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# Temperamental attention and activity, classroom emotional support, and academic achievement in third grade

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## **Abstract**

The purpose of this study is to examine the interplay of children's temperamental attention and activity (assessed when children were 4-and-a-half years old) and classroom emotional support as they relate to children's academic achievement in third grade. Particular focus is placed on the moderating role of classroom emotional support on the relationship between temperament (attention and activity level) and academic achievement. Regression analyses indicated that children's attention and activity level were associated with children's third grade reading and mathematics achievement, and classroom emotional support was associated with children's third grade reading and mathematics achievement. In addition, classroom emotional support moderated the relation between children's attention and reading and mathematics achievement, such that attention mattered most for reading and mathematics achievement for children in classrooms with lower emotional support. Findings point to the importance of understanding how children's temperament and classroom emotional support may work together to promote or inhibit children's academic achievement.

**Keywords:** temperament, attention, activity level, classroom environment, academic achievement

## 1. Introduction

Children's early academic achievement has been linked to later success in life in areas such as types of employment, life satisfaction, health, and the academic achievement of offspring (Easterlin, 2001; Murrell et al., 2003; Subasi & Hayran, 2005). More proximally, children's early academic achievement has important implications for their future academic achievement. According to Alexander, Entwisle, Blyth, and McAdoo (1988) "... by the end of the third grade, children are launched into achievement trajectories that they follow for the rest of their school years" (p. 1). Indeed, landmark legislation, No Child Left Behind (2002), mandated third grade as the first year of required annual testing of reading and mathematics achievement in all public schools (<http://www.ed.gov/nclb>). Thus, the importance of early academic achievement for ongoing academic success is widely accepted.

The need to understand influences on early academic achievement is urgent given the established importance of early achievement and the high stakes context of early education. Historically, several factors have been found to be associated with children's early achievement, including temperament and classroom support processes. However, we know less about the ways in which these child and process characteristics work *together* to predict children's academic outcomes. Thus, the purpose of this study is to examine the interplay of child temperament (attention and activity) before the onset of formal schooling and classroom emotional support in third grade as they relate to children's third grade academic achievement.

### 1.1. *Biological systems theory*

The bioecological systems theory (Bronfenbrenner & Morris, 1998) provides a model for considering the interacting influences of person, process, context, and time (PPCT) on children's development and academic achievement. Person characteristics influence children's development by affecting children's everyday interactions (i.e., proximal processes). For example, child characteristics can manifest as active behavioral dispositions that promote or hinder development as they interact with proximal processes. According to Bronfenbrenner, children's developmental competence emerges in the context of participation in increasingly complex, reciprocal proximal processes over time. In the current study, synergistic factors of child temperament (person) characteristics (i.e., attention and activity level) and proximal processes (i.e., classroom emotional support) are examined in relation to children's school achievement in reading and mathematics in third grade.

### 1.2. *Temperament*

Temperament refers to constitutionally based individual differences in *reactivity* and *regulation* (Rothbart, Derryberry, & Hershey, 2000). According to Rothbart and Derryberry (1981), the *constitutional* nature of temperament means that it is "the relatively enduring biological makeup of the [individual], influenced over time by heredity, maturation, and experience" (p. 40). Indeed, temperament is widely acknowledged to be relatively sta-

ble through early elementary school and beyond (Caspi & Silva, 1995; Kagan et al., 1988; Reznick et al., 1986; Rimm-Kaufman & Kagan, 2005; Rothbart & Posner, 2005). Temperament reflects an individual's *patterns* of behavior in response to the environment, rather than responses to isolated events (Rothbart & Bates, 2006). Extensive research with samples of young children and infants has revealed multiple dimensions of temperament that reflect reactivity (e.g., activity level, anger, shyness) and regulation (e.g., attention, inhibitory control) (Rothbart et al., 2001; Rothbart & Bates, 2006; Thomas & Chess, 1977). In the context of early schooling, two dimensions of temperament that may influence children's participation and response to the classroom environment are attention and activity level. Early work by Martin and colleagues (Martin et al., 1988; Martin & Holbrook, 1985) investigating associations between children's attention and activity level and academic achievement informed the current study. Specifically, this study is an examination of associations between attention and activity level in late preschool and children's third grade academic achievement.

Attention refers to a child's ability to sustain and shift attention to tasks, as needed (Rothbart & Jones, 1998). In a school environment, children temperamentally prone to regulating attention may more easily engage in classroom instruction, focus on assessments, and complete assignments. Attention, then, is an aspect of the *regulatory* temperament system (Henderson & Fox, 1998), such that attentional capacity allows an individual to shift and focus attention as required for specific situations, such as during classroom instruction.

Activity level refers to a child's tendency to exert gross motor activity (such as jumping up and down) in response to environmental stimuli (Rothbart & Jones, 1998); thus, it is an aspect of the *reactive* temperament system. In the classroom, more active children may be prone to expressing excitement and eagerness regarding instructional activities and learning. Alternatively, more active children may appear poorly regulated, have trouble sitting still or seem disruptive (Rothbart & Jones, 1998). Depending on the context, high activity level may be viewed as positive or engaged behavior, such as showing enthusiasm (e.g., jumping up and down in excitement about a present), being energetic (e.g., enjoying physical, rather than sedentary, activity), or being inquisitive. In other contexts and to greater extremes (i.e., very high levels of activity), activity may be viewed as negative, or disregulated behavior, such as being overly excited or unable to sit still. Therefore, context and perspective are important when considering whether high activity is positive or negative. High activity levels in home or playground settings may be viewed positively, but high activity in the classroom may be viewed as disruptive.

Children who demonstrate difficulties with attention and/or activity level (i.e., low attention levels and very high activity levels) are more likely to exhibit behavior problems (Kochanska et al., 1996; Kopp, 1989; Martin, 1989; Rothbart & Bates, 1998); while children who typically exhibit focused attention and moderate activity levels engage more productively in classroom (i.e., proximal) processes. According to Bronfenbrenner and Morris (1998), temperament characteristics that facilitate or impede productive engagement in proximal processes are expected to be more influential over time. In the current study, we examine associations between parent ratings of the temperament characteristics of attention and activity level when children were 4-and-a-half years of age and children's academic achievement in third grade. Thus, attention and activity were measured from the perspective of a primarily home context.

### *1.3. Contributions of temperament to academic achievement*

Although the relation between aspects of child temperament and academic achievement remains largely unexplored (Coplan, Barber, & Lagace-Seguin, 1999), research suggests that the temperament dimensions of attention and activity level may be associated with children's adaptation to the school environment (e.g. Lerner et al., 1985; Stright et al., 2008) and academic achievement (Martin & Holbrook, 1985). For example, studies have shown that greater effortful control (a broader temperamental construct that includes attention) aids academic achievement (Kendall, 1993; Alexander et al., 1993), while poorer attention can hinder achievement (Finn et al., 1995; Veldman & Worsham, 1983).

Several concurrent and longitudinal studies document associations between attention, activity level and school performance. While children with clinically high levels of inattention and activity (i.e., attention-deficit hyperactivity disorder, attention-deficit disorder) are prone to poorer academic achievement throughout schooling (Kos, Richdale, & Hay, 2006), children with sub-clinical levels of inattention and high activity may also be susceptible to difficulties in school achievement over time.

Martin and Holbrook (1985) examined associations between first grade children's attention and academic achievement (using report card grades and standardized test scores). Children rated as less distractible by teachers exhibited better grades and higher standardized achievement scores for reading and math, accounting for 21% to 44% of the variance. In a longitudinal follow-up study (Martin et al., 1988), less distractible (i.e., more attentive) preschool and kindergarten children demonstrated higher academic achievement than their more distractible classmates in first and fifth grades. Similar associations have been reported with parents' reports of children's attention. For example, when parents rated children as having poor regulation of attention at 5 years old, teachers reported the children as having difficulty with completing assignments and following directions (Nelson, Martin, Hodge, Havill, & Kamphaus, 1999).

Other studies have examined associations of attention and achievement from a clinical perspective. In a longitudinal study spanning kindergarten to fifth grade, Rabiner and colleagues (Rabiner & Malone, 2004; Rabiner et al., 2004) found that attention problems led to poorer reading achievement over time, rather than poorer reading achievement leading to attention problems. Inattentive first graders with average reading scores after kindergarten had poorer reading achievement in fifth grade than children without attention problems. Subsequent studies provide further support for the detrimental effect of inattention on early achievement. One study suggested that inattention (and not other behavior problems) was related to poor first grade overall academic achievement even after controlling for IQ and earlier reading ability (Rabiner et al., 2004). Furthermore, and highlighting the impact of attention problems on interactive instructional processes, tutoring efforts to remediate reading difficulties were effective with attentive, but not inattentive, kindergarten and first graders (Rabiner & Malone, 2004). So while it is clear that attention problems may impact children's engagement in academic processes and achievement, more research is needed on how typical variations in attention are associated with children's school achievement over time.

Research offers less conclusive information about the associations between children's activity level and academic achievement. Findings regarding the relationship between activity level and academic achievement may be related to the context in which activity is

assessed. On the one hand, concurrent and longitudinal studies examining activity and achievement in preschool and elementary grades have suggested that higher activity is detrimental to children's academic success (Martin et al., 1988; Martin & Holbrook, 1985; Palisin, 1986). For example, Martin and colleagues (i.e., Martin & Holbrook, 1985; Martin et al., 1988) used teacher ratings of children's gross motor activity in the classroom to predict academic achievement in elementary school. Their findings suggest that higher activity levels are associated with lower achievement, indicating that high levels of activity *in school* hinder academic performance. On the other hand, other studies predicting child cognitive outcomes from infant activity level (assessed by parents) indicate that higher activity level predicts better cognitive outcomes (DiLalla et al., 1990; Molfese et al., in press). DiLalla et al. found that infants with higher activity ratings at 9 months had higher intelligence scores at age three.

Results from these collective studies point to the importance of examining the contributions of children's attention and activity level to their academic outcomes in elementary school. We expected that children with better attention in late preschool would demonstrate higher reading and mathematics achievement in third grade. In addition, we explored associations of children's activity level in late preschool to reading and mathematics achievement in third grade.

#### ***1.4. Classroom emotional support***

Classrooms with high levels of emotional support provide an important context for children's early school success (Morrison & Connor, 2002; Rutter & Maughan, 2002; Thompson & Happold, 2002). Indeed, there is accumulating evidence pointing to the importance of classroom emotional support to children's academic outcomes, particularly for children at risk for academic difficulty (Brock et al., 2008; Doll et al., 2004; Hamre & Pianta, 2005; O'Connor & McCartney, 2007; Stipek et al., 1995). That is, teachers who provide child-centered classroom environments, marked by positive climate, warmth, and teacher sensitivity are more likely to have pupils who thrive academically (La Paro, Pianta, & Stuhlman, 2004).

Studies showing the value of classroom emotional support to children's academic outcomes include examinations of children in preschool and elementary school. With a sample of preschoolers, Howes and Smith (1995) revealed that children's positive interactions with teachers predicted their cognitive growth in preschool. Similarly, Stipek et al.'s (1995) study of the effects of child-centered (i.e., emotionally supportive; the extent to which children could choose from an array of play activities, teacher warmth, and teacher use of positive methods, such as interesting activities, to keep children engaged) classrooms on preschool and kindergarten-aged children's academic achievement and motivation showed that children in child-centered programs reported more motivation to succeed in school. However they did not have higher academic achievement. With samples of elementary aged children (grades 1 to 4, and grades 3 to 5), Rimm-Kaufman and Chiu (2007) and Brock et al. (2008) examined the academic outcomes of children in classrooms using the *Responsive Classroom (RC) Approach*. This approach to teaching in elementary school places equal emphasis on children's academic and social development, and fosters a climate of caring and support in the classroom. Results from both studies support the notion that classroom emotional support contributes to children's academic outcomes.

Specifically, Rimm-Kaufman and Chiu (2007) found teachers' greater use of the *RC Approach* predicted reading achievement gains. Brock et al.'s examination revealed positive relationships between classroom emotional support (i.e., use of the *RC Approach*) and children's reading achievement and teachers' perceptions of academic performance. In an examination of children in 14 first grade classrooms, Perry, Donohue, and Weinstein (2007) revealed that more classroom emotional support predicted higher year-end academic achievement in both mathematics and reading domains. Taken together, these studies support the idea that emotional support in the classroom has important contextual implications for young children's academic success.

The hallmark of a highly emotionally supportive classroom is that the teacher is in tune with the needs of students and readily responsive to them. Thus, classrooms high in emotional support may be particularly helpful for children whose temperamental characteristics are not well matched with the demands of the classroom (e.g., children low in attention or high in activity). Our search of the literature revealed only one study similar to ours investigating the interplay of temperament and classroom emotional support on children's achievement in elementary school. Hamre and Pianta (2005) examined the moderating role of classroom emotional support on the relation between children's functional risk (i.e., difficulties with attention, externalizing behavior, social skills, and academic competence) and achievement in first grade. As with the current study, Hamre and Pianta used data from the National Institute of Child Health and Human Development Study of Early Child Care and Youth Development (NICHD SECCYD), and examined the moderating role of classroom emotional support on achievement. In addition, they included a measure of inattention as part of functional risk. However, the focus of Hamre and Pianta's study was functional risk, rather than temperament, and achievement outcomes were assessed in first grade, rather than third grade. Their results showed that children with multiple functional risk factors in *highly* emotionally supportive classrooms performed just as well as those with little to no functional risk. However, in moderate and low emotional support classrooms, children with multiple functional risk factors were significantly out-performed by their low/no-risk peers. In this way, Hamre and Pianta's study provides key foundational knowledge about how classroom emotional support may buffer children with poor attention from academic difficulties.

### ***1.5. The current study***

The present study uses a longitudinal, national data set to examine relationships among children's temperament, third grade classroom emotional support, and third grade academic achievement. Children's temperament was assessed prior to formal schooling, when children were approximately 4-and-a-half years of age (i.e., late preschool). Classroom emotional support and academic achievement were assessed in the spring of third grade, the initial year for high stakes educational testing. This examination of children's achievement in the context of the initial high stakes year of educational testing (<http://www.ed.gov/nclb>) allows for deeper understanding of the factors that may be important for achievement and how classroom context may moderate this relation. In order to control for academic achievement prior to third grade, assessments of achievement from age 4-and-a-half years were included in the analyses.

The purpose of this study is to examine the contributions of children's temperament and classroom emotional support to academic achievement in third grade, before and after accounting for reading and mathematics achievement in preschool (i.e., age 4-and-a-half years). Because children's academic achievement and classroom emotional support were measured concurrently, this study is particularly focused on understanding how children's temperament characteristics (i.e., attention and activity level) and the emotional support of the classroom are associated with children's functioning (i.e., academic achievement) in that classroom. To that end, we ask the following research questions:

- 1) To what extent do attention and activity level and classroom emotional support relate to children's academic achievement in third grade? Do these relationships remain after accounting for achievement at age 4-and-a-half years?
- 2) To what extent does classroom emotional support moderate the relation between attention and activity level to children's academic achievement? Does this relationship remain after accounting for achievement at age 4-and-a-half years?

We expected that children in third grade classrooms with more emotional support would demonstrate higher achievement in third grade than those in classrooms with less emotional support, regardless of attention and activity levels. However, in classrooms with less emotional support, we expected that greater attention and less activity would be associated with better academic achievement. Therefore, the hypothesized relationships between temperamental characteristics and academic achievement are only expected to be present in classrooms where there is no sufficient emotional support. We hypothesize that more emotionally supportive classrooms will be more likely to facilitate children's *regulation* of activity.

## 2. Method

### 2.1. Participants

Participants for this study were part of the NICHD SECCYD. Mothers with children born in hospitals at 10 sites (Little Rock, AK; Irvine, CA; Lawrence, KS; Boston, MA; Philadelphia, PA; Pittsburgh, PA; Charlottesville, VA; Morganton, NC; Seattle, WA; and Madison, WI) in the United States were recruited for participation in the study in 1991. Out of 8986 mothers who gave birth during that time, 5416 (60%) were eligible for participation and agreed to a telephone interview. Mother-child pairs were ineligible for the study if the mother was not yet 18 years old, could not speak English, and/or did not plan to stay in the region in which she gave birth for at least 3 years, and if the infant had a disability evident at birth or was hospitalized more than 7 days after birth. Three thousand fifteen mothers (56%) were conditionally and randomly selected for a phone call. Of those, 1526 remained eligible for study participation; ultimately 1364 became study participants. Data for this study were obtained from Phase I (when children were 4-and-a-half years old) and Phase III (when children were in third grade). Given the longitudinal nature of this study, the number of participants decreased by Phase III. Specifically, at the start of Phase III (when children were in first grade), there were 1007 study children. Of



these, school data were available for 707 children who were distributed across 659 third grade classrooms, in both public and private schools, throughout the United States. In most cases, there was only one study child in a third grade classroom. However, there were two study children in 36 classrooms, three study children in four classrooms, and five study children in one classroom. Given the minimal nesting of students within classrooms, multilevel modeling was not needed to account for higher order correlations. This is a publicly available data set that may be obtained via <https://secc.rti.org/>. For further information regarding selection, sample, measures, and data collection, refer to the Manuals of Operation of the National Institutes of Child and Human Development Early Child Care Research Network (NICHD ECCRN, 1993).

The final sample ( $N = 707$ ) comprised 349 boys and 358 girls. In terms of ethnicity, 85% of the sample was White ( $n = 599$ ), 10% was Black/African American ( $n = 72$ ), and the remaining 5% was Hispanic, Asian American, or American Indian. Children ranged in age from 8.3 years (99 months) to 10.1 years (121 months). The mean age at the time of assessment was 8.9 years (107 months). In terms of socioeconomic status, the mean years of education for mothers was 14.2 years ( $SD = 2.5$ ), and the mean family income when children were in third grade was \$76,620 ( $SD = 64,741$ ). Tests of differences between children with and without third grade data revealed no significant differences by gender or mean family income (at birth). However, a chi-square analysis indicated significantly more White students had third grade data than expected ( $\chi^2_4 = 14.27, p < .05$ ).

Third grade teachers ( $n = 659$ ) had an average of 12.2 years ( $SD = 10.5$  years) of public school teaching experience. The mean age of third grade teachers was 42.8 years ( $SD = 10.8$ ) and 91% were White ( $n = 598$ ).

## 2.2. Instruments

### 2.2.1. Children's Behavior Questionnaire

Children's temperamental attention and activity were assessed through mother report on the Children's Behavior Questionnaire (CBQ; Rothbart, Ahadi, & Hershey, 1994) when children were 4-and-a-half years. Mothers rated children's behaviors related to attention and activity during the previous six months on a scale of 1 (extremely untrue) to 7 (extremely true). The CBQ is a widely-used, theoretically derived, rating scale of temperament, and has well-established external validity and reliability (Rothbart et al., 2001). Rothbart and colleagues examined the structural and convergent validity of the CBQ with multiple samples (including 4- to 5-year-olds, and 6- to 7-year-olds), and found that the factor structure was consistent across samples representing different ages and cultures. In addition, scores on the CBQ were related to measures of social behavior (such as aggression and empathy). As an example, 6- and 7-year-olds' scores for the broad temperament factor of effortful control (made up of scores from the inhibitory control, attentional focusing, low intensity pleasure, and perceptual sensitivity subscales) were positively related to concurrent ratings of empathy and guilt/shame.

The attentional focusing subscale (9 items) is a measure of a child's temperamental attention (i.e., the ability to concentrate and focus on a stimulus). Items from this subscale include "When drawing or coloring in a book shows strong concentration" and "When building or putting something together, becomes very involved in what s/he is doing, and works

for long periods." Internal consistency for this subscale with the current sample was .66. The activity level subscale (10 items) measures a child's tendency to engage in gross motor activity throughout the day. Sample items include "Tends to run rather than walk from room to room" and "Has difficulty sitting still at dinner" (Rothbart et al., 1994). Internal consistency for this subscale with the current sample was .69. Internal consistency values, while lower than the ideal .70-.80, are similar to those considered adequate for research purposes in other studies (Kochanska et al., 1994; Putnam & Rothbart, 2006; Rothbart et al., 2001).

### 2.2.2. Classroom observation system

Observers assessed classroom emotional support in children's third grade classrooms during the spring semester (i.e., between February and April). Global ratings, made during eight, non-contiguous 10-minute intervals throughout the 3-hour observation period, were used to assess the quality of interactions between teacher and students. A rigorous training protocol was used to train observers. Specifically, through practice observations using videotapes with a code manual, observers were required to reach 80% agreement with a master coder with six videotapes before assessing classrooms.

Scores for the following global classroom quality dimensions were summed to comprise classroom emotional support: teacher detachment (reflected), positive classroom climate, negative classroom climate (reflected), productive use of instructional time, and teacher sensitivity. Observers assessed dimensions on a scale of 1 to 7, with 1 indicating "uncharacteristic" of the classroom, and 7 indicating "extremely characteristic" of the classroom; thus, higher scores indicated greater emotional support. Brief descriptions of the classroom quality dimensions are given below.

A teacher who is higher on *teacher detachment* may ignore children's bids for attention or respond cursorily, allow children's difficulties with school work or social interactions to escalate without stepping in to help, rarely interact with children, and seem more interested in paperwork or talking with adults than engaging children. A teacher who is lower on this dimension does not allow much time to pass before acknowledging children's bids for attention, and appears to regularly monitor children's activities.

*Positive climate* is a rating of the extent to which a classroom is marked by warmth, laughter, enthusiasm of the teacher and students, physical affection, and an overall sense of happiness. A classroom with a lower positive climate score is marked by widespread disrespectful interactions (e.g., put downs or sarcasm) between students and between teachers and students, where students may seem afraid or the general tone of the classroom is neutral (i.e., lacking a positive tone).

*Negative climate* is a rating of the extent to which a classroom is marked by teacher disapproval, criticism, and hostility. A classroom high in negative emotional climate lacks features that show concern for children's well-being, and are focused on teacher needs to the detriment of students. In addition, these classrooms are punitive in nature. A classroom lower in negative climate lacks these characteristics.

A classroom higher on *productive use of instructional time* runs smoothly, such that students and teachers always seem to know the classroom rules, procedures, and expectations. Students' activities are appropriate so that every student is productively engaged. In a classroom with a lower score on this dimension, students seem to spend a lot of time waiting for or ignoring teacher instructions, or transitioning from one activity to another. In a classroom with a lower score on productive use of instructional time, for example,

teachers spend unnecessary time dealing with administrative tasks (e.g., taking roll) to the detriment of instructional time.

*Teacher sensitivity* refers to a teacher's ability to understand and appropriately respond to cues and needs of children. A teacher high in sensitivity is aware of the developmental levels and interests of the children, and that awareness guides interactions, instruction, and discipline. A teacher who is low on sensitivity may interact with students in a way that is incongruent with their developmental levels, or show little concern or change in behavior when students appear bored or confused.

Internal reliability for the combined classroom emotional support scale was  $\alpha = .82$ . The Manuals of Operation of the National Institutes of Child and Human Development Early Child Care Research Network (NICHD ECCRN, 1993) report two different reliability estimates for scores from the Classroom Observation System. The first is a Pearson correlation coefficient, and the second is derived from a repeated measures ANOVA that is an "unbiased estimator of the reliability of the mean of  $k = 2$  measurements after taking into account differences in the raters" (p. 69; NICHD ECCRN, 1993). For the classroom emotional support variable used in this study (referred to as "positive classroom climate with involved teacher composite" in the NICHD ECCRN Manuals of Operation), the Pearson correlation coefficient and the repeated measures ANOVA reliability estimates were high ( $\alpha = .73$  and  $.82$ ). In addition, paired observations were conducted at two randomly selected time points to assess inter-observer reliability. Correlation coefficients of inter-observer reliability for global classroom quality ratings averaged  $.71$  (NICHD ECCRN, 2005). Pianta, Belsky, Vandergrift, Houts, and Morrison (2008) calculated within classroom reliability for the NICHD SECCYD for ratings of third grade classrooms observed more than one time (because more than one study child was placed in that classroom), and reported a correlation of  $.91$  for observations made in the same classroom on the same day.

### 2.2.3. Woodcock–Johnson Psycho-educational Battery – Revised, Tests of Achievement

Academic achievement at age 4-and-a-half years and in third grade was assessed using the Woodcock–Johnson – Revised Test of Achievement (WJ-R ACH; Woodcock & Johnson, 1989; Woodcock, 1990). This test was administered to each study child in the lab in the spring semester (i.e., between February and April). Achievement at age 4-and-a-half years was assessed using standard scores from the Letter-Word Identification subtest (for reading) and the Applied Problems subtest (for mathematics). Reliability estimates for these subtests at age 4-and-a-half for children in this dataset were  $.85$  (Letter-Word Identification) and  $.84$  (Applied Problems). Achievement in third grade was measured using standard scores from five subscales (with Cronbach's alphas for the current sample): Letter-Word Identification ( $.79$ ), Passage Comprehension ( $.79$ ), Calculation ( $.68$ ), Applied Problems ( $.62$ ), and Word Attack ( $.91$ ). From these subscale scores, Broad Reading ( $\alpha = .94$ ) and Broad Math ( $\alpha = .68$ ) standard scores were obtained. These scores were intended to provide general measures of achievement in reading and mathematics (NICHD ECCRN, 1993).

## 2.3. Data analysis

### 2.3.1. Preliminary data analyses

Means, standard deviations, and correlation coefficients were calculated for all variables. These are shown in Table 1. Temperament ratings indicated that children in this sam-

ple had moderate to high levels of activity and attention. Scores for classroom emotional support were negatively skewed. Variables were not highly intercorrelated, with a few exceptions. Activity level and attention were negatively related ( $r = -.41$ ). Children's reading and mathematics achievement scores were moderately correlated at third grade ( $r = .64$ ) and at age 4-and-a-half ( $r = .60$ ). In addition, children's third grade reading achievement scores were moderately correlated with reading ( $r = .54$ ) and mathematics ( $r = .52$ ) achievement scores at age 4-and-a-half. Children's third grade mathematics achievement scores were also moderately correlated with reading ( $r = .46$ ) and mathematics ( $r = .54$ ) achievement scores at age 4-and-a-half. All other correlations were .31 or below.

### 2.3.2. Hierarchical regression analyses

A hierarchical regression analysis approach was chosen to enable estimation of specified interaction terms between each temperament variable and classroom emotional support (e.g., attention  $\times$  emotional support). Thus, a series of hierarchical regression analyses was conducted with reading and mathematics achievement regressed on previous achievement, temperament, classroom emotional support, and all two-way interactions between temperament and classroom emotional support (Baron & Kenny, 1986). Analyses were completed set-wise, with main effects entered in the first block and interaction terms entered in the second block. Given the significant correlation between children's activity and attention scores ( $r = -.41$ ), interaction terms were added to block 2 in two separate analyses, Table 2 and Table 3 (reading), Table 4 and Table 5 (mathematics) display results from both blocks. In accordance with Aiken and West's (1991) procedures for examining moderator effects, all variables involved in interaction terms (i.e., activity, attention, and classroom emotional support) were centered. Centered terms were used in regression analyses.

## 3. Results

### 3.1. Reading

For block 1, children's previous achievement, temperament (attention and activity level) and classroom emotional support accounted for 32% of the variance in children's

**Table 1.** Means, standard deviations and intercorrelations for all variables.

	Mean	SD	Range	AL	AT	CES	WJ-R	WJ-M	WJ-LW	WJ-AP
AL	4.82	.75	2.10–6.90	–						
AT	4.70	.84	1.63–6.88	-.41**	–					
CES	28.01	3.09	13.00–34.63	-.06	.17**	–				
WJ-R	111.64	12.98	59–143	-.04	.27**	.19**	–			
WJ-M	117.48	16.04	49–172	.00	.24**	.16**	.64**	–		
WJ-LW	99.43	13.04	65–163	-.12**	.30**	.15**	.54**	.46**	–	
WJ-AP	104.02	15.49	53–153	-.10*	.31**	.21**	.52**	.54**	.60**	–

AL = Activity Level, AT = Attention, CES = Classroom Emotional Support, WJ-R = Woodcock–Johnson Broad Reading (3rd grade), WJ-M = Woodcock–Johnson Broad Math (3rd grade), WJ-LW = Woodcock–Johnson Letter-Word Identification (4 ½ years), WJ-AP = Woodcock–Johnson Applied Problems (4 ½ years).

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

**Table 2.** Summary of hierarchical multiple regression analysis with children's reading achievement as criterion and attention  $\times$  classroom emotional support in block 2.

	<i>B</i>	SEB	$\beta$	$R^2$	$R^2\Delta$
<i>Block 1</i>				.32***	
WJ-LW (age 4 ½ years)	.49***	.03	.49		
AL	1.42*	.60	.08		
AT	2.31***	.56	.15		
CES	.40**	.13	.10		
<i>Block 2</i>				.33***	.01**
<i>Moderation</i>					
WJ-LW (age 4 ½ years)	.50***	.03	.50		
AL	1.42*	.60	.08		
AT	2.20***	.56	.14		
CES	.34*	.13	.08		
AT $\times$ CES	-.39**	.14	-.09		

AL = Activity Level, AT = Attention, CES = Classroom Emotional Support, WJ-LW - Woodcock-Johnson Letter-Word Identification (4 ½ years).

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

**Table 3.** Summary of hierarchical multiple regression analysis with children's reading achievement as criterion and activity level  $\times$  classroom emotional support in block 2.

	<i>B</i>	SEB	$\beta$	$R^2$	$R^2\Delta$
<i>Block 1</i>				.32***	
WJ-LW (age 4 ½ years)	.49***	.03	.49		
AL	1.42*	.60	.08		
AT	2.31***	.56	.15		
CES	.39**	.13	.10		
<i>Block 2</i>				.32***	.00
<i>Moderation</i>					
WJ-LW (age 4 ½ years)	.49***	.03	.49		
AL	1.45*	.61	.08		
AT	2.32***	.56	.15		
CES	.39**	.13	.09		
AL $\times$ CES	.07	.16	.01		

AL = Activity Level, AT = Attention, CES = Classroom Emotional Support, WJ-LW - Woodcock-Johnson Letter-Word Identification (4 ½ years).

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

third grade reading achievement scores ( $F_{4,697} = 83.18, p < .001, R^2 = .32$ ). Refer to Table 2 and Table 3 for results from both blocks. Specifically, children with higher previous achievement scores, higher attention ratings, higher activity ratings, and children in classrooms with more emotional support were more likely to have higher third grade reading achievement scores. Terms for interactions between children's temperament and classroom emotional support (i.e., attention  $\times$  classroom emotional support, activity level  $\times$  classroom emotional support) were added in the second block in separate analy-

**Table 4.** Summary of hierarchical multiple regression analysis with children’s mathematics achievement as criterion and attention × classroom emotional support in block 2.

	<i>B</i>	SEB	$\beta$	<i>R</i> <sup>2</sup>	<i>R</i> <sup>2</sup> $\Delta$
<i>Block 1</i>				.30***	
WJ-AP (age 4 ½ years)	.53***	.04	.50		
AL	2.11**	.74	.10		
AT	2.19**	.70	.12		
CES	.14	.17	.03		
<i>Block 2</i>				.30***	.00
<i>Moderation</i>					
WJ-AP (age 4 ½ years)	.53***	.04	.51		
AL	2.11**	.74	.10		
AT	2.12**	.70	.11		
CES	.09	.17	.02		
AT × CES	-.36*	.18	-.07		

AL = Activity Level, AT = Attention, CES = Classroom Emotional Support, WJ-AP = Woodcock-Johnson Applied Problems (4 ½ years).

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

**Table 5.** Summary of hierarchical multiple regression analysis with children’s mathematics achievement as criterion and activity level × classroom emotional support in block 2.

	<i>B</i>	SEB	$\beta$	<i>R</i> <sup>2</sup>	<i>R</i> <sup>2</sup> $\Delta$
<i>Block 1</i>				.30***	
WJ-AP (age 4 ½ years)	.53***	.04	.50		
AL	2.11**	.74	.10		
AT	2.19**	.70	.12		
CES	.14	.17	.03		
<i>Block 2</i>				.30***	.00
<i>Moderation</i>					
WJ-AP (age 4 ½ yrs)	.53***	.04	.50		
AL	2.15**	.75	.10		
AT	2.21**	.70	.12		
CES	.13	.17	.03		
AL x CES	.09	.19	.02		

AL = Activity Level, AT = Attention, CES = Classroom Emotional Support, WJ-AP = Woodcock-Johnson Applied Problems (4 ½ years).

\**p* < .05, \*\**p* < .01, \*\*\**p* < .001.

ses. The model including the interaction between attention and classroom emotional support in the second block ( $F_{5,696} = 68.74, p < .001, R^2 = .33$ ) showed the interaction explained 1% of additional variance in third grade reading achievement scores. Specifically, the interaction between attention and classroom emotional support was significantly related to third grade reading achievement. With the interaction between activity level and classroom emotional support the model remained significant ( $F_{5,696} = 66.50, p < .001, R^2 = .32$ ),

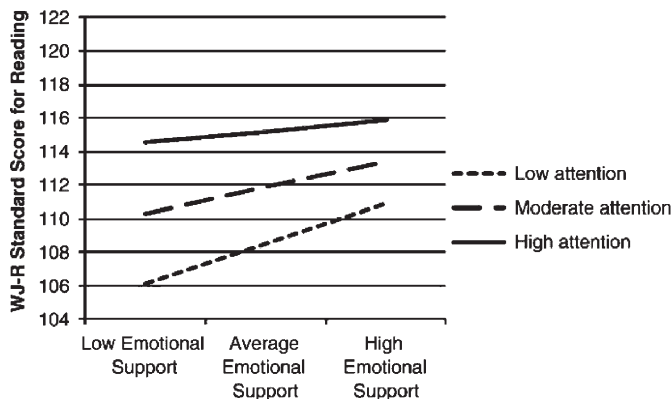
however, the interaction explained less than 1% of additional variance in reading achievement and the interaction term did *not* significantly predict children's reading scores.

In order to understand the statistically significant interaction (as determined by the statistically significant coefficient associated with the interaction term) between attention and classroom emotional support in predicting reading achievement, simple slopes of the regression of third grade reading achievement on attention at three points on the classroom emotional support continuum ( $-1$  SD, at the mean, and  $+1$  SD) were calculated. *T*-tests were examined to determine whether the slopes differed significantly from zero (Aiken & West, 1991).

The slope of the regression of reading achievement on attention for classroom emotional support 1 standard deviation *below the mean* was statistically different from zero ( $t = 6.80, p < .001$ ). The slope of the regression of reading achievement on attention for classroom emotional support *at the mean* was statistically different from zero ( $t = 7.0, p < .001$ ). Finally, the slope of the regression of reading achievement on attention for classroom emotional support 1 standard deviation *above the mean* was statistically different from zero ( $t = 3.70, p < .001$ ). Examination of the standardized coefficient for attention at low ( $-1$  SD) emotional support indicate that for every 1 SD increase in attention, children's reading achievement increased .32 SD. On the other hand, for children in high ( $+1$  SD) emotional support classrooms, a 1 SD increase in attention was related to a smaller (.19 SD) increase in reading achievement. Figure 1 portrays these slopes at three different levels of attention: Low ( $-1$  SD =  $-.84$ ), average ( $M = 0$ ), and high ( $+1$  SD =  $.84$ ).

### 3.2. Mathematics

For block 1, contributions to children's mathematics achievement were similar to those for reading achievement. Refer to Table 4 and Table 5 for results from both blocks. Children's previous achievement, temperament (attention and activity level) and classroom emotional support accounted for 30% of the variance in children's third grade mathematics achievement scores ( $F_{4,694} = 74.16, p < .001, R^2 = .30$ ). Specifically, children with higher



**Figure 1.** Predicting third grade reading achievement from attention at three levels of classroom emotional support.

previous achievement scores, higher attention ratings, higher activity ratings, and children in more emotionally supportive classrooms were more likely to have higher third grade mathematics achievement scores.

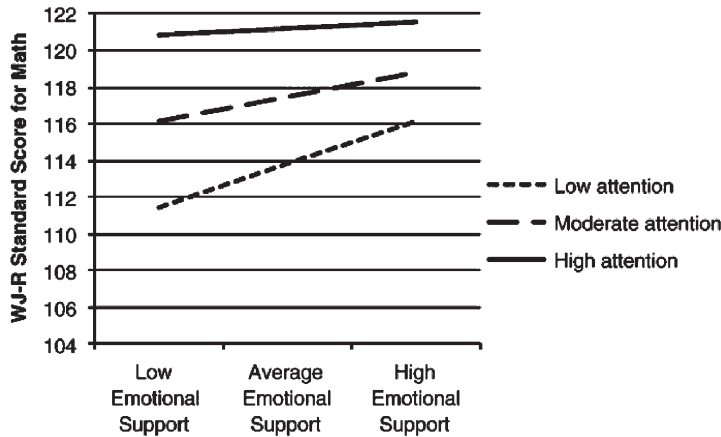
Again, terms for interactions between children's temperament and classroom emotional support (i.e., attention  $\times$  classroom emotional support, activity level  $\times$  classroom emotional support) were added in the second block in separate analyses. With the interaction between attention and classroom emotional support the model remained significant ( $F_{5,693} = 60.40, p < .001, R^2 = .30$ ) and explained less than 1% of additional variance in mathematics achievement. However, the interaction term between attention and classroom emotional support was significantly related to third grade mathematics achievement. The model including the interaction between activity level and classroom emotional support in the second block also remained significant ( $F_{5,693} = 59.31, p < .001, R^2 = .30$ ), and explained less than 1% of additional variance in mathematics achievement. Activity level  $\times$  classroom emotional support was not significantly related to children's mathematics achievement.

In order to understand the statistically significant interaction (as determined by the coefficient associated with the interaction term) between attention and classroom emotional support in predicting mathematics achievement, the same steps were followed as described above for reading achievement. The slope of the regression of mathematics achievement on attention for classroom emotional support 1 standard deviation *below the mean* was statistically different from zero ( $t = 6.06, p < .001$ ). The slope of the regression of mathematics achievement on attention for classroom emotional support *at the mean* was statistically different from zero ( $t = 6.24, p < .001$ ). Finally, the slope of the regression of mathematics achievement on attention for classroom emotional support 1 standard deviation *above the mean* was statistically different from zero ( $t = 3.30, p = .001$ ). Examination of the standardized coefficient for attention at low ( $-1$  SD) emotional support indicates that for every 1 SD increase in attention, children's mathematics achievement increased .29 SD. On the other hand, for children in high ( $+1$  SD) emotional support classrooms, a 1 SD increase in attention was related to a smaller (.17 SD) increase in reading achievement. Figure 2 portrays these slopes at three different levels of attention: Low ( $-1$  SD =  $-.84$ ), average ( $M = 0$ ), and high ( $+1$  SD =  $.84$ ).

#### 4. Discussion

The purpose of this study was to examine the extent to which children's temperamental attention and activity, and classroom emotional support were associated with children's achievement in third grade. Models regressing reading and mathematics achievement on children's previous achievement, temperament at age 4-and-a-half years (attention and activity), and classroom emotional support in third grade revealed three main findings. First, attention and activity level rated at age 4-and-a-half years were positively associated with reading and mathematics achievement in third grade. Third, higher levels of emotional support in the third grade classroom were related to children's higher reading and mathematics achievement in third grade. Finally, classroom emotional support moderated the relation between children's attention and their reading and mathematics achievement in third grade, such that poorer temperamental attention was asso-





**Figure 2.** Predicting third grade mathematics achievement from attention at three levels of classroom emotional support.

ciated with lower achievement for children in the *least emotionally supportive* classrooms. Each of these findings is discussed below.

Children whose parents rated them higher in attention at 4-and-a-half years demonstrated higher reading and mathematics achievement in third grade, a finding that confirms some previous research (Alexander et al., 1993; Finn et al., 1995; Kendall, 1993; Martin & Holbrook, 1985; Martin et al., 1988). A child's ability to attend during classroom activities (e.g., follow directions, pay attention to instruction) is an indicator of academic school readiness (Blair, 2002), and follows logically as a robust predictor of achievement. Rabiner et al. (2004) suggest that poor attention is generally associated with poor academic achievement and may even inhibit the ability to take advantage of interventions. However, our findings suggest that children with poorer attention (rated by parents in preschool) may benefit more from classroom emotional support than peers who attend well. It may be that children with poorer attention require more supportive settings to enhance their ability to benefit from classroom learning.

Previous research has included somewhat disparate findings on associations among children's activity levels and academic achievement. According to findings from some studies, children with higher activity levels had poorer academic achievement (Martin & Holbrook, 1985; Martin et al., 1988; Palisin, 1986), while other evidence suggests that higher temperamental activity may be related to academic success (DiLalla et al., 1990; Molfese et al., in press). We found that children with higher levels of activity had *better* academic achievement than less active children. This could be an artifact of when our temperament assessments were conducted. In our study, mothers reported activity level when children were 4-and-a-half years old, and achievement was assessed in third grade. Activity level prior to the start of formal schooling may be associated with different traits (e.g., energy, curiosity, and motivation) than when measured concurrently with achievement outcomes in school. In the latter case, high activity may be indicative of low inhibitory control or poor behavior regulation (i.e., the inability to sit still). On the other hand, high activity in preschool, or in infancy as found with DiLalla et al. (1990) and Molfese et

al. (in press), may be indicative of a willingness to explore and interact with the environment, contributing to a cognitive advantage. The fact that scores for attention and activity were negatively correlated, yet, when placed together in regression models, both were positively related to academic achievement, may offer another explanation. Activity level, as measured by parents in preschool, may provide meaningful information about student curiosity that relates to later academic achievement, after accounting for attention. All told, our findings offer additional evidence, but leave this question open for further examination of the role of activity level in academic achievement in the early grades. The level of emotional support in the third grade classroom emerged as an independent and interactive positive predictor of children's reading achievement in third grade. Although little research has examined contributions of classroom emotional support (as opposed to instructional support) to children's academic achievement, our results are consistent with previous investigations (Brock et al., 2008; Hamre & Pianta, 2005; O'Connor & McCartney, 2007; Perry et al., 2007; Stipek et al., 1995). Results from this study and others point to the importance of continuing efforts to understand the role of emotionally supportive classroom settings in children's academic achievement, as well as social development.

Finally, our results suggest that highly supportive classroom climates may buffer children from lower academic achievement associated with poor attention, and that children's temperamental attention and classroom emotional support *work together* to predict academic achievement. Thus, results from this study support those reported by Hamre and Pianta (2005) who examined the moderating role of classroom emotional support on the relation between children's functional risk (including attention difficulties) and academic achievement in first grade. Indeed, our findings for children in third grade are congruent with Hamre and Pianta's (2005) findings that the most emotionally supportive *first grade* classrooms buffered children with multiple risk factors from low academic achievement, whereas moderate and low emotional support classrooms failed to provide that buffer.

Careful examination of our results provides even more insight into the relationships between children's attention, classroom emotional support, and children's achievement. Results from simple slopes analyses indicated that attention was more important for achievement for children in classrooms with low, rather than high, emotional support. For example, for every 1 SD increase in attention, children's reading achievement increased .32 SD at the low level of emotional support, but increased only .19 SD at the high level of emotional support. This relationship was similar for mathematics achievement.

Taken together, these findings and those reported by Hamre and Pianta (2005) suggest that children in classrooms with the lowest levels of support need to rely on their own resources (i.e., ability to attend to classroom instruction, previous achievement) to be successful in the classroom. Alternatively, children in low support classrooms who are temperamentally prone to inattentiveness are at greater risk for academic difficulties than their counterparts in more highly emotionally supportive classrooms.

#### **4.1. Limitations**

Several limitations require mention. First, this sample has diversity constraints; for example, scores for classroom emotional support were negatively skewed, and the majority of participants were White. Second, assessments of temperament were only provided

by mothers. Although mothers have been identified as accurate raters of their children's temperament (Rothbart & Bates, 2006), measurement of this construct would be strengthened with reports by additional raters, such as fathers and teachers, and observations of behavior. Furthermore, our internal reliabilities on the CBQ scales, though comparable to those found in other studies, were lower than ideal. Third, effect sizes (i.e.,  $R^2$ ) for temperament and classroom emotional support in all models were small. Fourth, data collected from this sample did not include information about whether children had clinical diagnoses of attention or activity disorders. Future research should focus on examining associations using multiple measures of attention and activity with a more diverse sample of children and classrooms. Finally, because the focus of this study was classroom emotional support, it did not include examinations of classroom instructional support. It could be that teachers who provided a high degree of emotional support were also likely to provide a high level of instructional support, and it was the level of instructional support that drove these findings. Strengths of the current longitudinal study included allowing for identification and examination of multiple data points and multiple internal and external child characteristics (Singer & Willett, 2003). Thus, we were able to capitalize on the depth of the study, using multiple sources of information (i.e. children, parents, teachers) and multiple data collection techniques (i.e., questionnaires, observations, standardized achievement tests) in a longitudinal design (Allen, McElhaney, Kuperminc, & Jodl, 2004). These strengths allowed us to examine child and process factors in the context of the early educational environment.

#### *4.2. Implications and future research*

Results from this study indicate that more emotionally supportive classrooms are associated with better academic achievement, and, in classrooms with lower levels of emotional support, children with poor attention tend to have lower achievement. Recent research comparing children with attention disorders (ADHD) to those without disabilities provides evidence that some attention problems are associated with delays in brain (cortical) development, and not with structural or functional differences in the brain (Shaw et al., 2007). Stated simply, the regulatory structures of the brains of children with attention/hyperactivity disorders developed more slowly than children without the disorders, though the developmental patterns were highly similar. Because brain structure and function develop in concert with experience, these findings suggest that ensuring high quality experiences and environments for children with attention problems may buffer the long-term effects of delayed regulatory development. Clinical measures of attention and activity level were not used in the current study; however children lowest in attention performed most poorly when they were placed in the least emotionally supportive classroom contexts. Put another way, results from this study suggest that emotionally supportive classrooms may be *protective* for children with attention problems, providing high quality proximal processes to support children who have limited attention resources. Future research needs to more carefully consider how children with poorer attention can be supported in their academic achievement.

Teachers can benefit from these findings by modifying classroom routines, structures and interactions to maximize opportunities for emotional support and, thus enhance

learning for all students. Simply recognizing that emotional support in the classroom affects children can help teachers to differentiate interactions to meet children's needs. Finally, our findings should suggest to parents and school personnel that children with (subclinical) attention challenges may be at risk for early learning difficulties; at the same time, they may benefit from emotionally supportive learning environments.

School psychologists and administrators can use this information to inform student placement in classroom environments. Early screening of children's attention (even relying on parental report) may be used to place students in classrooms that will provide the best instructional match. For children with poor attention or other risk factors, placement in highly emotionally supportive classrooms may promote academic achievement. Indeed, Pianta, La Paro, Payne, Cox, and Bradley (2002), using data from the NICHD SECCYD, found that ratings of children's social and academic skills were higher in classrooms where classroom quality (measured as positive teacher-child interactions, instructional support, and emotional support) was higher.

School-wide efforts could be employed to support children's attentional development. For example, burgeoning research in school psychology and special education points to the use of positive behavioral support as helpful for increasing students' attention and reducing off-task behavior (Algozzine & Algozzine, 2007; Fox et al., 2002; Nelson et al., 2002). As teachers often find children with poorer attention and higher activity levels challenging, school psychologists could provide teachers with training in positive behavioral support to bolster efforts in the classroom. Furthermore, school psychologists can work with families to enhance parenting strategies that encourage children's development of self-regulation. Administrators and school psychologists can provide the structure and education teachers and families need to support children's development of the necessary approaches to learning, even for children with less-regulated temperamental characteristics.

Results reported here point to the need for examinations of the contributions of temperament and classroom emotional support to academic achievement in more diverse samples of children, classrooms, and schools. This research may also be extended by investigating the extent to which emotionally supportive classrooms act as a buffer for achievement outcomes in children with diagnosed attention or behavior problems.

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