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The Long-Term Implications of Attention for School Success among Low-Income Children

Rachel A. Razza[1]

Anne Martin[2]

Jeanne Brooks-Gunn[2]

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[1] Department of Child and Family Studies, Syracuse University.
[2] National Center for Children and Families, Teachers College, Columbia University.

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Abstract

This study examined the longitudinal associations between sustained attention in preschool and children's school success in later elementary school within a low-income sample (N = 2,403). Specifically, two facets of sustained attention (focused attention and lack of impulsivity) at age 5 were explored as independent predictors of children's academic and behavioral competence across eight measures at age 9. Overall, the pattern of results indicates specificity between the facets of attention and school success, such that focused attention was primarily predictive of academic outcomes while impulsivity was mainly predictive of behavioral outcomes. Both facets of attention predicted teacher ratings of children's academic skills and approaches to learning, which suggests that they jointly influence outcomes that span both domains of school success. Patterns of association were similar for children above and below the poverty line. Implications of these findings for interventions targeting school readiness and success among at-risk children are discussed.

Keywords: sustained attention, academic achievement, behavioral competence, low-income children

The Long-Term Implications of Attention for School Success among Low-Income Children

The extant literature suggests that attention-related self-regulatory skills have significant implications for children's school readiness, as difficulties in attention regulation are linked with poor academic performance (Alexander, Entwisle, & Dauber, 1993; Horn & Packard, 1985; Raver, Smith-Donald, Hayes, & Jones, 2005) and increased problem behaviors (Campbell, Pierce, March, Ewing, & Szumowski, 1994; Eisenberg et al., 2000; Rothbart & Bates, 2006) across the preschool and early elementary years. Not surprisingly, there is also growing evidence that early attention skills are predictive of children's school success in the longer term. For example, longitudinal research supports time-lagged associations between children's attention in early elementary school and externalizing behavior in the later elementary grades (Belsky, Pasco Fearon, & Bell, 2007). Moreover, the results of a meta-analysis across six studies identified attention skills at school entry as a unique predictor of later math and reading achievement (Duncan et al., 2007). Collectively, these studies highlight attention as a potential target for early intervention efforts aimed at promoting children's school readiness and later school success.

One fundamental component of attention that has received increased interest in recent years is sustained attention, which reflects the ability to direct cognitive resources to a stimulus or target in the environment and to process information related to it (Eisenberg et al., 2004; Ruff, 1986). Sustained attention involves both the ability to intentionally focus on a particular stimulus and the ability to avoid distraction over time (Derryberry & Rothbart, 1997). These processes reflect two important facets of sustained attention: focused attention and lack of impulsivity, respectively. Interestingly, some research suggests that these facets of sustained attention have unique associations with school success, and that these associations may vary by socioeconomic status. For example, among predominantly socioeconomically advantaged families, children's

focused attention at 54 months accounted for more variance in academic achievement than in behavior, while impulsivity accounted for more variance in behavior than academic achievement (National Institute of Child Health and Human Development [NICHD] Early Child Care Research Network [ECCRN], 2003). Within a low-income sample, focused attention at age 5 was associated with receptive vocabulary among all children (Razza, Martin, & Brooks-Gunn, 2010). However, impulsivity predicted vocabulary and behavior problems for poor but not near-poor children. While these findings support specificity in the associations between sustained attention and school success, they also highlight the need for future research into these patterns for at-risk children, as poor attention may have more wide-spread implications for their school readiness compared to their more advantaged peers.

In the present study, we address three limitations of the extant literature linking attention with school success. First, with the exception of the two above-mentioned studies (i.e., NICHD ECCRN, 2003, Razza et al., 2010), there has been little research examining the independent contributions made by the individual facets of sustained attention to children's academic and behavioral competence. In fact, most of the studies in this area focus exclusively on the link between impulsivity and externalizing behavior (e.g., Belsky et al., 2007; NICHD ECCRN, 2005). Second, the limited research that does exist is typically cross-sectional and thus the long-term associations between sustained attention and academic and behavioral competence remain largely unknown. Third, most of the research linking sustained attention and school readiness has been generated from a single data set representing a predominantly white, advantaged sample – the NICHD Study of Early Child Care and Youth Development (SECCYD; Belsky et al., 2007; Dilworth-Bart, Khurshid, & Vandell, 2007; NICHD ECCRN, 2003). Given recent evidence suggesting that the implications of sustained attention vary by poverty status (Razza et al., 2010),

it is imperative that we continue to investigate how sustained attention behaves within low-income samples. Thus, the current study examines the independent contributions of focused attention and lack of impulsivity at 5 years on children's academic and behavioral competence at age 9 within a low-income, at-risk sample. Identifying the specific links between sustained attention and school success may be particularly vital to improving the outcomes of poor children, as they are at pronounced risk of academic and behavioral difficulties (Entwisle, Alexander, & Olson, 2005; Klebanov, Brooks-Gunn, McCarton, & McCormick, 1998; Lengua, 2002; McLoyd, 1998; Miech, Essex, & Goldsmith, 2001).

The Association Between Sustained Attention and School Success

Attention-related skills are fundamental for school readiness, as a growing body of research demonstrates that they have significant implications for children's academic achievement (Alexander et al., 1993; Raver et al., 2005) and behavioral regulation (Eisenberg et al., 2004; NICHD ECCRN, 2003) in early elementary school. The importance of attention for children's school adjustment is not surprising, given that attentional processes underlie controlled cognitive activities and social behavior (Calkins & Fox, 2002; Lawson & Ruff, 2004), and thus directly influence both children's engagement in learning activities and their interpersonal relationships (Ladd, Birch, & Buhs, 1999; Pianta & Stuhlman, 2004). What is noteworthy, however, is the unique predictive power of early attention in predicting later school success independent of other indices of readiness. Specifically, research suggests that the associations between early attention and later academic achievement are independent of other pertinent factors, such as prior cognitive ability (McClelland, Morrison, & Holmes, 2000; Yen, Konold, & McDermott, 2004) or reading ability (Howse, Lange, Farran, & Boyles, 2003). Moreover, there is accumulating evidence that attention is more predictive of later achievement

than are social-emotional behaviors, such as externalizing, internalizing, or social skills (Duncan et al., 2007; Hinshaw, 1992; Konold & Pianta, 2005; Ladd et al., 1999). Thus, early attention appears to be directly relevant for children's learning and later success in school.

One facet of attention that is particularly salient during the early childhood years is sustained attention. Sustained attention represents the self-regulatory aspect of attention that allows children to remain focused on a task and avoid distraction over time (Ruff & Rothbart, 1996). Research suggests that signs of sustained attention can be detected as early as 2.5 years, but that considerable growth occurs during the preschool years before reaching stability during the early elementary years (Olson, Sameroff, Kerr, Lopez, & Wellman, 2005; Posner & Rothbart, 2000). As expected, individual differences in sustained attention have been associated with both academic and behavioral competence across early childhood (Choudhury & Gorman, 2000; Eisenberg et al., 2004). As previously noted, however, some evidence suggests that the associations between individual facets of sustained attention (i.e., focused attention and lack of impulsivity) and specific domains of school readiness may differ, and that these differences may themselves vary by socioeconomic status. Specifically, in a sample of predominantly socioeconomically advantaged children, focused attention was associated with both academic and behavioral outcomes, while impulsivity was more closely associated with behavioral outcomes (Belsky et al., 2007; NICHD, 2003). By contrast, in a sample of low-income children, impulsivity was associated with both academic and behavioral competence, but only for the poorest children, and focused attention was associated with only academic outcomes (Razza et al., 2010). Although the studies examining the specificity of these associations are notably limited in number, the discrepancy in findings suggests that this area warrants future examination.

Another limitation of previous research examining the links between individual facets of sustained attention and school success is that the few studies that do exist are limited in their longitudinal scope. Specifically, the only two studies (i.e., NICHD, 2003; Razza et al., 2010) to examine the implications of both facets of sustained attention simultaneously for academic and behavioral competence assessed all constructs contemporaneously (at 54 months and age 5, respectively). Thus, while these studies suggest that sustained attention at school entry is associated with children's early academic and behavioral competence, they do not address the long-term implications of sustained attention for children's later school success. However, broad measures of attention skills have been found to predict long-term academic and behavioral competence (Davies, Woitach, Winter, & Cummings, 2008; Duncan et al., 2007). Moreover, there is evidence that children who are unable to pay attention or control their impulses by first grade, when the learning environment becomes more structured, demonstrate difficulties with teachers and peers (Liew, Eisenberg, & Reiser, 2004; Olson et al., 2005; Pianta, Steinberg, & Rollins, 1995). Thus, while early attention skills appear to set the stage for later functioning, it is unclear whether either or both facets of sustained attention are particularly important for academic and behavioral outcomes.

Attention in Low-Income Samples

The negative implications of poverty for children's attention are well established, as the adverse conditions associated with poverty are thought to reduce the brain's ability to engage in attentive behavior (for review, see Mirsky, 1995). Indeed, studies find that low-income children score lower than their peers on sustained attention in early childhood (Dilworth-Bart et al., 2007; Entwisle et al., 2005; Miech et al., 2001). Given the demands made on attention by typical classroom activities, such as those requiring persistence on a task or compliance with directions,

poor attention regulation can easily undermine both academic and behavioral competence. It is not surprising, then, that early attention skills have captured the interest of proponents of school readiness. The promotion of school readiness among low-income children is particularly important, as these children typically demonstrate lower levels of readiness skills at school entry (Denton & West, 2002; Winsler et al., 2008) and continue to lag behind their peers academically for years thereafter (Lee & Burkam, 2002; McLoyd, 1998). Thus, interventions targeting early attention regulation may be an effective strategy for combating school failure and problem behavior among low-income children.

Attention regulation is responsive to training as early as the preschool years (Diamond, Barnett, Thomas, & Munro, 2007) and is already incorporated into effective comprehensive curricula targeting children's self-regulatory skills, such as Tools of the Mind (Barnett et al., 2008; Bodrova & Leong, 2007; Diamond et al., 2007). Given the centrality of attention for later school success, however, it may also be advantageous to design short-term interventions that focus solely on this construct. For example, there is evidence that a 5-day training intervention was successful in enhancing executive attention among 4- and 6-year–old children (Rueda, Rothbart, McCandliss, Saccomanno, & Posner, 2005). A first step in creating an intervention targeting sustained attention is clarifying how focused attention and impulsivity uniquely relate to school success, particularly among the low-income children who would benefit most from such a program. The specificity of these associations has important implications for intervention strategies because if one aspect of sustained attention (e.g., impulsivity) is more salient than another among low-income children, then it may be a higher priority for intervention. Therefore, additional research is needed to clarify how individual facets of early sustained attention affect later academic and behavioral competence among low-income children.

The Present Study

The purpose of this study was to increase our understanding of the association between sustained attention in preschool and school success in later childhood among low-income children. As previously noted, children from low-income families demonstrate lower levels of sustained attention compared to their peers (Dilworth-Bart et al., 2007; Entwisle et al., 2005; Miech et al., 2001) and are at increased risk of school failure (Klebanov et al., 1998; McLoyd, 1998). Past research highlights attention as an important component of school readiness and more recent work identifies sustained attention, in particular, as a mediator of the association between the early family environment and children's school readiness (NICHD ECCRN, 2003; Razza et al., 2010). In order to plan more effective interventions targeting school readiness, however, additional research elucidating the specificity of the links between facets of sustained attention and domains of school success among low-income children is needed.

The first aim of the present study was to examine the longitudinal associations between two facets of sustained attention (focused attention and lack of impulsivity) in preschool and both academic and behavioral competence in later childhood. In particular, we were interested in the possibility that the two facets of attention may relate differentially to academic and behavioral competence. Past research with two different samples found links between focused attention and academic competence, and between a lack of impulsivity and behavioral competence, but these studies were cross-sectional and children were preschool-aged (NICHD ECCRN, 2003; Razza et al., 2010). Furthermore, in the more advantaged sample, focused attention was associated with behavioral competence, while in the less advantaged sample, a lack of impulsivity was associated with academic competence. Because the sample used for this study is the less advantaged sample cited above, we predicted that focused attention would remain

unassociated with behavioral competence longitudinally, as it was at age 5. The potential for a lack of impulsivity to remain predictive of academic competence four years later was difficult to assess, particularly because it had been true only of children below the poverty line. In addition, this finding was limited to a single measure of receptive vocabulary; therefore, we offered no hypothesis regarding the independent contribution of impulsivity across a battery of academic outcomes. However, we predicted that a lack of impulsivity would remain predictive of behavioral competence at age 9 in light of the centrality of impulse control to socioemotional outcomes including externalizing problems and social competence (Belsky et al., 2007; Shoda, Mischel, & Peake, 1990).

We also predicted that focused attention at age 5 would predict academic competence at age 9. First, the children with the greatest focused attention at age 5 already exhibited greater academic competence at that time (Razza et al., 2010). Ample evidence shows that children who enter school with more skills experience greater academic growth over the course of schooling (Cunha, Heckman, Lochner, & Masterov, 2006; Entwisle et al., 2005). Second, children who entered school with greater focused attention may have benefited more from formal reading and math instruction, which in turn would have facilitated the earlier acquisition of additional skills (Duncan et al., 2007; Tamis-LeMonda & Bornstein, 1989; Velting & Whitehurst, 1997).

This second aim of this study was to examine poverty status as a moderator of the links between sustained attention and academic and behavioral competence. An earlier study with this sample (Razza et al., 2010) found that focused attention was associated with cognitive performance for both near-poor and poor children, but lack of impulsivity was linked to cognitive and behavioral competence in only the poor children. The authors speculated that the test of cognitive competence required impulse control for only the poorest children because they

had fewer experiences at home with activities such as shared reading that resembled the cognitive test. By the time the children were observed at age 9, however, they had had repeated exposure to test-like activities at school. Therefore, it seems likely that the academic testing at age 9 no longer made differential demands on children according to poverty status.

In addition, Razza et al. (2010) included a single measure each of academic/cognitive and behavioral competence, leaving unclear whether differential associations by poverty status were domain-wide or specific to those measures. To address this limitation, we tested whether the poorest children (i.e., those below the poverty line) were most vulnerable to the long-term effects of poor attentional skills using a more comprehensive battery of eight measures, four tapping academic outcomes and four tapping behavioral outcomes. We expected that focused attention would predict primarily academic outcomes and that lack of impulsivity would predict primarily behavioral outcomes for all children, regardless of poverty status. As stated earlier, although a lack of impulsivity was associated with academic competence among poor children at age 5, we did not expect that finding to emerge at age 9 in light of age-related habituation to test-taking.

Participants

The participants for this study were drawn from the Fragile Families and Child Wellbeing Study, which follows a birth cohort of (mostly) unwed parents and their children. At baseline, the predominantly low-income, minority sample included nearly 4,900 children born between 1998 and 2000 in 20 U.S. cities. By design, children born to unmarried parents were oversampled (n = 3,712 vs. n = 1,186 children born to married parents), and cities were selected to be representative of all U.S. cities with populations of 200,000 or more (for additional information on sample selection, see Reichman, Teitler, Garfinkle, & McLanahan, 2001). Mothers were interviewed in the hospital within 48 hours of the child's birth and fathers were interviewed soon

after. The core study consisted of mother and father phone interviews when the child was 1, 3, 5, and 9 years of age.

The present study draws on data from a subsample of the core called the In-Home Longitudinal Study of Preschool Aged Children. At the time of the core phone interview, mothers were invited to participate in this substudy, which required a visit to their homes by a data collector who interviewed the mother, observed the environment, and directly assessed the child. Specifically, 2,863 families across 18 cities were eligible for inclusion in our analytic sample because they participated in the in-home substudy at age 5, when sustained attention data were collected. An additional requirement for inclusion in our analytic sample was that children have data on at least one of the eight measures of school success at age 9. This criterion resulted in the exclusion of 460 families, which brought our final analytic sample to 2,403 families. As shown in Table 1, the analytic sample was predominantly socioeconomically disadvantaged and racially diverse. It should be noted that the final analytic sample was no longer representative of mid-sized U.S. cities and was slightly more advantaged than those lost to attrition at age 9. For example, families in the analytic sample were more likely to be white (22% vs. 19%) or black (53% vs. 47%), less likely to be Hispanic (22% vs. 31%), more likely to have some college education (43% vs. 34%), and less likely to be below the poverty line (42% vs. 47%).

Procedure

Data on children's sustained attention were collected via direct assessment by trained interviewers at age 5 as part of the in-home substudy. Age 9 school success data included direct assessments and teacher reports of children's academic competence as well as maternal reports and teacher reports of children's behavioral competence. Specifically, as part of the in-home substudy at age 9, trained interviewers administered direct assessments of children's academic

competence and mothers completed questionnaires regarding their child's behavior. At the time of the age 9 interview, parents also gave consent for study staff to contact teachers regarding their child's academic skills and classroom behavior. Teachers were sent questionnaires via mail. In our analytic sample, we have teacher reports for 1,612 children (67%). The majority of children were in 3rd (66%) or 4th (20%) grade at the time of the teacher report.

Measures

Sustained attention. Children's sustained attention at age 5 was assessed using the Attention Sustained task from the Leiter International Performance Scale-Revised (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's performance across four timed trials was averaged to yield two attention scores. The number of correct responses (cross-outs of objects matching the target) reflected the child's *focused attention*, while the number of incorrect responses (cross-outs of objects not matching the target) was reverse coded to represent the child's *lack of impulsivity*. Scores were 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 ($r = .85$) (Roid & Miller, 1997).

Academic competence. Children's academic competence at age 9 consisted of a battery of measures, which included direct assessments of digit span, passive comprehension, applied problems, and teacher-reported academic skill. The Digit Span subtest from the Wechsler Intelligence Scale for Children (WISC- IV; Wechsler, 2003) taps children's auditory short term memory, sequencing skills, attention and concentration. The task consisted of 16 items across

two sections (forward and backward tests). For each item, interviewers read a sequence of numbers (which increased in length over the test), and children were asked to repeat the number sequence, either as heard (forward) or in reverse order (backward). Each item contained two chances for a child to repeat the span correctly and was scored as either 1 (*correct*) or 0 (*incorrect*). Children's performance across both sections was averaged and the raw scores were converted to standard scores (M = 100, SD = 3) based on national norms by age. This measure has high internal (α = .87) and test-retest (r = .75) reliability (Williams, Weiss, & Rolfhus, 2003).

Passage Comprehension and Applied Problems constitute two subtests of the Woodcock Johnson III Tests of Achievement (WJ-III; Woodcock, McGrew, & Mather, 2001). The WJ-III is nationally normed by age (standard score of M = 100, SD = 15) and has high test-rest reliability for this age group (α = .81-.94). Passage Comprehension taps a child's ability to understand what he/she reads. Children are asked to identify a missing key word that makes sense in the context of the sentence or passage (e.g., "Woof," said the _____, biting the hand that fed it."), first pictorially and then orally. The items become increasingly difficult by removing pictorial stimuli and by increasing passage length, level of vocabulary, and complexity of syntactic and semantic cues. Applied Problems measures the child's ability to analyze and solve math problems. Children are presented with math word problems orally and visually, and are asked to solve the problems with paper and pencil. Standardized scores on both tasks were used in analyses.

The final academic measure, Academic Skills Rating, was a composite of three items asking teachers to rate the child relative to his/her peers on language and literacy skills, science and social studies, and mathematical skills. Each item was rated on a 5-point scale ranging from 1 (*far below average*) to 5 (*far above average*). Items were averaged (α = .91), with higher scores indicating higher levels of teacher-reported academic skills.

Behavioral competence. Children's behavioral competence at age 9 was assessed via two maternal report measures and two teacher report measures. First, mothers rated children's externalizing and internalizing behaviors using the Child Behavior Checklist (CBCL/6-18; Achenbach & Rescorla, 2001). The Externalizing subscale consisted of 35 items (α = .91) tapping aggressive and rule-breaking behaviors; sample items include "child argues a lot" and "child lies and cheats." The Internalizing subscale consisted of 32 items (α = .89) tapping anxiety/depression, somatic complaints, and withdrawn/depressed behaviors; sample items include "child cries a lot," "child has aches or pains without known cause," and "child is nervous, highstrung, or tense." For each item, mothers rated whether it was *not true* (0), *sometimes true* (1), or *very true* (2) of her child. Items were summed, with higher values indicating more problem behaviors.

Second, teachers rated children's relations with peers and approaches to learning using scales derived from the Early Childhood Longitudinal Program - Kindergarten Class of 1998-99 (ECLS-K; see http://nces.ed.gov/ecls/kindergarten.asp). The Relations with Peers scale, which is an adaptation of the Social Skills Rating System (Gresham & Elliott, 2007), consisted of 10 items (α = .95) reflecting children's competence in peer relations; sample items include "comforts or helps other children" and "accepts peers' ideas for group activities." The Approaches to Learning scale consisted of 7 items (α = .93) capturing children's behaviors during learning activities; sample items include "persists in completing tasks" and "follows classroom rules." For each item, teachers rated the frequency of the child's behavior using a 4-point scale ranging from 1 (*never*) to 4 (*very often*). Scores represent averages across items within each subscale.

Control variables. Key characteristics of the child and his or her family were included as controls in all multivariate models. Indicators were created to reflect child's sex and mother's race/ethnicity (white, black, Hispanic, and other). Maternal age at the time of the child's birth was recorded at baseline. Difficult temperament in infancy was assessed at 1 year and represents the average of three items (α = .60) drawn from the Emotionality scale of the Emotionality, Adaptability, Sociability (EAS) Temperament Survey for Children (Buss & Plomin, 1984). The remaining control variables were collected at age 5. Specifically, maternal education was coded as less than high school, high school graduation or general equivalency diploma, or some college or more. Maternal marital status was coded as married, cohabiting, or single. A ratio of adults to children living in the household was calculated based on a household roster. The number of transitions in father figures between birth and age 5 was calculated by counting the entries and exits of the biological father and any social fathers reported at ages 1, 3, and 5. Both maternal and child receptive vocabulary was assessed using the PPVT-III (Dunn & Dunn, 1997) during the in-home visit and standardized scores were used. The family's poverty status, which the total household income expressed as a proportion of that year's official poverty threshold for that household size, was categorized as follows: 1 (*0-49%*), 2 (*50-99%*), 3 (*100-199%),* 4 (*200-299%),* and 5 (*300% and above*). Maternal depression was a count of depressive symptoms (0-7) during the past year collected via the Composite International Diagnostic Interview – Short Form (CIDI-SF) Section A (Kessler, Andrews, Mroczek, Ustun, & Wittchen, 1998). Maternal warmth and stimulation were measured using items from the HOME Inventory (Caldwell & Bradley, 1984). Maternal warmth was the average of 8 dichotomous items (α = .80) observed by the data collector that denoted the mother's responsiveness and affection towards the child during the

home visit. Maternal stimulation was the average of 11 dichotomous items (α = .67) indicating the availability of toys that promote learning and motor development.

Missing Data

Among the 2,403 families in the analytic sample, approximately 25% were missing data on at least one of the control variables. Each of these variables was missing for less than 5% of cases, with the exception of number of transitions (7%), maternal receptive vocabulary (16%), child receptive vocabulary at age 5 (18%), and maternal warmth at age 5 (27%). In addition, attention data were missing for 23% of the children, largely due to data collection by phone instead of in-person. Based on the assumption that data were missing at random (that is, their missingness could be modeled by observed characteristics; Allison, 2009), we used multiple imputation in Stata 11 (StataCorp, College Station, TX) to create 5 complete data sets with control and predictor variables. The ICE command in Stata (Royston, 2007) conducts multiple imputation based on a regression switching protocol using chained equations. Although the outcome variables were used in imputation models for other missing variables, they themselves were not imputed, as recommended by von Hipple (2007). The 5 data sets were analyzed using the mi beta prefix for regression analyses in Stata, which combines coefficients and standard errors across imputed data sets and estimates standardized regression coefficients.

Results

Table 1 presents the percentages, means, and standard deviations for all study variables. Bivariate correlations among the measures of sustained attention at age 5 and school success at age 9 are displayed in Table 2. The two facets of sustained attention were positively correlated (r = .15, $p < .001$), indicating that children who demonstrated higher levels of focused attention were also less impulsive. Moreover, as expected, significant associations were found between

both facets of sustained attention and all school outcomes, suggesting that sustained attention at age 5 years was associated with children's academic and behavioral competence at age 9.

Data analysis involved a two-step process. In the first step, school success outcomes at age 9 were regressed on both facets of sustained attention at age 5, simultaneously. This set of regression models tested the independent contributions of focused attention and impulsivity on children's academic and behavioral competence, which was the first aim of our study. In the second step, we examined poverty status as a moderator of the above associations, which was the second aim of our study. For these analyses, we included interactions between poverty and each facet of sustained attention in the above regressions. Specifically, poverty status was dichotomized to represent families below (0-99%) and above (100%+) the poverty line and was multiplied by either focused attention or impulsivity, depending on which facet was significant in the first step described above.

As previously mentioned, all regression models included a comprehensive set of controls for child and family characteristics and processes. Child characteristics included sex, infant temperament, and general cognitive ability, as indexed by receptive vocabulary (i.e., PPVT-III). Maternal characteristics reflected race/ethnicity, education, marital status, age, general cognitive ability (PPVT-III), depression, and warmth and stimulation directed toward the child. Additional family variables included household adult:child ratio, number of father figure transitions, and poverty category. Models used robust standard errors to account for clustering by city. Finally, models predicting externalizing and internalizing behaviors at age 9 included scores on these scales from the age 5 assessment (i.e., CBCL/4-18; Achenbach, 1991) as controls. (No other measures of behavioral competence at age 9 were collected at age 5.).

The Effects of Sustained Attention on School Success

A series of ordinary least squares regressions were conducted to examine the longitudinal associations between children's sustained attention at age 5 and their school success at age 9. Of particular interest was whether focused attention and lack of impulsivity would be differentially related to children's outcomes in the academic and behavioral domains. Thus, a separate regression model was conducted for each of the eight measures in which the outcome was regressed simultaneously on both facets of attention plus the controls.

The results of the regressions predicting academic outcomes are displayed in Table 3. Focused attention significantly predicted digit span (β = .14, p < .01), passage comprehension (β = .11, p < .01), applied problems (β = .15, p < .001), and academic skills rating (β = .14, p < .01). Specifically, the children who displayed higher levels of focused attention at age 5 scored higher on cognitive and achievement tests and were rated higher on academic skills by teachers at age 9 than their less attentive peers. Lack of impulsivity predicted only one of the four measures of academic competence -- academic skills rating (β = .07, p < .05).

A similar series of ordinary least squares regressions were conducted to examine the longitudinal associations between children's sustained attention at age 5 and their behavioral competence at age 9. The results of the regressions predicting behavioral outcomes are displayed in Table 4. Lack of impulsivity significantly predicted externalizing behaviors (β = -.07, p < .05), internalizing behaviors (β = -.06, p < .05), and approaches to learning (β = .08, p < .05). Specifically, the children who displayed less impulsivity at age 5 were rated as demonstrating fewer externalizing and internalizing behaviors by mothers as well as more appropriate learning behaviors by teachers at age 9 relative to their more impulsive peers. The only measure of behavioral competence predicted by focused attention was approaches to learning (β = .10, p < .05). Neither facet of attention significantly predicted children's relations with peers.

Poverty Interactions

Additional regression analyses were conducted to test whether poverty status moderated the associations obtained between sustained attention and school success. Poverty interactions were tested in all models in which either facet of attention significantly predicted school success. Specifically, the poverty by focused attention interaction was tested for all four academic outcomes, and the poverty by lack of impulsivity interaction was tested for three of the four behavioral outcomes (relations with peers was the exception). Both interactions were entered in the models for academic skills rating and approaches to learning, as both facets of attention were independent predictors of these outcomes in the first step of analyses. The poverty by attention interactions did not reach significance in any of the models (results not shown), suggesting that the influence of early attention on later school success is similar for both poor and near-poor children.

Discussion

The present study highlights the importance of early sustained attention for later school success among low-income children. In particular, this study advances our knowledge regarding the specificity of the links between these two constructs by elucidating the associations between individual facets of sustained attention and children's academic and behavioral competence. Overall, results suggest that focused attention is predominantly predictive of academic outcomes while lack of impulsivity is primarily predictive of behavioral outcomes. This pattern of findings was supported for all children in the sample, indicating that poverty status did not moderate the associations between attention and school readiness.

This study makes three significant contributions to the attention literature. First, it increases our understanding of the independent contributions made by individual facets of

sustained attention to children's competence across both the academic and behavioral domains of school success. Specifically, results indicate that when considered simultaneously, focused attention was more closely associated with children's academic outcomes, while lack of impulsivity was more relevant for children's behavioral outcomes. Second, the present study extends the time-frame over which the specificity among these constructs was considered. Although previous studies have documented differential concurrent associations between facets of sustained attention and school outcomes, our study confirms the long-term implications of children's sustained attention at age 5 for their school success at age 9. Third, this study furthers the examination of the attention-school success link within low-income children. Findings indicated that poverty status did not moderate the associations between attention and school success, as the poverty by attention interactions failed to reach significance.

Specificity in the Associations Between Sustained Attention and School Success

As expected, sustained attention in preschool had significant implications for children's academic and behavioral competence in later elementary school. Focused attention significantly predicted all four of the academic outcomes, including digit span, passage comprehension, applied problems, and academic skills rating. This finding extends previous research identifying concurrent associations between focused attention and cognition and achievement at preschool age (NICHD ECCRN, 2003; Razza et al., 2010). Notably, we find that focused attention is predictive of both math and reading, and of both directly assessed and teacher reported measures of achievement. These results are consistent with the notion that focused attention facilitates learning by allowing children to concentrate on lessons and remain actively engaged with tasks. Thus, focused attention may increase the amount of time that children participate in learning activities, thereby promoting their academic skills.

Also as hypothesized, lack of impulsivity significantly predicted three of the four behavioral outcomes, namely externalizing behaviors, internalizing behaviors, and approaches to learning. Moreover, given that our models controlled for children's externalizing and internalizing behaviors at age 5, these results indicate that impulsivity at preschool age independently contributes to later problem behaviors. These findings provide additional support for the fundamental role of impulsivity in behavioral skills (Belsky et al., 2007; Shoda et al., 1990). Specifically, it is thought that a lack of impulsivity directly influences children's socioemotional development and learning behaviors by facilitating self-control and positive interactions with others. While the positive association between impulsivity and externalizing behaviors is well-established, the positive link between impulsivity and internalizing behaviors is a novel finding that at first glance appears to contradict previous research by Eisenberg and colleagues (2001; 2009). However, the negative association they obtained between impulsivity and internalizing problems held only when models controlled for children's externalizing behavior. Thus, it is possible that the impulsivity–internalizing behavior link is enhanced by, or even mediated by, co-occurring externalizing behaviors. For example, children with poor impulse control may exhibit aggressive behaviors, leading to social isolation, which in turn causes feelings of sadness and loneliness. Future research examining the association between impulsivity and internalizing behaviors is needed to address this possibility.

Contrary to our expectations, lack of impulsivity did not predict teacher-reported relations with peers. Although it is possible that a lack of impulsivity has greater implications for preventing problem behaviors than promoting social skills, our failure to replicate previously reported links between impulsivity and social competence (i.e., NICHD ECCRN, 2003) may be due to power problems. The association between lack of impulsivity and relations with peers was

positive and approached significance (β = .07, p = .10), but due to teacher non-response the sample size was 30% smaller for teacher-reported behaviors than mother-reported behaviors. An additional explanation centers on the measure of relations with peers, which had fewer items and less variability than the problem behavior scales.

Overall, the pattern of results indicates specificity in the associations between the individual facets of attention and the different domains of school success, such that focused attention predicted academic outcomes, whereas a lack of impulsivity predicted behavioral outcomes. However, there were two exceptions. Focused attention predicted approaches to learning, and lack of impulsivity predicted the academic skills rating. Although these findings were not expected, a careful review of these two constructs might resolve the apparent inconsistency.

First, ATL is a multi-dimensional construct tapping attentiveness, persistence, flexibility, curiosity, and compliance (Fantuzzo et al., 2007; McWayne, Fantuzzo, & McDermott, 2004). Collectively, these behaviors reflect attentional, cognitive, and behavioral control. One reason such behaviors are adaptive in the classroom is that they allow children to focus their attention on lessons despite distraction or disinterest; another is that they reflect the desire to be challenged (Blair, 2002; Raver, 2002; Stipek, Newton, & Chudgar, 2010). Thus, ATL may be conceived of as a measure of cognitive competence as well as of behavioral competence. It follows, then, that it was influenced by focused attention as well as lack of impulsivity.

Similarly, although we categorized the academic skills rating as a measure of academic achievement, teachers may have had difficulty isolating children's achievement per se from their learning-related behaviors. Indeed, in our sample, the academic skills rating was as highly correlated with ATL (r = .57, p < .01) as it was with Passage Comprehension and Applied

Problems (r = .58 for both, p < .01). Thus, the academic skills rating may have been predicted by impulsivity as well as by focused attention because it reflected children's behavior as well as achievement. In sum, the findings may be interpreted as suggesting a consistent pattern: Measures of achievement were predicted by focused attention, measures of behavior were predicted by impulsivity, and measures of both achievement and behavior were predicted by both types of sustained attention.

Finally, poverty status did not moderate the link between sustained attention and school success, as the patterns of associations between these constructs were similar across all low-income children in the sample. This finding appears inconsistent with a previous study finding that impulsivity in preschool was cross-sectionally associated with a wider range of outcomes for poor children than non-poor children (Razza et al., 2010). However, the authors' proposed explanation for that finding is consistent with the present results. Specifically, cognitive tasks may have been particularly demanding on poor children's impulsivity during early childhood, as such children have less exposure at home to assessment-like experiences requiring behavioral control, such as book-reading activities (Bradley, Corwyn, McAdoo, & García Coll, 2001). However, it is likely that the influence of impulsivity on academic testing diminishes over time for these children, as they are increasingly exposed to test-taking situations across the elementary school years. Our results support this experience-related development, as early impulsivity was largely unrelated to academic competence at 9 for children both below and above the poverty line. Thus, it appears that the links between sustained attention and school success become increasingly differentiated by domain over time and are increasingly generalizable across all children. Indeed, the overall pattern suggesting that focused attention is more predictive of

academic competence and impulsivity is more predictive of behavioral competence is consistent with exisiting cross-sectional data from more advantaged children (i.e., NICHD ECCRN, 2003).

Conclusions and Limitations

Although the present study adds to our understanding of the links between early sustained attention and later school success among low-income children, it is important to note its limitations. First, although our data are longitudinal, we are unable to establish causal links between sustained attention at age 5 and school success at age 9, as we did not have earlier data on the majority of outcome measures. Thus, it is possible that sustained attention mainly influenced children's academic and behavioral competence concurrently at school entry, and that had we adjusted for children's earlier performance on these outcomes, the longitudinal associations would not have been supported. We feel that this possibility is unlikely, however, as early attention was predictive of later externalizing and internalizing behaviors, the two outcome measures for which we did have age 5 data. In addition, all models accounted for children's general cognitive competence at age 5, which should have been at least moderately associated with children's concurrent academic readiness outcomes.

Second, our test for poverty moderation was limited given that our sample was predominantly low-income. Because the upper range of income for the group above the poverty line was truncated, our comparison was between poor and near-poor (but not affluent) families. Thus, it is possible that poverty does significantly moderate the longitudinal associations between sustained attention and school outcomes, but that we were unable to detect these differences within our sample. Ideally, future studies should examine poverty as a moderator of these associations by using socioeconomically-advantaged children as a comparison group

Finally, a third limitation of the current study is its exclusive focus on sustained attention as a predictor of school success. Attentional skills are certainly important for children's socio-emotional development and academic achievement, as they are inherent in children's self-regulation. Specifically, attention is an essential component of both effortful control (EC) and executive function (EF), and represents an important commonality between these two self-regulatory processes (Liew, 2011; McClelland & Cameron, 2011; Zhou, Chen, & Main, 2011). However, EC and EF are both multidimensional constructs, of which attention is just one component. Thus, other notable components, such as inhibitory control and working memory, may interact with attentional skills in the prediction of school success or make their own unique contributions to these outcomes. Unfortunately, additional measures of children's self-regulation were not collected in the Fragile Families and Child Wellbeing study, so we were unable to address this possibility with our data. Given the increasing call from the field for an integrated model of self-regulation (Liew, 2011; Zhou et al., 2011), however, it is imperative that future research in this area considers the associations both between and across the individual components of EC and EF.

In conclusion, the present study makes an important contribution to the field, as it is the first to examine how individual facets of sustained attention in preschool uniquely predict children's academic and behavioral competence in later elementary school within a low-income sample. In general, the pattern of results indicated that focused attention was predictive of academic outcomes while impulsivity was predictive of behavioral outcomes. Although these trends are largely consistent with the literature, they require replication with other samples, particularly those high in socio-demographic diversity which would allow for the direct comparison of models across SES and race/ethnicity groups within a single study. Nevertheless,

our results emphasize the critical role of early attention for later academic and behavioral success and highlight sustained attention as a potential target for intervention to enhance school success among low-income children. In particular, it appears that focused attention and impulsivity represent two distinct avenues for intervention, as their effects were domain specific. However, results also suggest the added benefit of targeting both facets of attention, as they each made independent contributions to ATL, which has important implications for children's academic trajectories. Specifically, individual differences in ATL predicted both reading and math achievement across elementary school in a large-scale, nationally representative sample (Li-Grining, Votruba-Drzal, Maldonado-Carreño, & Haas, 2010). Thus, initiatives that promote both aspects of sustained attention may be particularly effective strategies for increasing school success among low-income children in the long run.

Our findings also underscore the importance of intervening early, as there is growing evidence that skills at school entry set the stage for later competence (Duncan et al., 2007; Li-Grining et al., 2010). These results are consistent with the cumulative advantage theory (DiPrete & Eirich, 2006), which posits that advantages accumulate over time. Therefore, in addition to directly influencing their later academic and behavioral skills, early attention may also indirectly impact children's long-term school success by enhancing these competencies at school entry. Fortunately, attention regulation is already being successfully targeted by interventions with preschool-aged children (Diamond et al., 2007; Rueda et al., 2005). At present, however, these efforts are restricted to packaged curricula (i.e., *Tools of the Mind*) or single training studies. Thus, additional work is needed to design effective strategies targeting attention that teachers can incorporate into their early childhood classrooms, particularly those serving low-income

children. For example, play-based activities may be a fruitful approach, as these are relatively inexpensive to administer but effective at fostering attention-related skills (Berk, 1994).

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Table 1.

Descriptive Statistics for Control, Predictors, and Outcome Variables

Variable	*M*	*SD*	*%*
Controls			
Child male			52.06
Maternal race/ethnicity			
White			21.81
Black			52.96
Hispanic			22.44
Other			2.79
Maternal education			
Less than high school			29.78
High school graduation/GED			26.82
Some college or more			43.40
Maternal marital status			
Single			39.95
Cohabiting			26.84
Married			33.21
Poverty category			
0-49%			21.60
50-99%			20.68
100-199%			25.68
200-299%			13.69
300% or more			18.35
Maternal age	25.07	6.02	

Maternal receptive vocabulary	89.47	12.49
Child receptive vocabulary	93.95	15.88
Infant difficult temperament	2.82	1.06
Adult:child household ratio	0.99	0.75
Number of father figure transitions	1.12	1.13
Maternal depression	1.02	2.09
Maternal warmth	0.77	0.24
Maternal stimulation	0.89	0.14
Predictors		
Focused attention	12.72	3.34
Lack of impulsivity	10.05	2.89
Outcomes		
Academic competence		
Digit span	9.42	2.80
Passage comprehension	93.00	14.55
Applied problems	97.99	16.61
Academic skills rating	2.92	0.90
Behavioral competence		
Externalizing behaviors	6.54	7.18
Internalizing behaviors	5.13	5.89
Relations with peers	3.03	0.71
Approaches to learning	2.90	0.77

Note. Calculations are based on five multiply imputed data sets. N = 2,403.

Table 2

Correlations among Measures of Sustained Attention and School Success

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Focused attention	--									
2. Lack of impulsivity	.15	--								
3. Digit span	.18	.10	--							
4. Passage comprehension	.24	.14	.47	--						
5. Applied problems	.25	.14	.48	.67	--					
6. Academic skills rating	.26	.16	.41	.58	.58	--				
7. Externalizing behaviors	-.09	-.12	-.13	-.16	-.17	-.16	--			
8. Internalizing behaviors	-.09	-.07	-.10	-.10	-.14	-.15	.67	--		

9. Relations with peers	.12	.12	.19	.27	.25	.37	-.35	-.10	--	
10. Approaches to learning	.19	.15	.25	.32	.35	.57	-.30	-.16	.75	--

Note. Table presents bivariate correlations. Only unimputed values are included in calculations. All correlations are significant at $p < .01$.

Table 3.

Results of Models Predicting Academic Competence at Age 9

Variable	*B*	*SE*	β
	Digit span (*n* = 2,387)		
Focused attention	.11	.03	.14**
Lack of impulsivity	.04	.02	.04
R^2		.10***	
	Passage comprehension (*n* = 2,359)		
Focused attention	.46	.11	.11**
Lack of impulsivity	.13	.13	.03
R^2		.28***	
	Applied problems (*n* = 2,368)		
Focused attention	.74	.13	.15***
Lack of impulsivity	.29	.14	.05
R^2		.26***	
	Academic skills rating (*n* = 1,603)		
Focused attention	.04	.01	.14**
Lack of impulsivity	.02	.01	.07*
R^2		.23***	

Note. Models include controls for child sex, infant temperament, child receptive vocabulary, maternal race/ethnicity, maternal education, maternal marital status, maternal receptive vocabulary, maternal age, poverty status, adult:child household ratio, number of father figure

transitions, maternal depression, maternal warmth, and maternal stimulation. Robust standard errors account for clustering by city.

$^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.

Table 4.

Results of Models Predicting Behavioral Competence at Age 9

Variable	*B*	*SE*	β
	Externalizing behaviors (*n* = 2,371)		
Focused attention	-.02	.05	-.01
Lack of impulsivity	-.17	.07	-.07*
R^2		.25***	
	Internalizing behaviors (*n* = 2,374)		
Focused attention	-.09	.04	-.05
Lack of impulsivity	-.12	.04	-.06*
R^2		.15***	
	Relations with peers (*n* = 1,621)		
Focused attention	.01	.01	.03
Lack of impulsivity	.02	.01	.07
R^2		.14***	
	Approaches to learning (*n* = 1,625)		
Focused attention	.02	.01	.10*
Lack of impulsivity	.02	.01	.08*
R^2		.16***	

Note. Models include controls for child sex, infant temperament, child receptive vocabulary, maternal race/ethnicity, maternal education, maternal marital status, maternal receptive vocabulary, maternal age, poverty status, adult:child household ratio, number of father figure transitions, maternal depression, maternal warmth, and maternal stimulation. In addition, child

externalizing or internalizing behaviors at age 5 was included as a control in the models for externalizing and internalizing behaviors at age 9, respectively. Robust standard errors account for clustering by city.

$^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.