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Development in Reading and Math in Children from Different SES Backgrounds: The Moderating Role of Child Temperament

Zhe Wang,

Virginia Polytechnic Institute and State University

Brooke Soden,

Vanderbilt University

Kirby Deater-Deckard,

Virginia Polytechnic Institute and State University

Sarah L. Lukowski,

The Ohio State University

Victoria J. Schenker,

The Ohio State University

Erik G. Willcutt,

University of Colorado at Boulder

Lee A. Thompson, and

Case Western Reserve University

Stephen A. Petrill

The Ohio State University

Abstract

Socioeconomic risks (SES risks) are robust risk factors influencing children's academic development. However, it is unclear whether the effects of SES on academic development operate universally in all children equally or whether they vary differentially in children with particular characteristics. The current study aimed to explore children's temperament as protective or risk factors that potentially moderate the associations between SES risks and academic development. Specifically, latent growth modeling (LGM) was used in two longitudinal datasets with a total of 2236 children to examine how family SES risks and children's temperament interactively predicted the development of reading and math from middle childhood to early adolescence. Results showed that low negative affect, high effortful control, and low surgency mitigated the negative associations between SES risks and both reading and math development in this developmental period. These findings underline the heterogeneous nature of the negative associations between SES risks and academic development and highlighted the importance of the interplay between biological and social factors on individual differences in development.

Keywords

socioeconomic risks; temperament; academic achievement; reading; math; LGM

Children's academic development has been at the center of attention for parents, researchers, educators, and policy makers, as academically competent children have been shown consistently to earn more income, gain higher social prestige, and have better physical and psychological health later in their lives (Ashby & Schoon, 2010; Lee, 2010). A better understanding of the origins and developmental pathways that lead to the vast individual differences in various academic areas during childhood and adolescence may not only help improve students' academic performance, but also may reveal potential opportunities for promoting long-term psychosocial health and functioning. Development in academic learning processes involves complex interplay between individuals and the multi-layered ecological contexts in which they are embedded (Bronfenbrenner & Ceci, 1994). In the current study, we focused on exploring how individuals' temperament and their socioeconomic backgrounds together shape the developmental trajectories of academic outcomes in two academic subject areas, reading and math, throughout middle childhood and early adolescence.

Socioeconomic Risks and Academic Achievement

Family socioeconomic status (SES) is one of the most heavily studied family environmental factors in child development. SES, defined by household income, parental education and occupation, material resources, and neighborhood characteristics (Coleman, 1988; Entwisle & Astone, 1994), is a persistent and robust predictor of academic achievement (Sirin, 2005; White, 1982). Children who experience greater socioeconomic adversity, in particular during early development periods, exhibit lower academic competence compared to their peers from socioeconomically advantaged backgrounds (Bradley & Corwyn, 2002; Brooks-Gunn & Duncan, 1997). Multiple pathways are shown to account for the negative impacts of SES risks on academic performance (Bradley & Corwyn, 2002). Children growing up in low SES families are more likely to be exposed to risks to physical health, such as inadequate nutrition, poor housing conditions, and exposure to toxins, which are all factors impairing brain and cognitive development (Brooks-Gunn & Duncan, 1997; Evans & Kantrowitz, 2002). In addition, lack of cognitively stimulating resources and poor parenting quality are observed more often in low SES households which may also contribute to delayed or impaired intellectual development (Blair & Raver, 2012; Hackman, Farah, & Meaney, 2010; Hoff, 2003; Raviv, Kessenich, & Morrison, 2004). Finally, disparities among different SES backgrounds may also extend beyond the household boundaries. Low SES families are more likely to live in dangerous neighborhoods and to send their children to under-resourced schools (Brooks-Gunn & Duncan, 1997; Evans & Kantrowitz, 2002). These more proximal processes together are evidenced to mediate the associations between SES risks and children's intellectual development (Bradley & Corwyn, 2002).

Resilience against SES Risks

Compared to the large number of studies examining the mechanisms of SES on children's academic development (mediation effects), few have investigated the conditions under which SES risks play the most versus the least significant role in the development of various academic outcomes (moderation effects; Bradley & Corwyn, 2002). This gap in the literature is in drastic contrast to contemporary theories and empirical evidence showing that the effects of SES risks on socio-emotional development are anything but "one size fits all" (Braveman et al., 2005; Wang & Deater-Deckard, 2013). Wide variation in socio-emotional outcomes emerge even among children who are raised under the most stressful and risky conditions; some are greatly impaired whereas others thrive in spite of these environmental adversities. Several factors have been identified as potential resilience factors against SES adversities. These include personal characteristics such as temperament and personality, family characteristics such as parenting quality, and external support systems (Jaffee, Caspi, Moffitt, Polo-Tomas, & Taylor, 2007; Rutter, 2006). It is possible that similar processes are also involved in the development of academic outcomes. In the current study, we focused on exploring whether children's temperament would function as resilient factors that protect children's academic development against SES risks.

Temperament refers to stable individual differences in emotional, attentional, and motor reactivity and regulation that are genetically based and are open to experiential influences (Rothbart & Bates, 2006; Zentner & Bates, 2008). The most frequently studied temperament characteristics include three broad dimensions: effortful control, surgency, and negative affect. Effortful control captures the capacity to self-regulate such as sustaining attention and inhibiting dominant and inappropriate responses. Surgency captures the tempo and vigor of motor movement, and the positive pole is characterized by impulsivity, high activity level, lack of shyness, and enjoyment of high intensity pleasure. Negative affect, such as anger, fearfulness, and sadness, captures individual differences in the latency, intensity, and duration of the negative emotional reactivity toward disturbing external or internal stimuli.

In general, higher capacity to sustain attention, less impulsiveness, and lower negative affect predict higher academic competence during school years both concurrently (Deater-Deckard, Mullineaux, Petrill, & Thompson, 2009; Gumora & Arsenio, 2002; Martin & Holbrook, 1985; Mullola et al., 2011) and longitudinally (Guerin, Gottfried, Oliver, & Thomas, 1994; Seknan, McClelland, Acock, & Morrison, 2010; Zhou, Main, & Wang, 2010). The regulatory component of temperament, such as sustaining attention, is key to successful learning in the classroom context which requires children to constantly follow teachers' instructions and ignore distraction from their surroundings (Posner & Rothbart, 2007). Additionally, low negative affect and modest energy levels are qualities that better fit the demands in the classroom (Keogh, 1986). A child with these qualities is more likely to demonstrate appropriate school-related behaviors and develop high quality relationships with teachers and peers that are important to academic success (Keogh, 1986).

To the extent that high capacity to sustain attention, non-impulsiveness, and low negative affect serve as promotive factors in academic development, do these temperamental characteristics also yield protective effects on academic development for children who are

confronted with powerful environmental stressors, or are their promoting effects subsumed by the influences of negative life experiences? Thus far, very few studies have investigated how temperament and SES risks interact to predict academic performance, and the limited number of studies that addressed this question showed that regulatory attention positively predicted academic achievement during preschool and school years regardless of the presence of SES risks (Duncan et al., 2007; McClelland & Wanless, 2012; Sektnan et al., 2010).

Given the extant evidence, understanding of the interactive effects between temperament and familial SES risks on academic development is very limited. Thus, the current goal was to improve our understanding in this area via examining how the interplay between SES risks and temperament (both the regulatory and reactive dimensions) shaped the long-term developmental trajectories of academic outcomes. To understand whether these interactive effects (if any) generalize to multiple academic subject areas or whether they are specific to only certain subject areas, we examined both reading and math development. To address these research questions, two independent longitudinal samples were used in which both reading and math were repeatedly assessed over school years. The first sample is ideal for examining long-term developmental trajectories as it features multi-wave assessments of academic outcomes (reading in particular) that spans across 6 years throughout middle childhood and early adolescence. Although the second sample covers a relatively shorter developmental period with sparser time sampling, it features families from more diverse socioeconomic backgrounds, and complements the first sample in which higher-risk families are underrepresented. Together, these samples complemented each other, and allowed us to examine the replicability and generalizability of the current findings.

Study 1

Methods

Participants—A total of 436 families with twin siblings (57% female) from the State of Ohio participated in the Western Reserve Reading and Math Project (Hart, Petrill, Thompson, & Plomin, 2009). Families were recruited through school nomination, Ohio state birth records, and media advertisement. Ninety-one percent of the sample was White, 5% African American, and 2% Asian.

Procedure—Data collection began in preschool, kindergarten or first grade, and continued approximately annually across eight years. The current study used data collected in six waves. Each wave was on average one year apart from its adjacent waves. Children's average age in each wave was 6.09 (SD = .69), 7.16 (SD = .67), 8.20 (SD = .82), 9.81 (SD = .98), 10.90 (SD = 1.01), and 12.21 (SD = 1.19). We labeled the six waves as Reading1, Reading2, Reading3, Reading/Math4, and Reading/Math5, and Reading/Math6.

At each home visit, parental consent and children's assents were first obtained. Subsequently, parents completed a series of questionnaires, and children completed a series of questionnaires and cognitive assessments. Siblings were assessed separately by different trained testers in separate areas of the home. Families received a \$100 honorarium for

participation in each visit. All procedures were approved by The Ohio State University and Case Western Reserve University.

Measures

Socioeconomic Risks: Mothers and trained testers provided reports on several socioeconomic risk indicators in the first home visit, including paternal education level [1 = high school or less (18%) vs. 0 = some college or higher education], maternal education level [1 = high school or less (12%) vs. 0 = some college or higher education], paternal employment status [1 = unemployed or part-time job (5%) vs. 0 = full-time job], marital status [1 = single (9%) vs. 0 = married or cohabited with partner], housing [1 = subsidized housing, apartment, or town-house (7%) vs. 0 = detached house], and safe neighborhood play area [1 = no (7%) vs. 0 = yes]. The socioeconomic risk index was computed by averaging across these six indicators, representing the percentage of risks present in each household.

Temperament: Mothers and fathers completed the Child Behavior Questionnaire Short Form (CBQ-SF; Putnam & Rothbart, 2006) following the second annual home visit (i.e., Reading2). The CBQ-SF includes 94 items that are rated on a 7-point Likert scale (1 = extremely untrue of your child; 7 = extremely true of your child), and measures 3 dimensions of child temperament including effortful control, negative affect, and surgency. Cronbach's α s for the scales ranged from .60 to .87. In the current study, mothers and fathers provided reports on temperament for 414 and 205 children, respectively. Mother and father ratings on each of the three dimensions were moderately correlated ($r = .37$ to $.70$, $p < .001$). In order to better incorporate multiple informants' reports and to maximize sample size, composite temperament scores were computed by averaging mother and father ratings on each of the three dimensions when available, and single parent report was used otherwise.

Reading: Reading achievement was measured using the Word Identification, Word Attack, and Passage Comprehension subtests from the Woodcock Reading Mastery Test (WRMT; Woodcock, 1998) in all six waves. The Word Identification and Word Attack subtests measure children's decoding ability. The Word Identification subtest requires participants to recognize and read a list of real words aloud. The Word Attack subtest requires participants to pronounce a list of low-frequency words or nonwords. The Passage Comprehension subtest is a cloze format test of reading comprehension in which participants read aloud a series of short paragraphs and provide the missing words. The median internal reliabilities were .95, .94, and .83 for Word Identification, Word Attack, and Passage Comprehension, respectively (Woodcock, 1998). W-scores were used in the current study for all three subtests. The W-scale is an equal interval scale such that a given interval between two sets of scores within each subtest represents the same amount of difference in the ability measured regardless of where the sets of scores are situated on the scale. Principal component analysis on the 3 subtest scores in each of the 6 waves all suggested a single component solution (total variance explained = 77 to 91%, component loadings = .84 to .97). Therefore, a composite reading score was computed in each wave by averaging the 3 subtest scores.

Math: Math achievement was measured using the Calculation, Math Fluency, and Applied Problems subtests from the Woodcock Johnson III Test of Achievement (Woodcock, McGraw, & Mather, 2001) in waves Reading/Math4, Reading/Math5, and Reading/Math6. The Calculation subtest measures a participant's mathematical computation ability, and includes addition, subtraction, multiplication, and division of positive and negative numbers, whole numbers, percentages, decimals, and fractions. The Math Fluency subtest measures a participant's ability to solve simple arithmetic problems within a 3-minute time limit. The Applied Problems subtest requires a participant to read a problem, decide which mathematical operation to use, and complete necessary calculations. Thus, it measures a child's ability to integrate his or her math knowledge, quantitative reasoning, and calculation skills in solving math problems. The median internal reliabilities were .85 for Calculation, .89 for Fluency, and .92 for Applied Problems (Woodcock et al., 2001). W-scores were used for all math subtests. Principal component analysis on the 3 subtest scores in each of the 3 waves all suggested a single component solution (total variance explained = 71 to 76%, component loadings = .78 to .93). Therefore, a composite math achievement score was computed in each wave by averaging the 3 subtest scores.

Analytic Strategies—First, descriptive and correlation analyses were conducted using SPSS 22. Next, latent growth models (LGM) were applied to examine the predictive effects of family SES risks and child temperament on the developmental trajectories of reading and math using Amos 22. The basic LGM without predictors was first conducted to obtain parameter estimates regarding the developmental trajectories of reading and math over time. In the reading model, the intercept had fixed loadings of 1 to each measurement occasion, and the slope had fixed loadings of 0 and 1 to the first and sixth occasions respectively, and had free-estimated loadings to the rest of the occasions to better approximate the actual shape of the developmental curve. Because math achievement was only assessed at three time points, the intercept had fixed loadings of 1 to each measurement occasion, and the slope factor had fixed loadings of 0 and 1 to the first and third occasions respectively, and had free-estimated loadings to the second occasion. Predictors were subsequently added to the basic LGM by regressing the intercepts and slopes on the predictors to examine how SES risks, each of the three temperament factors, and the interactions between SES risks and each temperament factor predicted the developmental trajectories of achievement over time. This model built on the basic LGM model by adding one time invariant covariate (i.e., age) and three time invariant predictors (i.e., temperament, SES risk index, and the interaction between temperament and SES risk index). The three temperament factors were examined separately in three different models.

Both siblings within each family were included in the analyses to maximally utilize all available data. The procedures outlined in Griffin & Gonzalez (1995) were used in the correlation analyses, and the procedures outlined in Olsen & Kenny (2006) were used in the LGM, both in order to control for the biased standard errors arising from sibling non-independence in these analyses.

Missing Values—Multivariate analysis of variance was used to examine basic attrition patterns in these longitudinal data. In particular, we examined whether there were mean

differences in SES risks and initial reading scores between children who did and did not have missing values on reading scores in the last wave. Results showed that there were no mean differences on SES risks between children who did and did not have missing values on reading scores in wave Reading/Math6 ($F(1, 206) = 1.29$ to $1.40, p > .05$). However, compared to children with no missing values on reading in the last wave, children who had missing values on reading in the last wave had higher initial reading scores in Reading1 ($F(1, 206) = 5.51$ to $8.84, p < .05$). For math, results showed that there were no mean differences in SES risks or initial math scores between children who did and did not have missing values on math scores in wave Reading/Math6 ($F(2, 160) = .50$ to $.96, p > .05$). Full information maximum likelihood estimation was used for all of the model-fitting procedures.

Results

Descriptive Statistics and Correlations—Descriptive statistics are shown in the upper part of Table 1. Distribution of SES risks is shown in Figure 1a. SES risks were skewed such that the sample included very few high risk families and only 5% of the families had over half of the risk indicators present in their households. On average, families had 9% of the total risks (0.5 out of the six total risks). The three temperament factors all were distributed widely and normally, as were the reading and math scores. Outliers, defined as values more than four standard deviations away from the mean, were excluded from further analyses (8 for reading and 1 for math). Means of both the reading and math scores increased over time.

Correlations between main study variables are shown in the upper part of Table 2. SES risks were modestly negatively correlated with effortful control, reading scores in the last three occasions, and all math scores. Effortful control was modestly and negatively correlated with both negative affect and surgency. The three temperament factors were minimally correlated with reading and math scores. Both reading and math scores exhibited moderate to substantial stability over time. Additionally, math and reading scores were moderately correlated with each other.

Latent Growth Models

Models for Reading: A basic LGM was first conducted to obtain parameter estimates regarding the developmental trajectories of reading (Table 3). A positive mean of the slope, together with the loadings of the slope to the six measurement occasions (i.e., .00, .40, .68, .87, .94, and 1.00), indicated an overall decelerated growth trajectory in reading. Significant variances for both the intercept and slope indicated that children differed in both their baseline reading scores and rates of growth in reading. Furthermore, the intercept and slope terms were substantially negatively correlated, indicating a “catch-up” effect where children with lower initial reading scores grew faster than children with higher initial reading scores.

Predictors were subsequently added to the basic LGM to examine the predictive effects of SES risks, each of the three temperament factors, and the interactions between SES risks and each temperament factor on the development of reading. Temperament and SES risks were standardized and centered prior to model fitting in order to compute the interaction terms. Results of these three models are shown in the first horizontal block in Table 4. Overall, age

positively predicted the intercept and negatively predicted the slope, suggesting that older children had higher baseline reading scores and exhibited slower growth over time. More SES risks predicted lower intercept and higher slope, suggesting that children from high risk families had lower initial reading scores but exhibited faster growth.

The model that examined the effects of effortful control and SES risks (Table 4, 1st horizontal block, left column) revealed that higher effortful control predicted higher initial reading scores. In addition, the interaction between effortful control and SES risks positively predicted the slope. Post-hoc probing was subsequently conducted to further examine the interaction effects by estimating the effects of SES risks on the slope at low (1SD below the mean), medium (the mean), and high (1SD above the mean) levels of effortful control (Holmbeck, 2002). Results of the post-hoc analyses (Table 5, 1st horizontal block, left column) revealed that as levels of effortful control increased, SES risks more strongly positively predicted the slope. To better visualize the effects of the interaction term, the estimated reading development curves as a function of levels of effortful control and family SES risks are presented in Figure 2a. These results indicated that there was a gap in the initial reading achievement between children from high versus low SES risk families regardless of effortful control level. However, this achievement gap remained constant over time at low effortful control but diminished over time at high effortful control. This pattern suggested that high effortful control children from high risk families were gradually catching up with their socioeconomically advantaged peers, whereas low effortful control children from high risk families remained behind their peers on their reading achievement.

Turning to the interaction between negative affect and SES risks (Table 4, 1st horizontal block, middle column), negative affect predicted neither the intercept nor the slope factor. The interaction between negative affect and SES risks marginally negatively predicted the intercept. Post-hoc probing was conducted to further investigate this marginally significant interaction effect using the same procedure described above. Results (Table 5, 2nd horizontal block, left column) revealed that SES risks more strongly negatively predicted the intercept at higher levels of negative affect. Figure 2b shows the estimated reading development curves as a function of negative affect and SES risks. Although the achievement gap between low and high SES children decreased over time at all levels of negative affect, the overall achievement gap was smaller at lower compared to higher negative affect.

The model examining the effects of surgency and SES risks (Table 4, 1st horizontal block, right column,) revealed that higher surgency predicted lower initial reading scores. In addition, the interaction between surgency and SES risks negatively predicted the slope. Post-hoc analyses (Table 5, 3rd horizontal block, left column) showed that SES risks more strongly positively predicted the slope at lower levels of surgency. Figure 2c shows the estimated reading development curves as a function of surgency and SES risks. Overall, the baseline achievement gap between high versus low SES children were present at all levels of surgency. However, the SES achievement gap remained constant in high surgency children but diminished in low surgency children over time.

Models for Math: Parameter estimates from the basic LGM on math are presented in Table 3. The positive mean of the slope, together with the loadings of the slope to the three

measurement occasions (i.e., .00, .59, and 1.00), indicated an overall linear growth in math. Unlike reading, the intercept and slope factors were minimally correlated for math.

The model examining the effects of effortful control and SES risks (Table 4, 2nd horizontal block, left column), indicated that higher SES risks negatively predicted both the intercept and slope, suggesting that children from high risk families exhibited lower initial scores and slower growth rates in math. Higher effortful control predicted higher intercept. In addition, the interaction term marginally significantly predicted the slope which was further subjected to post-hoc probing. Results (Table 5, 1st horizontal block, right column) revealed that SES risks more strongly negatively predicted the slope at lower effortful control. Figure 3a presents the estimated math development curves as a function of effortful control and SES risks. Overall, the math achievement gap between high versus low SES children remained constant for high effortful control children but widened over time for low effortful control children.

Turning to the interaction between negative affect and SES risks (Table 4, 2nd horizontal block, middle column), higher negative affect predicted lower intercept. In addition, the interaction term negatively predicted the intercept. Post-hoc analyses (Table 5, 2nd horizontal block, right column) showed that SES risks more strongly negatively predicted the intercept at higher negative affect. Figure 3b shows the estimated math development curves as a function of levels of negative affect and SES risks. The math achievement gap between high and low SES children widened over time at all levels of negative affect, but was overall smaller at lower negative affect.

The model that examined the effects of surgency and SES risks on math development (Table 4, 2nd horizontal block, right column) revealed that surgency did not predict the intercept or slope. The interaction between surgency and SES risks negatively predicted the slope. Post-hoc analyses (Table 5, 3rd horizontal block, right column) showed that SES risks more strongly negatively predicted the slope at higher surgency. Figure 3c shows the estimated math development curves as a function of levels of surgency and SES risks. The math achievement gap between high versus low SES children remained constant for low surgency children but widened over time for high surgency children.

Study 2

In Study 1, the effects of family SES risks and child temperament on academic development were examined, and high effortful control, low surgency, and low negative affect were found to mitigate the negative associations between SES risks and academic development. However, because the majority of families in Study 1 are low to modest risk families and high risk families are severely underrepresented, it is unclear whether the moderation effects of these temperament characteristics would generalize to families with higher risks. Therefore, a sample of families from more diverse socioeconomic backgrounds was used in Study 2 to address this question.

Methods

Participants—In total, 1364 children (48% female) and their families participated in the NICHD Study of Early Child Care and Youth Development (SECCYD; <https://www.nichd.nih.gov/research/supported/Pages/seccyd.aspx>). Families were recruited from 9 states across the country and represented a diverse range of socioeconomic backgrounds (NICHD ECCRN, 2001). Child's race was 80% White, 13% African American, 2% Asian, and 5% other.

Procedure—Data collection began when infants were born and continued across fifteen years. When children were 1 month old, mothers completed a series of questions concerning their demographic information. Children and their mothers participated in lab visits at 54 months, and the first, third, and fifth grades. At the 54 month lab visit, mothers completed a series of questionnaires including a child temperament questionnaire. At the first, third, and fifth grade lab visits, children completed a series of achievement assessments. Additional details about procedures of data collection can be found on the study's website (<https://www.nichd.nih.gov/research/supported/Pages/seccyd.aspx>). All procedures were approved by The Ohio State University.

Measures

Socioeconomic Risks: Mothers provided reports on socioeconomic risks when children were 1 month old, including paternal education level [1 = high school or less (29%) vs. 0 = some college or higher education], maternal education level [1 = high school or less (31%) vs. 0 = some college or higher education], paternal employment status [1 = unemployed (7%) vs. 0 = employed], marital status [1 = single (15%) vs. 0 = married or cohabited with partner], and income-to-need ratio [1 = below 1 (20%) vs. 0 = above 1]. The socioeconomic risk index was computed by averaging across these five indicators, representing the percentage of risks present in each household.

Temperament: Mothers completed an abbreviated version of the Child Behavior Questionnaire (CBQ; Rothbart, Ahadi, Hershey, & Fisher, 2001) when children were 54 months old. The CBQ includes 196 items that are rated on a 7-point Likert scale (1 = extremely untrue of your child; 7 = extremely true of your child), and measures 3 broad dimensions of child temperament including effortful control, negative affectivity, and surgency. In the current study, mothers completed 80 items on the original measure. Cronbach's α for these scales ranged from .60 to .85.

Reading: Reading achievement was measured using the Letter-Word Identification and Picture Vocabulary subtests from the Woodcock-Johnson Psycho-Educational Battery-Revised (WJ-R; Woodcock & Johnson, 1989) in the first, third, and fifth grades. The Letter-Word Identification subtest requires children to read and recognize a list of letters and words and measures children's decoding ability. The Picture Vocabulary subtest measures children's verbal comprehension as it requires children to name familiar and unfamiliar pictured objects. The split-half internal reliabilities ranged from .88 to .92 for the Letter-Word Identification subtest, and .72 to .75 for the Picture Vocabulary subtest. W-scores were used for both subtests. The Letter-Word Identification and Picture Vocabulary subtest scores

were moderately correlated within each wave ($r = .39$ to $.61$, $p < .001$). Therefore, a composite reading score was computed in each wave by averaging the two subtest scores.

Math: Math achievement was measured using the Applied Problems subtest from the Woodcock-Johnson Psycho-Educational Battery-Revised (WJ-R; Woodcock & Johnson, 1989) in the first, third, and fifth grades. The Applied Problems subtest requires a participant to read a problem, decide which mathematical operation to use, and complete necessary calculations. The split-half internal reliabilities for this test ranged from .80 to .83. The W-score was used.

Analytic Strategies—Analytic procedures are the same as in Study 1.

Missing Values—Basic attrition patterns were examined using the same procedure as in Study 1. There were no mean differences on either the SES risk index or reading/math scores in the first grade between children who did and did not have missing values on reading/math scores in the fifth grade (For reading, $F(2, 997) = .63$, $p > .05$; for math, $F(2, 994) = 1.44$, $p > .05$).

Results

Descriptive Statistics and Correlations—Descriptive statistics are shown in the lower part of Table 1. Distribution of SES risks is shown in Figure 1b. SES risks were skewed but were more widely distributed across households compared to Study 1. On average, families had 22% of the total risks (one out of the five total risks). Overall, 17% of the families had over half of the risk indicators, and 4% had all five risks indicators present in their households. The three temperament factors were distributed widely and normally. Outliers, defined as values more than four standard deviations away from the mean, were excluded from further analyses (5 for reading and 10 for math). All reading and math scores more closely approximated normal distributions after excluding these outliers. Means of both the reading and math scores increased over time. Correlations between the main study variables are shown in the lower part of Table 2. The overall correlation pattern resembled that in Study 1.

Latent Growth Models

Models for Reading: Parameter estimates regarding the developmental trajectories of reading are shown in Table 3. A positive mean of the slope indicated an overall increase in reading scores over time. Loadings of the slope to the three measurement occasions (i.e., .00, .68, and 1.00) indicated a decelerated growth rate. Significant variances for both the intercept and slope indicated diverse growth trajectories in reading. The intercept and slope factors were negatively correlated, suggesting a catch-up effect in reading development.

Regarding the effects of effortful control and SES risks on reading development (Table 4, 3rd horizontal block, left column), SES risks negatively predicted the intercept. Higher effortful control predicted higher intercept and marginally predicted lower slope. In addition, the interaction between effortful control and SES risks negatively predicted the intercept and positively predicted the slope. Post-hoc analyses on these interaction effects (Table 5, 4th

horizontal block, left column) revealed that SES risks more strongly negatively predicted the intercept at higher effortful control. In addition, SES risks did not predict the slope at lower effortful control, but positively predicted the slope at higher effortful control. Figure 4a presents the estimated reading development curves as a function of levels of effortful control and SES risks. Overall, there was a larger initial achievement gap between children from high versus low SES families at higher levels of effortful control, primarily driven by the particularly high performance in high effortful control children from low risk families. In addition, the achievement gap between high versus low SES children remained constant over time in low effortful control children but decreased over time in high effortful control children. This pattern suggested that high effortful control children from high risk families were gradually catching up with their socioeconomically advantaged counterparts who were the front-runner in their reading skills among all children from the very beginning. This “catch-up” pattern was not observed in low effortful control children. These results were consistent with Study 1.

The model that examined the effects of negative affect and SES risks (Table 4, 3rd horizontal block, middle column) indicated that higher negative affect predicted lower intercept and higher slope. In addition, the interaction between negative affect and SES risks marginally negatively predicted the intercept. This interaction effect was subjected to further post-hoc probing, and results (Table 5, 5th horizontal block, left column) indicated that SES risks more strongly negatively predicted the intercept at higher levels of negative affect. Figure 4b presents the estimated development curves in reading as a function of negative affect and SES risks. Similar to Study 1, the overall achievement gap was smaller at lower negative affect.

The model that examined the effects of surgency and SES risks (Table 4, 3rd horizontal block, right column) indicated that neither surgency nor its interaction with SES risks predicted individual differences in reading development.

Models for Math: The basic LGM for math did not converge successfully. Subsequently, variances of the error terms to the first two measurement occasions were constrained to be equal to each other in order to fix the non-convergence issue. Parameter estimates of the modified LGM are shown in Table 3. A positive mean of the slope, together with the loadings of the slope to the three measurement occasions (i.e., .00, .69, and 1.00), indicated an overall decelerated growth trajectory. Additionally, the intercept and the slope factors were moderately negatively correlated, suggesting a “catch-up” developmental pattern.

The left column within the 4th horizontal block in Table 4 shows results from the model that examined the effects of effortful control and SES risks. SES risks negatively predicted the intercept. Effortful control positively predicted the intercept and marginally negatively predicted the slope. In addition, the interaction between effortful control and SES risks marginally positively predicted the slope. Post-hoc analyses (Table 5, 4th horizontal block, right column) indicated that SES risks positively predicted the slope at higher but not lower effortful control. Figure 5a presents the estimated math development curves as a function of levels of effortful control and SES risks. High effortful control children from high risk families were gradually catching up with their socioeconomically advantaged counterparts

who exhibited the best math performance among all children from the very beginning, whereas low effortful control children from high risk families remained behind their peers over time.

The model that examined the effects of negative affect and SES risks (Table 4, 4th horizontal block, middle column) revealed that negative affect marginally negatively predicted the intercept. In addition, the interaction between negative affect and SES risks negatively predicted the intercept. Post-hoc analyses (Table 5, 5th horizontal block, right column) indicated that SES risks more strongly negatively predicted intercept at higher negative affect. Figure 5b presents the estimated development curves in math as a function of negative affect and SES risks. Similar to reading development, the overall math achievement gap was smaller at lower negative affect.

Regarding the effects of surgency and its interaction with SES risks (Table 4, 4th horizontal block, right column), surgency did not predict the intercept or the slope. The interaction between surgency and SES risks positively predicted the intercept and negatively predicted the slope. Post-hoc analyses (Table 5, 6th horizontal block, right column) suggested that SES risks more strongly negatively predicted the intercept at lower levels of surgency. In addition, SES risks positively predicted the slope only in children with low surgency, but not in those with moderate to high surgency. Figure 5c presents the estimated development curves in math as a function of surgency and SES risks. Overall, there was a larger initial math achievement gap between children from high versus low SES families at lower levels of surgency. Low surgency children from high risk families exhibited faster growth rates in math compared to their socioeconomically advantaged counterparts, demonstrating a “catch-up” developmental pattern, whereas the initial SES achievement gap persisted over time in those high in surgency.

Discussion

The current study examined whether children’s development in reading and math was predicted by the interplay between their temperament and family SES risks. Findings from both samples showed that high effortful control, low surgency, and low negative affect mitigated the negative associations between SES risks and children’s academic development, effects that can be generalized to both reading and math.

Findings from both samples revealed that, on average, the development of reading spanning middle childhood and early adolescence followed a nonlinear decelerated growth trajectory. In addition, the intercept and the slope of this growth trajectory was moderately to substantially negatively correlated, indicating that children with poorer initial reading skills grew faster than children with better initial reading skills. Such findings are consistent with previous studies that have examined the growth in reading achievement in similar developmental stages (Aikens & Barbarin, 2008; Parrila, Aunola, Leskinen, Nurmi, & Kirby, 2005). For math, findings from both samples showed that children’s math scores experienced decelerated growth over time on average. This decelerated growth pattern in math has also been observed in other studies that examined similar age ranges (Caro, McDonald, & Willms, 2009; Ding & Davison, 2005). However, unlike reading, a “catch-up”

pattern in math was observed only in Study 2 but not Study 1, an important difference between the two studies that we return to later in the discussion.

Though it is important to describe the overall developmental pattern in achievement, our main goal was to understand how individual characteristics (i.e., temperament) and family background (i.e., SES risks) together contribute to the vast individual differences in academic development. Findings from both studies showed that children high in effortful control and low in surgency and negative affect exhibited resilience on academic development under high SES risk environment. Specifically, low negative affect weakened the negative associations between family SES risks and baseline reading and math scores such that the overall achievement gap between children from high versus low risk families was smaller at lower negative affect throughout middle childhood and early adolescence. Children with high effortful control and low surgency from high risk families demonstrated faster growth rates in reading and math (or equivalent growth rates in math in Study 1) compared to their counterparts from low risk families. In other words, the achievement gap between children from high versus low risk families decreased (or did not widen further in math in Study 1) over time at high effortful control and low surgency. This closing achievement gap between children from high versus low risk families was not observed in those with low effortful control and high surgency.

The present findings suggest that the observed resilience on academic achievement associated with high effortful control, low surgency, and low negative affect are generalizable to multiple academic areas including reading and math. These temperamental profiles are shown to be related to a variety of abilities that promote effectiveness in general learning. Neurologically, better effortful control and lower surgency indicate better development and functioning of the prefrontal cortex and its associated networks (Posner & Rothbart, 2007; Whittle et al., 2008). These neurological foundations underlie essential cognitive abilities required for effective learning such as working memory, attentional control, and cognitive flexibility (Arnsten & Li, 2005; Jurado & Rosselli, 2007). Behaviorally, children high in effortful control and low in surgency are better regulated. They are better able to remain in one place during class, persist through tasks, concentrate on learning materials, and shield against distractions from their surroundings (Checa, Rodriguez-Bailon, & Rueda, 2008; Matheny, 1989). Socially, children with high effortful control, low surgency, and low negative affect evoke more maternal sensitivity and social support, and are perceived as more teachable by their teachers and more likable by their peers (Keogh, 1994; Propper et al., 2008; Rudasill & Rimm-Kaufman, 2009; Valiente, Lemery-Chalfant, Swanson, & Reiser, 2008). Therefore, it is probable that these temperamental characteristics may mitigate the negative associations between SES risks and academic achievement through these general learning and social processes.

More importantly, the current findings contribute to the literature by showing that temperament characteristics including high effort control, low negative affect, and low surgency are particularly important to children from socioeconomically disadvantaged backgrounds such that these temperamental characteristics gradually help compensate for the academic disadvantages associated with socioeconomic constraints. Why do these temperament characteristics confer more advantages to children from high risk families

compared to those from low risk families? Parental investment theory argues that family SES is associated with children's academic development primarily through parental investment in materials, experiences, and services that are aimed to build the human capital of their children (Yeung, Linver, & Brooks-Gunn, 2002). Such parental investment is contingent upon not only the amount of resources available, but also children's reproductive fitness—compared to children with low reproductive fitness, children with high reproductive fitness are expected to receive more investment from parents with low resources and less investment from parents with high resources (Bugental & Beaulieu, 2003). It is possible that the well-developed cognitive, behavioral, and social abilities observed in children with high effortful control and low negative affect and surgency may serve as potential indicators of future success and wellbeing. Therefore, these temperamental characteristics might be particularly important in eliciting parental (and even teacher's) investment when resources are scarce and competitive, and in turn provides unique opportunities for socioeconomically disadvantaged children to thrive.

Despite these commonalities, there are also important differences between the two studies. First, a “catch-up” effect was observed in math development in Study 2, but not in Study 1. This may be a result of different ages between the two samples when math was assessed—math was measured in late elementary and early middle school years in Study 1 whereas it was measured in early to late elementary school years in Study 2. Early math education focuses more on basic concepts and procedures that are relatively easy to master. It is possible that repeated instruction and practice of such basic math knowledge allow children who lag behind in their math skills at early school entry to still be able to catch up with their peers by the end of elementary school. By late elementary school, more advanced materials are introduced, such as fraction and proportional relationships which are central to subsequent development in math proficiency but are more difficult to acquire (Siegler et al., 2012). Our findings showed that those who still lag behind in their math understanding by this phase of schooling generally remain behind in subsequent math development. Such findings are also consistent with previous evidence suggesting more catching-up pattern in math development in younger students compared to older students (Ding & Davison, 2005).

Another important difference between the two studies is the degrees to which effortful control and surgency moderated the predictive effects of SES risks on reading development. Specifically, although the initial reading achievement gap between children from high versus low risk families decreased over time at high effortful control and low surgency in both studies, this SES-related reading achievement gap was almost completely eliminated by late elementary school in Study 1, whereas sizable SES-related reading achievement gap was still present by late elementary school in Study 2. This discrepancy may be attributable to the difference in the demographic characteristics between the two studies—Study 1 only included families with low to modest risks (e.g., few families have more than 3 out of 6 risks) whereas Study 2 comprised families from more diverse socioeconomic backgrounds including higher risk families (e.g., 17% percent families had 3 and above out of 5 risks). Therefore, it is plausible that while high effortful control and low surgency may compensate for the academic disadvantages associated with modest socioeconomic constraints, their compensation effects may be limited and cannot completely offset the negative effects of

SES risks in more extreme circumstances. Such a possibility remains to be investigated by future studies featuring extremely high risk families.

Several limitations should be noted. First, extremely high risk families were underrepresented in both samples which constrained our ability to generalize the present findings to these families. Second, family SES risks and child temperament were both included as time-invariant predictors due to constraints in data availability. Thus, the effects of changes in both family SES risks and child temperament on academic development remain an important question for future research. Third, SES is a multifaceted construct (Duncan & Magnuson, 2001) and different risk indicators might interact with child temperament in different ways. Further investigation is needed to identify the potential heterogeneity among various SES risk indicators. Fourth, there was some variation in participants' age within each measurement occasion in Study 1. As such, there is a possibility that the growth curves may follow different patterns in participants of different ages. It is important to note that the current analyses were not able to capture such potential heterogeneity; rather, the presented results only reflected the average growth pattern within this sample. Finally, the correlational nature of the current study constrained our ability to make causal inferences. Therefore, experimental designs such as clinical studies that involve random assignment of treatment groups that target improving SES conditions or children's temperament characteristics are needed to pinpoint the causal relations among these developmental processes.

Despite these limitations, the use of two independent longitudinal studies and the replication of the overall findings across studies support the robustness of the current results, at least for a sizable portion of the SES distribution. The current findings also have important theoretical and clinical implications. Though it is well established that children raised in high SES risk families tend to have poorer academic outcomes, the current findings demonstrate that those born and raised in high risk families who are also temperamentally difficult (i.e., poorly self-regulated, highly impulsive and hyperactive, and emotionally reactive) are potentially under the most severe risk for poor academic development. Intervention programs that target these children may be most effective and efficient. In addition, rather than focusing exclusively on those identified as high risk, it is also crucial to understand the mechanisms of and the biosocial pathways leading to resiliency. More research is needed to better understand why and how children with certain temperament profiles thrive in spite of their apparently disadvantaged circumstances.

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Research Highlights

- Both reading and math skills experienced decelerated growth throughout middle childhood and early adolescence, but individuals showed diverse growth trajectories.
- Higher SES risks are generally associated with poorer academic outcomes, but these associations are moderated by child temperament.
- High effortful control, low surgency, and low negative affect gradually help compensate for the academic disadvantages associated with socioeconomic constraints.

a.

b.

Figure 1.
Distribution of SES risk factors in the two samples.

Figure 2.

Estimated reading developmental trajectories in Study 1 WRRMP. The pair of numbers adjacent to each group of developmental curves indicates differences in reading scores associated with one SES risk difference in the first and last waves of assessment. Numbers in parentheses indicate the same reading achievement gap in standard deviation units (standard deviation of reading scores at the first time point was used in the standardization). Developmental curves were not estimated at 4, 5, or 6 SES risks due to small sample size ($n=5$).

Figure 3.

Estimated math developmental trajectories in Study 1 WRRMP. The pair of numbers adjacent to each group of developmental curves indicates differences in math scores associated with one SES risk difference in the first and last waves of assessment. Numbers in parentheses indicate the same math achievement gap in standard deviation units (standard deviation of math scores at the first time point was used in the standardization). Developmental curves were not estimated at 4, 5, or 6 SES risks due to small sample size ($n=5$).

Figure 4.

Estimated reading developmental trajectories in Study 2 SECCYD. The pair of numbers adjacent to each group of developmental curves indicates differences in reading scores associated with one SES risk difference in the first and last waves of assessment. Numbers in parentheses indicate the same reading achievement gap in standard deviation units (standard deviation of reading scores at the first time point was used in the standardization).

Figure 5.

Estimated math developmental trajectories in Study 2 SECCYD. The pair of numbers adjacent to each group of developmental curves indicates differences in math scores associated with one SES risk difference in the first and last waves of assessment. Numbers in parentheses indicate the same math achievement gap in standard deviation units (standard deviation of math scores at the first time point was used in the standardization).

Table 1

Descriptive Statistics of the Study Variables

Variables	Study 1 WRRMP					
	M	SD	Skewness	Kurtosis	Min	Max N
SES risks	.09	.16	2.12	5.17	.00	1.00 419 [*]
Effortful control	5.28	.61	-.22	-.07	3.22	6.75 429
Negative affect	3.86	.67	-.05	.24	1.48	5.84 429
Surgency	4.48	.74	-.12	.09	2.09	6.64 429
Reading1	422.80	29.72	.39	-.51	340.00	502.33 618
Reading2	461.62	26.21	-.65	-.04	390.00	508.67 551
Reading3	483.65	20.75	-1.03	1.61	395.50	528.00 600
Reading4	500.25	15.09	-.87	1.54	434.33	534.33 576
Reading5	506.87	13.80	-.63	.86	450.00	544.50 527
Reading6	512.57	12.82	-.72	1.03	462.00	544.33 524
Math4	503.61	12.49	-.27	.05	460.50	544.00 567
Math5	511.30	12.59	-.59	1.96	444.00	555.00 517
Math6	517.48	13.34	.11	.92	473.67	566.00 512

Study 2 SECCYD					
SES risks	.22	.29	1.22	.56	.00 1.00 1323
Effortful control	4.69	.71	-.33	-.06	2.33 6.54 1054
Negative affect	4.28	.62	-.21	.01	2.10 6.26 1001
Surgency	4.81	.60	.01	.33	2.46 6.75 1041
Reading 1 st grade	468.16	15.50	-.12	.27	408.50 511.50 1026
Reading 3 rd grade	495.41	13.50	-.95	2.88	403.50 529.50 1016
Reading 5 th grade	507.99	13.33	-.97	4.01	419.00 544.00 993
Math 1 st grade	470.05	15.54	-.04	-.07	408.00 516.00 1023
Math 3 rd grade	497.33	13.19	-1.54	5.59	408.00 528.00 1013
Math 5 th grade	509.82	12.85	-1.30	5.39	424.00 547.00 993

Note: M = mean, SD = standard deviation, Min = minimum value, Max = maximum value, N = number of individuals.

^{*} = number of families.

Table 2

Correlations between the Study Variables

Variables	Study 1 WRRMP											
	1 SES risk	2	3	4	5	6	7	8	9	10	11	12
2.Effortful control	-.14 [*]											
3.Negative affect	.08	-.13 [*]										
4.Surgency	.00	-.24 ^{***}	.05									
5.Reading1	-.03	.03	-.01	-.10								
6.Reading2	-.08	.00	-.02	-.04	.82 ^{***}							
7.Reading3	-.10	.09	.03	-.10	.63 ^{***}	.80 ^{***}						
8.Reading4	-.15 ^{**}	.15 [*]	-.07	-.04	.45 ^{***}	.58 ^{***}	.77 ^{***}					
9.Reading5	-.17 ^{**}	.11	-.07	-.02	.33 ^{***}	.48 ^{***}	.71 ^{***}	.91 ^{***}				
10.Reading6	-.17 ^{**}	.10	-.07	-.02	.34 ^{***}	.48 ^{***}	.68 ^{***}	.88 ^{***}	.91 ^{***}			
11.Math4	-.15 ^{**}	.08	-.14 [*]	.02	.49 ^{***}	.55 ^{***}	.59 ^{***}	.63 ^{***}	.56 ^{***}	.54 ^{***}		
12.Math5	-.19 ^{**}	.04	-.04	.05	.40 ^{***}	.49 ^{***}	.58 ^{***}	.61 ^{***}	.58 ^{***}	.57 ^{***}	.88 ^{***}	
13.Math6	-.22 ^{***}	.01	-.07	.10	.29 ^{***}	.36 ^{***}	.49 ^{***}	.57 ^{***}	.57 ^{***}	.60 ^{***}	.77 ^{***}	.83 ^{***}

Variables	Study 2 SECCYD								
	1 SES risk	2	3	4	5	6	7	8	9
2.Effortful Control	-.24 ^{***}								
3.Negative affect	.05	-.26 ^{***}							
4.Surgency	.05	-.33 ^{***}	.10 ^{**}						
5.Reading 1 st grade	-.38 ^{***}	.28 ^{***}	-.10 ^{**}	-.01					
6.Reading 3 rd grade	-.39 ^{***}	.28 ^{***}	-.03	.01	.80 ^{***}				
7.Reading 5 th grade	-.41 ^{***}	.26 ^{***}	.01	.04	.76 ^{***}	.88 ^{***}			
8.Math 1 st grade	-.31 ^{***}	.23 ^{***}	-.07 [*]	-.02	.64 ^{***}	.57 ^{***}	.54 ^{***}		
9.Math 3 rd grade	-.31 ^{***}	.22 ^{***}	-.04	-.01	.59 ^{***}	.62 ^{***}	.59 ^{***}	.68 ^{***}	
10.Math 5 th grade	-.38 ^{***}	.23 ^{***}	-.07 [*]	-.02	.56 ^{***}	.59 ^{***}	.61 ^{***}	.68 ^{***}	.74 ^{***}

Note:

$p < .001$

 $p < .10$
**
 $p < .50$
*

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Table 3

Latent Growth Models without Predictors: Parameter Estimates and Model Fit Indices

		Study 1 WRRMP Reading	Study 1 WRRMP Math	Study 2 SECCYD Reading	Study 2 SECCYD Math
Intercept	Mean (SE)	420.30(1.26) ***	503.24(.50) ***	468.15(.47) ***	469.91(.47) ***
	Variance (SE)	1011.70(59.20) ***	145.38 (10.44) ***	187.53(11.81) ***	187.68(10.43) ***
Slope	Mean (SE)	92.41(1.19) ***	14.48 (.33) ***	40.14(.32) ***	40.32(.36) ***
	Variance (SE)	813.59(53.43) ***	22.16 (11.06) *	29.06 (12.78) *	53.70(7.04) ***
Intercept-Slope correlation		-.92 ***	-.25	-.46 ***	-.66 ***
Residuals	E1 Variance (SE)	157.81 (21.48) ***	16.04(6.01)**	54.064 (9.05) ***	48.054(2.55) ***
	E2 Variance (SE)	149.10(10.89) ***	13.44(2.41) ***	17.28 (2.45) ***	48.054(2.55) ***
	E3 Variance (SE)	101.15(6.22) ***	40.51(4.64) ***	18.75(3.53) ***	26.11(3.19) ***
	E4 Variance (SE)	23.23(1.39) ***	--	--	--
	E5 Variance (SE)	13.82(1.07) ***	--	--	--
	E6 Variance (SE)	15.36(1.26) ***	--	--	--
Model Fit Indices	χ^2 (df)	472.70 (24)	.00(0)	.00(0)	17.48(1)
	RMSEA	.15	.00	.00	.11
	CFI	.95	1.00	1.00	.99

Note. *df* = degrees of freedom; RMSEA = root mean square error of approximation; CFI = comparative fit index.

* $p < .05$;

*** $p < .001$

Table 4

Latent Growth Model: Model Fit Indices and Standardized Parameter Estimates of the Predictive Effects of Temperament and SES Risks

		Effortful Control and SES Risks		Negative Affect and SES Risks		Surgency and SES Risks	
		Intercept	Slope	Intercept	Slope	Intercept	Slope
Study 1 WRRMP Reading	Age	.74 ***	-.77 ***	.74 ***	-.77 ***	.74 ***	-.77 ***
	SES	-.13 ***	.09 **	-.12 ***	.07 *	-.14 ***	.08 *
	Temperament	.14 ***	-.04	-.03	.01	-.06 ***	.03
	SES x Temperament	-.00	.06 *	-.05 +	.01	-.01	-.05 *
	Fit Indices	$\chi^2(df) = 545.65(52)$ RMSEA = .10; CFI = .95		$\chi^2(df) = 536.10(52)$ RMSEA = .10; CFI = .95		$\chi^2(df) = 569.33(52)$ RMSEA = .11; CFI = .93	
Study 1 WRRMP Math	Age	.47 ***	-.62 ***	.45 ***	-.59 ***	.47 ***	-.64 ***
	SES	-.16 ***	-.11	-.16 ***	-.18 **	-.19 ***	-.15 *
	Temperament	.17 ***	-.09	-.13 ***	.08	-.01	.01
	SES x Temperament	.02	.15 +	-.08 *	.02	-.03	-.15 *
	Fit Indices	$\chi^2(df) = 12.32(10)$ RMSEA = .02; CFI = 1.00		$\chi^2(df) = 20.48(10)$ RMSEA = .04; CFI = 1.00		$\chi^2(df) = 18.93(10)$ RMSEA = .03; CFI = 1.00	
Study 2 SECCYD Reading	SES	-.40 ***	.10	-.43 ***	.09	-.44 ***	.10
	Temperament	.21 ***	-.11 +	-.10 **	.23 ***	.02	.07
	SES x Temperament	-.08 **	.13 *	-.06 +	-.06	.06	-.03
	Fit Indices	$\chi^2(df) = 3.79(3)$ RMSEA = .01; CFI = 1.00		$\chi^2(df) = 5.95(3)$ RMSEA = .03; CFI = 1.00		$\chi^2(df) = 4.41(3)$ RMSEA = .02; CFI = 1.00	
Study 2 SECCYD Math	SES	-.34 ***	.06	-.37 ***	.06	-.38 ***	.07
	Temperament	.17 ***	-.10 +	-.07 +	.02	.02	-.01
	SES x Temperament	-.06	.10 +	-.07 *	.01	.10 **	-.14 **
	Fit Indices	$\chi^2(df) = 19.17(4)$ RMSEA = .05; CFI = .99		$\chi^2(df) = 22.47(4)$ RMSEA = .06; CFI = .99		$\chi^2(df) = 19.28(4)$ RMSEA = .05; CFI = .99	

Note. *df* = degrees of freedom; RMSEA = root mean square error of approximation; CFI = comparative fit index.+ *p* < .07;

.100' > *d*

; .10' > *d*
**
'50' > *d*
*

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Table 5

Post-hoc Analyses: Standardized Parameter Estimates of the Predictive Effects of SES Risks at Different Levels of Temperament

	Value	Reading			Math		
		SES Risk → Intercept	SES Risk → Slope	SES Risk → Intercept	SES Risk → Intercept	SES Risk → Slope	SES Risk → Slope
Study 1 WRRMP	-1 SD	--	.03	--	--	--	-.26***
	M	--	.09**	--	--	--	-.11
	+1 SD	--	.16**	--	--	--	.04
	-1 SD	-.08	--	-.09	--	--	--
	M	-.12***	--	-.16***	--	--	--
	+1 SD	-.17***	--	-.23***	--	--	--
Study 2 SECCYD	-1 SD	--	.13***	--	--	--	-.01
	M	--	.08*	--	--	--	-.15*
	+1 SD	--	.03	--	--	--	-.29***
	-1 SD	-.32***	-.04	--	--	--	-.04
	M	-.40***	.10	--	--	--	.06
	+1 SD	-.49***	.24**	--	--	--	.16*
Study 3 SECCYD	-1 SD	-.37***	--	-.29***	--	--	--
	M	-.43***	--	-.37***	--	--	--
	+1 SD	-.50***	--	-.44***	--	--	--
	-1 SD	--	--	-.48***	--	--	.22**
	M	--	--	-.38***	--	--	.07
	+1 SD	--	--	-.27***	--	--	-.08

Note: -1SD = 1 standard deviation below mean. M = mean. +1SD = 1 standard deviation above mean. "--" = moderation effects not significant and post-hoc analyses not conducted.

* $p < .05$;

** $p < .01$;

$\cdot 100 > d$

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