

Positive Mother–child Interactions in Kindergarten: Predictors of School Success in High School

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Abstract. This longitudinal study followed 142 children to determine whether the quality of mother–child interactions, as measured in kindergarten, predicted high school academic achievement and attainment. Findings showed that, regardless of race/ethnicity, socioeconomic status, gender, and IQ, positive mother–child interactions in kindergarten were associated with an increased likelihood of high school graduation and, for some students, a higher grade-point average by 12th grade. However, mother–child interactions in kindergarten were not related to reading or math achievement test scores. The findings suggest that school psychologists should attend to children’s interactions with their caregivers during their earliest years of school to forecast and deflect future problems given the long-lasting importance of early mother–child interactions for children’s educational attainment and the protective function of such interactions for children facing risk.

Poor grades, low achievement, and high rates of high school dropout are national problems. Estimates of high school dropout suggest that one in ten young adults do not reach the equivalent of high school educational attainment (National Center for Education Statistics, 2006). Many of the youth remaining in high school underachieve; roughly 35% of children are not proficient in reading, and more than 15% are not reaching basic math achievement levels by the 12th grade (National Center for Education Statistics, 2007). Ethnic and socioeconomic gaps in high school achievement and graduation rates persist, despite decades of school-based reforms designed to reverse such trends (e.g., Fuller, Gesicki, Keng, & Wright, 2006). Such facts

are only superficial indicators of larger national concerns. Our educational system is falling behind others around the world (Trends in International Mathematics and Science Study, 2000), and the proportion of individuals in the United States who are highly educated has begun to drop relative to the proportion of highly educated individuals in other countries (National Center on Education and the Economy, 2007).

Given the high prevalence of achievement problems and early dropout from school, there is a critical need for research with a longitudinal focus that strives to identify predictors of these difficulties (Jimerson, Ege-land, & Sroufe, 2000). The present study was motivated by recently stated needs in school

The authors acknowledge the support of the Robin Hood Foundation. Also, the authors thank Dr. Robert Pianta and the graduate students who assisted in the research: Tse-Hua Shih, Michael B. Ripski, and Jessica O. Kostelnik.

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psychology—specifically, Shapiro’s (2006) call for school psychologists to orient themselves toward the prevention of problems and Hojniski and Missall’s (2006) call for family-centered interventions that increase school readiness. In addressing the call, we take a developmental perspective and focus on social processes that are most proximal to youth—namely, the nature of interactions between parents and their children (Van den Boom, 1997). This approach is consistent with early childhood research suggesting that children’s competencies are a product of the contexts in which they spend their time.

Risk and Protection

Risk for Low Achievement

Early childhood poverty can set students on negative achievement trajectories with few opportunities for deflections toward higher achievement (Cappella & Weinstein, 2001). In 2004, low-income adolescents were five times more likely to drop out than adolescents from high-income families (National Center for Education Statistics, 2006). Numerous contributors in the home (e.g., lack of cognitively stimulating material) and in schools (e.g., poorly qualified teachers) explain in part why economic disadvantage is linked to poor schooling outcomes (Hoff, 2003).

Beyond socioeconomic status, racial/ethnic group membership has also been found to be a risk for low achievement, as seen in the continued gap in reading and math achievement between African American and White high school students (Gregory & Weinstein, 2004; National Center for Education Statistics, 2005). Racial group membership is not an inherent risk factor, but a product of cumulative experience. African American youth, including well-resourced youth, are subject to subtle forms of racial discrimination and oppression that can manifest in underresourced schools and family disruption (APA Task Force, 2008). Negative school and home experiences can be further exacerbated by racial profiling or low expectations (e.g., Weinstein, 2002). Taken together, both family low in-

come and racial group membership are early risk factors for later poor school outcomes.

Promotive or Protective Factors?

There has been some debate in the field as to what constitutes a promotive or a protective factor (Luthar, Cicchetti, & Becker, 2000). Some argue that a protective factor alters a child’s response to a risk that predisposes him or her to a maladaptive outcome (Luthar et al., 2000). Gutman, Sameroff, and Cole (2003) argue that a protective factor has a positive, direct effect on all children regardless of their level of risk. These definitions imply that a factor is either promotive or protective. Instead, it may be the case that a factor can exert an especially positive effect on children facing high risk (protective) and, at the same time, benefit all children (promotive).

Morrison, Rimm-Kaufman, and Pianta (2003) found evidence for the dual role of sensitive mother–child interactions as both protective and promotive. First, as a promotive factor, high-quality mother–child interactions, observed in kindergarten, were associated with higher academic performance in middle school after taking into account child IQ, socioeconomic status, race/ethnicity, and gender and accounted for 3% of the variance in academic performance. Second, as a protective factor, high-quality mother–child interactions buffered risk. African American children, but not White children, with positive maternal interactions exhibited significantly fewer negative classroom behaviors in middle school. Mother–child interaction quality accounted for 4% of the variance in negative classroom behaviors—a small but practically meaningful amount of variance explained (Fan, 2001). Whether positive mother–child interactions remain protective for older adolescents facing risk and promotive for all adolescents, regardless of risk, remains open to question.

Early Mother–Child Interactions

Sensitive and Positive Interactions

“Sensitivity” between parents and children is one dimension of the family context

that has received considerable attention in research (Van den Boom, 1997). Sensitive parenting in infancy has been characterized as allowing a smooth, flowing, noninterrupted exchange with the infant (Van den Boom, 1997). In toddlerhood, a sensitive parent organizes his or her behavior in light of the toddler's mood, behavior, and needs (Sroufe, Egeland, Carlson, & Collins, 2005). Similarly, at school entry, a parent recognizes the child's needs for support, encouragement, and autonomy (Pianta & Harbers, 1996).

Despite some arguments that sensitivity is a characteristic of the parent alone, there is widespread acknowledgment that sensitivity is best measured by observing both child and parent in interaction with one another (Van den Boom, 1997). Stated differently, sensitivity is a dyadic process that unfolds between parent and child. Thus, sensitivity or positive quality can be best operationalized by capturing the pattern of behaviors and sequence of interactions that occur between an adult and a child as they engage in a task together. This is in keeping with a systems point of view (Pianta, 1999) and decades of attachment research (e.g., Ainsworth, 1979) that focuses on the development of competencies within social contexts.

Numerous processes may help explain why early interactions with parents are predictive of children's later high school achievement and educational attainment. Children learn through repeated interactions with caregivers. Mothers who are sensitive to children's cues and promote their engagement in a problem-solving task may be more likely to offer support in the home environment (Sroufe et al., 2005), demonstrate their knowledge of children's individual needs, and provide scaffolding as children engage in increasingly challenging social and academic tasks, in contrast to mothers who do not offer these opportunities (Calkins & Hill, 2006). As a consequence of repeated sensitive and caring interactions, children may internalize a set of standards and expectations that are likely to be perpetuated in their social interactions with teachers and peers (Bowlby, 1988). The nature of these social interactions may provide a ba-

sis for emotional and behavioral engagement in school, ultimately leading to academic success. The quality of mother–child interactions can be improved with intervention (Cowan, Powell, & Cowan, 1998), which provides an important rationale for investigating the long-term correlates of high-quality interactions.

Predicting Academic Success in Early Schooling

Convincing evidence has accrued that the quality of mother–child interactions in infancy (Teo, Carlson, Mathieu, & Egeland, 1996) and in preschool (Pianta, Nimetz, & Bennett, 1997) is linked with positive developmental outcomes in preschool and early elementary school. In a sample of low-income, predominantly African American preschoolers, Pianta et al. (1997) found that children who were observed having warm affective exchanges with their mothers had less conflict with their preschool teachers. In fact, mother–child interactions were more predictive of the quality of kindergartener–teacher relationships than previous relationships with preschool teachers. Moreover, Pianta and Harbers (1996) found a link between quality of parent–child interaction and achievement in elementary school; before mother's education and cognitive ability were considered, the interaction measure accounted for between 17% and 22% of the variance in standardized test scores in second through fourth grades.

Predicting Academic Success in Later Schooling

Research on the effects of the early mother–child interactions on children's early schooling is extensive, but research that follows children into their high school years is less common. Three longitudinal studies stand out. The crosscutting findings from these studies suggest that high-quality early maternal–child interactions may be linked with later school achievement, despite children's intervening experiences in elementary and middle school. One of the longitudinal studies was conducted with a low-income, predominately White (63%) sample in Rochester, New York,

and found that a composite of ten environmental risk factors at age 4—including negative maternal interactions—significantly predicted lower grade-point averages (GPAs) through the end of 12th grade (Gutman et al., 2003). They also found that higher risk 4-year-olds experienced a downward trend in GPAs across their years in schooling. In the second longitudinal study, comprised of a French Canadian sample of 4,330 primarily White kindergarteners, parents' reports of the pleasure they take in their child was linked to a lower risk for dropout (Vitaro, Brendgen, Larose, & Tremblay, 2005). This measure of pleasure may be conceptually consistent with observed parental sensitivity.

The third longitudinal study is the most in-depth examination of the effects of maternal sensitivity over the course of children's development. Sroufe et al. (2005), in their prospective study of a cohort of low-income, predominantly White mothers and their infants in Minneapolis, found that early care predicted reading and math achievement as measured at age 16. More specifically, early history accounted for an additional 5% of the variance in 16-year-olds' math and reading scores on the Woodcock-Johnson Test of Achievement, beyond the effects of child IQ (Teo et al., 1996). Early history included a measure of attachment at 12 and 18 months, the child's psychological adjustment, as measured by his or her experience during a problem-solving task at 24 months and persistence during a maternal teaching task at 42 months, and the child's psychosocial home environment, as measured by observation and interviews at 30 months. Sroufe et al. (2005) also examined predictors of dropout. Strikingly, using measures of early quality of care up until 42 months (e.g., emotional climate, stimulating materials, and parental responsiveness to the child as observed in the home), they were able to predict dropout with 77% accuracy. Child IQ and achievement did not improve the accuracy of this prediction. In fact, Sroufe et al. (2005) found that the quality of mother-child interaction when the child was 42 months was a significant predictor of education attainment roughly 20 years later. Taken together, the findings from the

three longitudinal studies suggest that the quality of mother-child interactions, measured in kindergarten, can predict educational success in high school.

Previous studies did not address the promotive versus protective function of mother-child interactions, which may have been from the lack of economic, racial, and ethnic diversity of the samples (Gutman et al., 2003; Sroufe et al., 2005; Vitaro et al., 2005). What remains to be known is whether positive mother-child interactions are promotive for all students and, at the same time, protective for those faced with risk associated with low income and ethnic minority status. To address this question, we build on what is already known about early predictors of later high school outcomes. Numerous studies have shown a link between childhood IQ and later achievement (for a review, see Neisser et al., 1996). In addition, studies have shown that males and females differ in GPA and performance on standardized tests (for a review, see Raffaele Mendez, Mihalas, & Hardesty, 2006). As a result, IQ and gender will be taken into account in all analyses.

In sum, this study extends previous research with a sample of kindergarteners, whose outcomes were examined in their middle school years (Morrison et al., 2003), but not in their high school years. It is anticipated that early mother-child interaction will be a significant predictor of high school academic outcomes for all students (promotive), yet its strength as a predictor will be greater for those facing sociodemographic risks (protective). Identifying the predictive strength of maternal-child interaction quality is important given the potential for early interventions that target modifiable factors.

Method

Participants

Participants were the entire entering class of public school kindergarten in 1988 in a school district of a small city in the Southeast with a socioeconomically diverse population. The sample consisted of 342 kindergarteners (Pianta, Smith, & Reeve, 1991). Fol-

Table 1
Descriptive Analysis of Child and Mother Characteristics

Variable	School Entry	9th Grade Math Test ^a	12th Grade GPA	High School Graduation
Total sample size	342	122	105	142
White (%) ^b	202 (59)	72 (59)	63 (60)	85 (60)
African American (%) ^b	136 (40)	50 (41)	42 (40)	57 (40)
Asian (%) ^b	4 (1)	0	0	0
Male (%) ^b	168 (49)	44 (36)	42 (40)	53 (37)
Female (%) ^b	174 (51)	78 (64)	63 (60)	89 (63)
Maternal education mean (<i>SD</i>) ^c	3.3 (1.4)	3.8 (1.5)	3.8 (1.4)	3.6 (1.4)
Mother–child mean (<i>SD</i>) ^d	3.5 (.72)	3.6 (.73)	3.6 (.75)	3.6 (.73)
IQ mean (<i>SD</i>)	95.05 (13.93)	95.33 (14.77)	95.82 (15.00)	95.4 (14.70)

^aThe reading test score had one fewer student than the math test score.

^bPercentage of sample in parentheses.

^cThe mean of maternal education was based on a 6-point scale (e.g., 1 = 8 or fewer years of education and 6 = graduate work).

^dThe mean of quality of mother–child interaction.

low-up data were extracted from the school records of students who remained in the school district into high school. Table 1 shows that the high school sample varied in size from 105 to 142, depending on the school outcome under examination. Across each sample, about 60% of the students were White and 40% were African American. The high school sample was comparable to the kindergarten sample on racial composition, but the samples differed on gender ($\chi^2[1, N = 142] = 5.63, p < .05$). As compared to the gender composition of the kindergarten sample, the high school sample had a greater proportion of girls than boys.

Most of the mothers had between a high school diploma and some college (Table 1). However, some women had eight or fewer years of schooling and others had completed graduate work. The high school samples were comparable to the original sample on maternal education with one exception. The students with missing standardized math scores had mothers with slightly lower education ($t = 2.47[30], p < .05$). Thus, with only one exception, the participants used in each analysis did not differ by sociodemographic risk.

Measures

Sociodemographic characteristics.

Mothers of the kindergartners reported on their children's gender, race/ethnicity, and their own highest level of education, a commonly used proxy for socioeconomic status in educational research (Bornstein, Hahn, Suwalsky, & Haynes, 2003; National Institute of Child Health and Human Development [NICHD], 2002). Coding of the six levels of maternal education meant that higher numbers equaled higher education (e.g., 1 = 8 or fewer years of education and 6 = graduate work).

Child IQ. At entry into kindergarten, children were administered the Vocabulary and Pattern Analysis subtests of the Stanford Binet Intelligence Scale: Revised, Fourth Edition (Thorndike, Hagen, & Sattler, 1986). The tests measured cognitive abilities in verbal reasoning and abstract/visual reasoning and have been found to be highly correlated with the general intelligence factor (Sattler, 1985). As recommended by the administration guide and using the test manual's age-based normed tables, the subtest scaled scores were converted into area scores. The area scores were

summed and, using the manual's tables, converted to a composite measure of IQ (Thorndike et al., 1986).

Mother-child interaction score. An observational coding system of dimensions of mother-child interactions was developed for the original study (Pianta et al., 1991). After observing mother-child problem-solving tasks, the observers rated the child and the mother on eight dimensions using a 5-point Likert-type scale from (1) *very low* to (5) *very high*. The three maternal dimensions included supportive presence (providing encouragement, warmth, and emotional support), quality of instruction (explaining the task, timing, pacing, and appropriateness of hints), and respect for the child's autonomy (encouraging the child's independence). The five child dimensions included affection (smiles, hugs, verbalizations), reliance on the adult for help (passive or active efforts to get the mother to solve the problem), negative affect (negative affect directed at mother), task orientation (compliance, attention to mother's directions, persistence), and enthusiasm (statements of pride or confidence, eagerness to approach tasks).

Behavioral descriptors for each scale point of each dimension were developed to help achieve reliable coding of the mother-child interactions. For instance, very low (1) on the dimension of supportive presence was described as "Fails to be supportive. Either unavailable or hostile when the child shows need of support. Little orientation to child's cues." In contrast, very high (5) on that same dimension was described as "Skillful, setting up the situation with full confidence in the child. Rejects wrong solutions without reducing support. Structures situation so that child is rewarded for his or her success." Very low (1) on the dimension of reliance on the adult for help was described as "Self-reliant; always showing a sense of self-initiative. The child requests help if frustrated but incorporates that help into his/her own plan." Very high (5) on that same dimension was defined as "Preoccupied with help-seeking, for example, the child may make mistakes so the mother does the

task. The child initiates very few efforts without maternal help."

After being trained in the behavioral descriptors of each scale point, 10 graduate students coded videotaped mother-child interactions that had been previously coded by the principal investigators (Pianta et al., 1991). The principal investigators' coding of the tapes was considered the gold standard. To be considered in agreement, a graduate student had to select the exact same scale point on a given dimension as the gold standard coding. The percent of agreement index was calculated by the number of times the coder agreed with the gold standard coding divided by the total agreements plus disagreements and then multiplied by 100 (Hintze, 2005). Each of the 10 coders exceeded 75% agreement with the gold standard coding.

The ten coders then conducted in-person observations of the participating mothers' interactions with their kindergarteners during standardized problem-solving tasks. Mothers were instructed to ask their children to put together 24 blocks as they were represented in pictures. After 4 min, mothers were asked to switch tasks and to ask their child to name "many things to ride in, like a bus" and to name "things to wear, like shoes." Problem-solving tasks are common in family research as they require sustained interaction and offer observers a sequence of behaviors (actions and reactions) across the dyad (Pratt, Kerig, & Cowan, 1988). After the mother-child problem-solving tasks, the observers rated the child and the mother on the eight dimensions of the interactions.

Factor analysis suggested that the eight mother-child dimensions were one factor and could be combined in a single interaction score (Pianta & Harbers, 1996). Moreover, the eight dimensions were found to be internally consistent in this study (Cronbach's $\alpha = .86$). As a result, the dimension ratings were averaged, with reverse scoring of child negative affect and reliance on mother for help. A higher mother-child score indicated higher quality interactions between mother and child.

Fifty mother-child dyads were randomly selected for second coders to rate. The

mother–child interaction scores across coders were compared using a Pearson’s r correlation. As reported in Pianta and Harbers (1996), coders had high interrater reliability ($r = .82$). Ratings from the observational coding system have shown predictive validity; mother–child interaction scores were related to middle school outcomes in the expected manner (Morrison et al., 2003).

Academic achievement. Several indicators of achievement were drawn from student records and transcripts. We obtained students’ GPAs at the end of high school, which the school district weighted such that high-level courses, such as advanced and honors, were given extra weight in the calculation of the average. We obtained Stanford 9 scaled test scores in reading and math, which had been administered to ninth-grade students.

High school graduation. High school graduation was measured by whether students successfully graduated or dropped out, as noted on their school transcripts. The district officials made considerable effort to ensure reliability of drop-out status. They investigated every extended student absence and attempted to speak with each student after 15 missed school days to confirm whether the absence was because of school transfer, illness, or dropping out from school.

Procedures

In 1988, an entering class of public school kindergarten students and their mothers participated in a screening procedure on the first day of school. Mothers and their kindergartners completed a series of problem-solving tasks used to measure the quality of the maternal–child interaction. Researchers observed and rated the quality of interactions during the tasks. Mothers also completed a written survey, and their children completed subtests of the Stanford-Binet IQ test. In 2005, school officials extracted records for the kindergartner cohort who had attended the city’s one local public high school.

Data Analytic Plan

Our data analysis involved three steps: we examined descriptive statistics and correlations among the variables to identify general trends in the data; we conducted logistic regression with the graduation outcomes; and we ran multivariate regression analyses with the achievement outcomes. All regression analyses included IQ, mother’s education, student race/ethnicity, and student gender in order to test whether mother–child interactions were linked with adolescent outcomes beyond the contribution of IQ and demographic factors.

For the multivariate regression analyses, blocks of predictors were entered consecutively. The first block included the covariates of IQ, maternal education, race/ethnicity, and gender. It was important to take these factors into account as covariates to identify whether mother–child interactions explained variance beyond that explained by these well-established, individual characteristics known to predict achievement (e.g., Neisser et al., 1996; Raffaele Mendez et al., 2006). The second block included the quality of mother–child interactions. To address the possibility of protective properties of early family factors in the face of risk, the second block also included two- and three-way interaction terms (e.g., Mother–Child Interaction \times Race \times Maternal Education). The interaction terms were removed if they were not found significant. We examined changes in the amount of variance explained after entering each block of variables into the regression analyses. The following variables were coded dichotomously (0 versus 1) in the respective order: Gender (male, female); race/ethnicity (African American, White); and high school graduation (no, yes). The following additional variables were treated as continuous scores: IQ composite, Mother–Child Interaction score, GPA, and Stanford 9 reading and math scores.

Results

Descriptive Findings

The quality of Mother–Child Interactions ranged from just above (1) *very low* to

Table 2
Intercorrelations Among Student Demographic, Achievement,
and Mother–Child Interaction Variables

	1	2	3	4	5	6	7	8	9
1. Maternal education	—	.47**	-.01	.53**	.61**	.61**	.63**	.27**	.52**
2. Race/ethnicity		—	.05	.50**	.51**	.54**	.57**	.12	.31**
3. Gender			—	-.00	.06	.12	.14	.05	.07
4. IQ				—	.64**	.60**	.51**	.21*	.39**
5. S9 Reading					—	.77**	.73**	.34**	.41**
6. S9 Math						—	.70**	.31**	.43**
7. GPA							—	.46**	.49**
8. Graduation								—	.32**
9. Mother–child interaction									—

Note. S9 = Stanford 9 test.

* $p < .05$.

** $p < .01$.

(5) *very high*, with an average around 3.6, as shown for the samples in Table 1. Student IQ was widely distributed with a range from 63 to 143 and an average around 95. The achievement outcomes in high school were also widely distributed. The Stanford 9 reading test had a sample mean of 710 ($SD = 49$, Min = 596, Max = 842) and the math test had a sample mean of 700 ($SD = 49$, Min = 621, Max = 844). In 1999, the statewide mean was 708 for reading and 691 for math (Virginia State Assessment Program, 1999). The GPAs ranged from a low of 0.4 to a high of 4.6, which according to typical 4- to 5-point GPA scales would be considered low D or F to high A ($M = 2.8$, $SD = 1.1$). By the end of high school, 126 of the students (89%) had graduated, and 16 students (11%) had dropped out.

Table 2 shows the intercorrelations among variables. Positive and significant correlations were in the expected direction, for the most part. All the demographic variables, except gender, were correlated with one another (r ranges from .47 to .53). White children were more likely than African American children to have mothers with higher education ($r = .47$). Despite the strength of this correlation, White and African American mothers were distributed across the levels of maternal education. Higher maternal educa-

tion was moderately correlated with higher achievement through high school (r ranges from .61 to .63) and higher likelihood of school graduation ($r = .27$). Similarly, student race/ethnicity was moderately correlated with achievement, such that the White students were more likely to have higher GPAs and higher standardized test scores (r ranges from .51 to .57). Counter to expectation, race/ethnicity was not significantly correlated with school graduation.

Positive mother–child interactions were associated with child race/ethnicity and maternal education ($r = .31$ and $r = .52$), respectively. In addition, positive interactions were correlated with higher student achievement in high school (r ranges from .41 to .49) and graduation from school ($r = .32$).

Mother–Child Interactions and Graduation

Table 3 presents the effects of mother's education, race/ethnicity, gender, IQ, and mother–child interaction in the logistic regression model that predicts children successfully graduating from high school. The odds ratio (OR) associated with each predictor and the 95% confidence intervals for each OR represent the effect of an individual predictor (e.g.,

Table 3
OR for Predictors of Graduation

Variables	<i>N</i> = 142	
	OR	95% CI
Maternal education	1.671	(0.889–3.141)
Race/ethnicity	0.809	(0.232–2.818)
Gender	0.617	(0.173–2.204)
IQ	1.020	(0.962–1.082)
Mother–child interaction	3.544*	(1.342–9.362)

Note. OR = odds ratio; CI = confidence interval.

* $p < .05$.

mother–child interaction) on the dependent variable (e.g., graduation). If an OR is larger (or smaller) than 1.00, it depicts the increase (or decrease) of the chance of graduating successfully from high school for a unit increase (or decrease) on the scale of a predictor. If the OR for a predictor is statistically different from 1.00, it can be observed that the 95% confidence interval does not contain 1.00. Results showed that mother–child interaction had the highest OR (3.54) compared to maternal education, race/ethnicity, gender, and IQ. This result showed a strong effect of mother–child interaction on the chance of a child successfully graduating from high school, while holding maternal education, race/ethnicity, gender, and IQ at a fixed value. A child with one unit higher mother–child interaction score measured at the start of kindergarten is 3.54 times more likely to graduate successfully from high school approximately 12 years later.

Mother–Child Interactions and Standardized Test Scores

Table 4 shows the results of the stepwise, multiple regression analyses, with maternal education, race/ethnicity, gender, IQ, and mother–child interaction regressed on high school standardized test scores for reading and math. The nonsignificant betas for mother–child interaction suggest that the quality of early maternal–child interactions, as measured in kindergarten, was not predictive

of later performance in reading and math in ninth grade as measured by the Stanford 9 standardized tests, when taking into account sociodemographic risk. However, higher maternal education and higher IQ, also measured in kindergarten, were significantly associated with higher scores on reading and math. Racial group membership was also predictive of math scores such that White students scored higher than African American students. Together, the cognitive and demographic variables accounted for 52% of the variance in test scores, as shown in the R^2 statistic. None of the two- or three-way statistical interactions with the risk variables was significant.

Mother–Child Interaction and Grades

Table 5 shows the results of maternal education, race/ethnicity, gender, and mother–child interactions as predictors of GPA at the end of high school. Higher mother’s education and higher child IQ, as measured in kindergarten, predicted higher GPA. Female students and white students were also more likely to have a higher GPA. In the second block, the quality of mother–child interactions along with two- and three-way statistical interactions were entered into the equation. We found a significant and positive beta of the three-way interaction (Maternal Education \times Race \times Mother–Child interaction ($\beta = -1.20$, $p < .05$). The second block of predictors explained an additional 5% of variance and approached significance after taking into account maternal education, race/ethnicity, gender and IQ (R^2 change = .05, F Change = 2.30, $p = .051$).

To interpret the significant three-way interaction, we undertook two strategies. We plotted the estimated GPAs of children for four groups, all with average IQ (Figure 1). Shown are plotted regression estimates for African American adolescents and White adolescents whose mothers had less than a high school education or graduated from college and who vary on observed quality of mother–child interactions in kindergarten (1 *SD* above or below the mean). We also conducted subgroup regression analyses with GPA as the dependent variable. Four subgroup samples

Table 4
Regression Analysis for Variables Predicting Stanford 9 Standardized Test Scores

Step	Predictor Variable	<i>F</i> Change	<i>R</i> ² Change	Beta ^a at Each Step
Stanford Reading Test				
Step 1.		31.95***	.52***	
	Maternal education			.33***
	Race/ethnicity			.13
	Gender			.06
	IQ			.40***
Step 2.		2.34	.00	
	Mother-child interaction			.05
Stanford Math Test				
Step 1.		31.49***	.52***	
	Maternal education			.34***
	Race/ethnicity			.22*
	Gender			.12
	IQ			.31***
Step 2.		1.4	.01	
	Mother-child interaction			.09

^aStandardized beta coefficient.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

were tested: high socioeconomic status (SES; mothers with a college education), low SES (mothers with less than a high school education), African American, and White.

Figure 1 shows a positive slope for all groups except White children with college-educated mothers. Results from the subgroup analyses concur. Taking into account race/ethnicity, gender, and IQ, the quality of mother-child interactions was nonsignificant for the high SES sample ($\beta = -.05$, ns). Similarly, taking into account gender, maternal education, and IQ, the coefficient for quality of mother-child interactions was nonsignificant for the white sample ($\beta = -.03$, ns). Figure 1 also shows that the predictive power was strongest for children with the highest risk—namely, those who were African American children and in families with mothers who lacked a high school education. Again, results from the subgroup analyses concur. Taking into account race/ethnicity, gender, and IQ,

the quality of mother-child interactions was significant and positive for the low SES sample ($\beta = .52$, $p < .05$). Similarly, taking into account gender, maternal education, and IQ, the coefficient for mother-child interaction was significant in the African American sample ($\beta = .44$, $p < .05$).

Discussion

This study found that interactions between a mother and her kindergartener during block-building and word-generation tasks that were observed as supportive, scaffolding, respectful, encouraging, responsive, appropriately interdependent, and on-task increased the likelihood of graduation 12 years later. A one-unit increase in quality of mother-child interactions in kindergarten related to more than three and a half times increased likelihood of graduation. These findings held for all

Table 5
Regression Analysis for Variables Predicting Grade Point Average ($N = 105$)

Step	Predictor Variable	F Change	R^2 Change	Beta ^a at Each Step
Grade Point Average				
Step 1.		27.21***	.52***	
	Maternal education			.42***
	Race/ethnicity			.28**
	Gender			.17*
	IQ			.16
Step 2.		2.30 ⁺	.05 ⁺	
	Mother–child ^b			.36**
	Maternal education \times mother–child			–.18
	Race \times mother–child			.21
	Race \times maternal education			.93
	Race \times maternal education \times mother–child			–1.20*

^aStandardized beta coefficient.

^bMother–child interaction quality.

⁺ $p < .06$.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

participants, regardless of race/ethnicity, gender, social class, and IQ; they suggest the promotive function of early mother–child interactions. The study also found that positive mother–child interactions in kindergarten were linked with higher grades 12 years later for children at risk for school failure, which suggests a protective function of early mother–child interactions. There was no association between early mother–child interaction quality and achievement as measured by high school standardized tests, after controlling for students' sociodemographic characteristics.

The present study extends existing research demonstrating the association between the quality of early mother–child interaction and children's later academic outcomes and provides a nuanced view of how high-quality parent–child relationships are more important for some school outcomes than others. On the one hand, the present findings replicate previous research. For example, Teo and colleagues reported that early maternal sensitivity predicted 5% of the variance in 16-year-olds'

achievement (Teo et al., 1996). On the other hand, the present study extends existing research by describing the extent to which such findings are evident in a diverse sample, using observationally based measures of mother–child interaction, examining the interactions between distinct risk factors and processes, and expanding the range of outcomes to include those most relevant to policy makers (i.e., high school graduation).

Possible Mechanisms Explaining the Contribution of Mother–Child Interactions

It is worth speculating on the most likely mechanisms explaining the link between maternal interactional quality and high school achievement and educational attainment. We offer the following explanations, ranging from proximal and direct to distal and indirect. The first possibility is that children with sensitive mothers develop emotion regulation skills in the context of their home environment in early childhood and transfer these skills to the

school setting. For instance, research on emotion regulation has suggested that parents play an important role in teaching children how to monitor and control their emotional responses to other children and adults (Eisenberg, Spinrad, & Smith, 2004); such skills have been linked to higher achievement (McCabe, Cunnington, & Brooks-Gunn, 2004). Particularly for low-income families, how mothers interact with their toddlers in modeling problem-solving behavior has been modestly linked with later emotion regulation in kindergarten (Supplee, Shaw, Hailstones, & Hartman, 2004). Thus, children with sensitive interactions with their mothers may learn strategies for successful help-seeking and emotional self-control that carry over into their relationships with teachers in schools (O'Connor & McCartney, 2006) with positive implications for students' subsequent academic gains (Hamre & Pianta, 2001).

A second possible mechanism to help explain how high-quality mother-child inter-

actions are linked to high school outcomes is school-related parenting practices. Maternal sensitivity may reflect parents' explicit efforts to teach their children academic skills. Work by Downer and Pianta (2006) demonstrates that children's emergent cognitive and academic skills mediate the relation between early childhood family factors (including maternal sensitivity) and performance in first grade. Others have pointed to the importance of mothers' sensitive interactions with their children in book-reading tasks as accounting for many of the successful reading outcomes that stem from these experiences (Clingenpeel & Pianta, 2007; Roberts, Jurgens, & Burchinal, 2006). Applied to the present findings, it is possible that maternal sensitivity contributes to students' eventual academic success indirectly and that early maternal sensitivity simply indicates parents' successful efforts to bolster students' academic skill throughout their education.

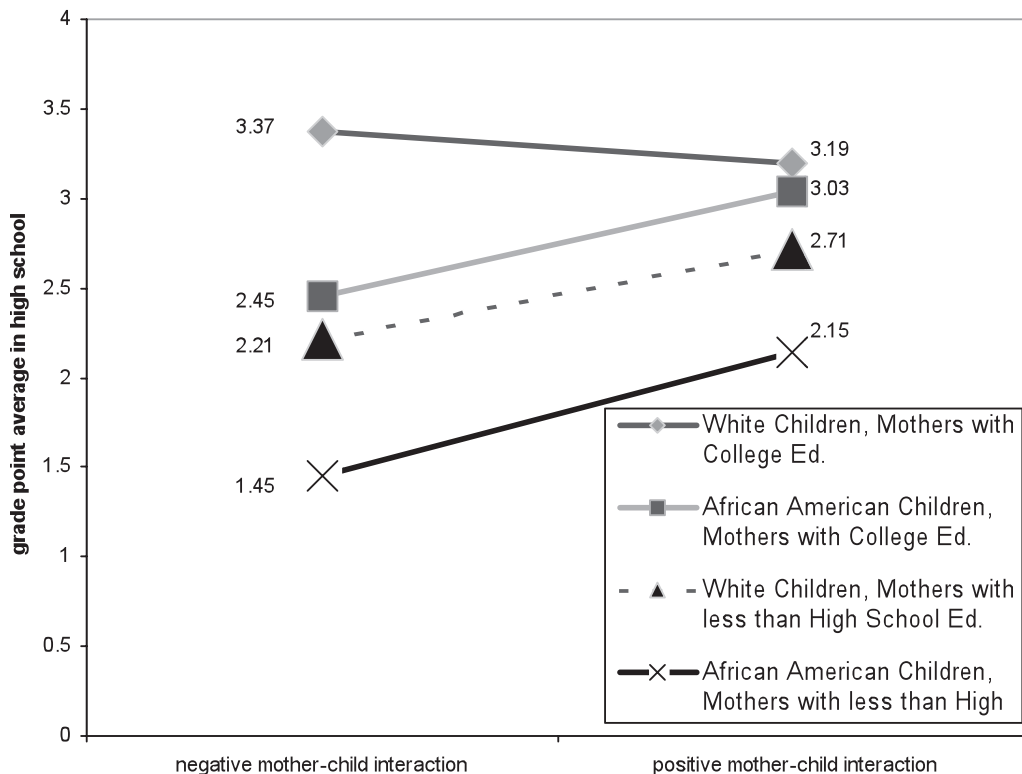


Figure 1. Mother-child interactions predicting adolescents' GPA

Differential Prediction of School Outcomes

The present findings show the predictive power of mother–child interaction quality in relation to high school graduation, but no comparable findings for test scores in high school (after controlling for sociodemographic characteristics of the family). In fact, the child’s IQ was the strongest predictor in relation to test scores. This finding is consistent with observations within the field of education that standardized tests do not measure nonacademic skills included in the most broadly construed mission of school (Rothstein, 2004). It appears that the quality of mother–child interactions are more important predictors of an achievement outcome (e.g., GPA, high school graduation) that involve academic, nonacademic, and socioemotional skills as compared to those achievement outcomes more closely linked to intelligence.

Along with their cumulative experiences of academic failure, students drop out of school because they feel disengaged from school activities and alienated from school staff; thus, school dropout is a reflection of a failed relationship between an individual and his or her school community (Croninger & Lee, 2001). Likewise, teachers issue grades in a relational context. Along with student achievement on classroom assignments, positive or negative interpersonal experiences with students may influence how teachers assign students a grade.

Findings from interventions aimed at improving the quality of teacher–student interactions provide support for the importance of socioemotional skills for a range of schooling outcomes. For instance, children in the treatment condition of the Seattle Social Development Project, a socioemotional intervention in elementary schools, experienced lower high school dropout and less school misbehavior at age 18, compared to those in the control condition (Hawkins, Guo, Hill, Battin-Pearson, & Abbott, 2001). The two groups did not differ on standardized achievement test scores (Hawkins et al., 2001). These findings suggest that the benefits of high-quality relationships

with adults may be linked to achievement outcomes that draw more heavily on nonacademic skills.

Therefore, it is quite possible that the social skills learned in early mother–child interactions may benefit adolescents by supporting their development of successful relationships with teachers later in their schooling. This explanation is consistent with research that links positive mother–child relationships (operationalized as children with secure attachments to their parents) to improved social skills and better quality teacher–child relationships (O’Conner & McCartney, 2006). Further, this work is consistent with research suggesting that a positive relationship between an adolescent and his or her teacher can reduce the likelihood of school dropout (Croninger & Lee, 2001).

Protective and Promotive Contribution of Mother–Child Sensitivity

The findings showed that sensitive mother–child interactions matter the most for the GPAs of ethnic minority children whose mothers have lower educational levels (i.e., the group most at risk for school failure given the sociodemographic characteristics of the sample). This finding implicates the protective role of quality mother–child interactions in adolescents’ classroom grades. In other words, the quality of mother–child relationships does not contribute consistently across groups, but rather matters more for children at risk for school failure. This finding is consistent with other research that describes the way in which positive social and interactive processes can compensate for the lack of economic resources (Gregory & Weinstein, 2004) or the risk facing children of color (Meehan, Hughes, & Cavell, 2003) in predicting positive youth outcomes. Further, the present findings are consistent with those that indicate that supportive, positive parenting (i.e., parenting characterized by rules and structure, warmth and closeness, and high expectations for achievement and prosocial behavior) offer a resiliency resource for children living under adverse conditions (Gutman et al., 2003).

Our definition of maternal sensitivity was applied across White and African American children alike and in essence considered the warmth and responsiveness of the mother toward the child. The finding that links maternal sensitivity to graduation and GPA, for African American children, is worth careful consideration in light of other studies. As one example, data from a cluster analysis of 700 African American mothers and their toddlers were analyzed. A disproportionate number of African American mothers showed behaviors categorized as *tough love* and characterized as both warm and high in harsh control. This combination appeared beneficial for the school readiness of African American children, whereas comparable levels of harsh control were not associated with positive outcomes for White children (Brooks-Gunn & Chase-Lansdale, 1995). Our findings offer a different view and suggest that maternal sensitivity defined in terms of the sensitive contingent relations between mothers and their children were even more important for African American than White children.

Limitations

Four limitations require explanation. First, it is possible that the small sample size did not provide sufficient power to detect significant relationships between the mother-child interactions and the standardized test scores. Second, although the predictors explained a sizable portion of the variance (between 33% and 52% of variance in achievement and dropout), the analyses left more than 50% of the variance unexplained. Most likely, this variance can be attributed to a variety of personal attributes and experiences beyond the scope of the present study. These include students' attentional and behavioral attributes (Hinshaw, 1992), the quality of students' classroom experiences (Rutter & Maughan, 2002), the nature of students' relationships with their teachers (Croninger & Lee, 2001), and the quality of the out-of-school contexts to which the child has been exposed (Lauer, Akiba, & Wilkerson, 2006). Third, we failed to measure many intervening experiences dur-

ing a child's years in school that contribute to his or her high school achievement and dropout. Dropout, for example, has been described as a long process of disengagement, with many markers of school failure and disengagement through earlier years of schooling beyond the scope of the present study (Christenson & Thurlow, 2004; Vitaro et al., 2005). Fourth, the current study focused on measuring mother-child relationships at only one time point (instead of multiple points across development), thus capturing a limited view of the consequences of mother-child relationships over time.

Future Directions

These limitations set the stage for future inquiry on maternal sensitivity. The research on maternal sensitivity in early childhood offers a road map for the types of research questions to be asked in school-aged children. For example, the NICHD Study for Early Child Research Network modeled change in mother-child interaction between 15 and 54 months. When the quality of the mother-child interaction improved over this time, children who were insecurely attached showed decreases in externalizing behavior (NICHD, 2006). Applied to school-aged children, this work suggests the importance of modeling change and growth in the nature of children's observed interactions with their mothers. Such work points to the importance of extending this research to older children to consider the confluence of maternal sensitivity and school social processes for predicting youth outcomes.

Several other critical questions emerge as promising. For example, are sensitive mother-child interactions most important early, before children become engaged (or disengaged) from the educational process, or are they equally important during the late childhood and early adolescent years? Further, to what extent do sensitive mother-child relationships show heterotypic continuity whereby sensitivity takes one form in early childhood and a quite different form in adolescence?

Summary and Implications for School Psychology

The study found that the quality of interactions between a kindergartener and his or her mother as assessed during brief problem-solving tasks was a significant promotive and protective factor in regard to high school outcomes. Providing support for a promotive function for all adolescents, the findings showed that a child whose interaction patterns with his or her mother goes from low quality to medium quality—a 1-unit change—was associated with his or her chances of graduating roughly threefold. Moreover, serving as a protective factor, positive mother–child interactions predicted higher GPAs by 12th grade for children facing sociodemographic risks, based on mother’s education and race/ethnicity. The findings suggest that school psychologists need to think developmentally about interrupting negative achievement trajectories before they take hold (NICHD et al., 2007; Webster-Stratton, 2005). The work in early childhood collectively suggests that gains in parental sensitivity are as or more important than initial level of sensitivity (e.g., NICHD, 2006; Hirsh-Pasek & Burchinal, 2006). As school psychologists are called on to use more family-oriented approaches (Hojnoski & Missall, 2006), interventions to change levels of parent sensitivity may hold promise.

That said, it is important to be cautious in making causal assertions. These methods do not support causal inferences between maternal sensitivity and school performance. Further, it is quite possible that when children achieve more, show less externalizing behavior, and manage their attention more effectively, it becomes easier for mothers to respond sensitively and responsively to their children. Although it is impossible to make causal assertions, the findings offer school psychologists promising intervention targets in mother and child behavior: mother’s emotional warmth, ability to instruct her child, and respect for her child’s autonomy. From the child’s side of the interaction, target behavior includes the child’s help seeking, regulation of negative affect, and the quality of engagement

in tasks. Carefully conducted interventions will offer the opportunity to go beyond the correlational evidence presented in this study to causal evidence of the relationship between quality of interaction and high school achievement and attainment.

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Date Received: February 11, 2008

Date Accepted: September 1, 2008

Action Editor: Stephanie McConaughy ■

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