,686

Note. PPVT = Peabody Picture Vocabulary Test-III; WJ = Woodcock-Johnson Test of Achievement.

Table 2

Correlations among Family Environment, Sustained Attention, and School Readiness

	1.	2.	3.	4.	5.	6.	7.
1. Maternal parenting behaviors	--						
2. Maternal mental health	-.22 (1,701)	--					
3. Sustained attention	.16 (1,701)	-.06 (1,701)	--				
4. Receptive vocabulary	.36 (1,687)	-.17 (1,687)	.36 (1,687)	--			
5. Letter-word identification	.19 (1,696)	-.11 (1,696)	.29 (1,696)	.42 (1,683)	--		
6. Externalizing behaviors	-.19 (1,687)	.33 (1,687)	-.09 (1,687)	-.11 (1,685)	-.13 (1,682)	--	
7. Prosocial behaviors	.27 (1,686)	-.17 (1,686)	.10 (1,686)	.24 (1,684)	.19 (1,681)	-.06 (1,686)	--

Note. Table presents bivariate correlations with n in parentheses. All correlations are significant at the $p < .01$ level.

Table 3

Family Environment as a Predictor of Children's Sustained Attention (n = 1,701)

	<i>B</i>	<i>SE</i>	β
Maternal parenting behaviors	.44	.13	.09***
Maternal mental health	-.06	.13	-.01
R^2		.11***	

Note. Models control for child sex, child age, infant temperament, low birth weight, maternal race, maternal education, maternal marital status, maternal age at first birth, poverty status, city, and household child:adult ratio.

*** $p < .001$

Table 4

Results of Hierarchical Models Predicting Academic School Readiness Outcomes

	Step 1			Step 2		
	<i>B</i>	<i>SE</i>	β	<i>B</i>	<i>SE</i>	β
Receptive vocabulary (<i>n</i> = 1,687)						
Maternal parenting behavior	3.96	.50	.19***	3.36	.48	.16***
Maternal mental health	-1.24	.51	-.05*	-1.15	.48	-.05*
Sustained attention	--	--	--	1.35	.09	.30***
<i>R</i> ² or ΔR ²		.27***			.08***	
Letter-word identification (<i>n</i> = 1,696)						
Maternal parenting behavior	2.63	.53	.13***	2.08	.51	.10***
Maternal mental health	-.59	.54	-.02	-.51	.51	-.02
Sustained attention	--	--	--	1.21	.10	.28***
<i>R</i> ² or ΔR ²		.16***			.07***	

Note. Models control for child sex, child age, infant temperament, low birth weight, maternal race, maternal education, maternal marital status, maternal age at first birth, poverty status, city, and household child:adult ratio.

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

Table 5

Results of Hierarchical Models Predicting Behavioral School Readiness Outcomes

	Step 1			Step 2		
	<i>B</i>	<i>SE</i>	β	<i>B</i>	<i>SE</i>	β
Externalizing behaviors (<i>n</i> = 1,687)						
Maternal parenting behavior	-1.01	.23	-.11***	-.96	.23	-.11***
Maternal mental health	2.61	.24	.26***	2.60	.24	.26***
Sustained attention	--	--	--	-.11	.05	-.06*
<i>R</i> ² or ΔR^2		.17***			.002*	
Prosocial behaviors (<i>n</i> = 1,686)						
Maternal parenting behavior	.98	.13	.20***	.95	.13	.20***
Maternal mental health	-.54	.13	-.10***	-.54	.13	-.10***
Sustained attention	--	--	--	.06	.02	.06*
<i>R</i> ² or ΔR^2		.15***			.003*	

Note. Models control for child sex, child age, infant temperament, low birth weight, maternal race, maternal education, maternal marital status, maternal age at first birth, poverty status, city, and household child:adult ratio.

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