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Academic Resilience Despite Early Academic Adversity: A Three-Wave Longitudinal Study on Regulation-Related Resiliency, Interpersonal Relationships, and Achievement in First to Third Grade

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Abstract

Using a bio-social-ecological systems framework, we examined whether interpersonal relationships at school (specifically teacher-student and peer relationships) mediated the link between child resiliency (temperament-based adaptability) and reading or math achievement in a sample of children assessed as experiencing early academic adversity. Participants were 784 ethnically diverse students (mean age at Year 1 = 6.57 years, $SD=0.39$) who began school as struggling readers or as weak in reading skills relative to their peers (scoring below the median on a school-wide standardized literacy exam). Data on children's resiliency, teacher-student warmth and conflict, peer social preference and peer liking, and reading and math achievement scores were collected across 3 years and three-wave longitudinal models of mediation were tested. Accounting for students nested within classrooms and for baseline covariates (i.e., ethnicity, social economic status, gender), results showed that peer relationships mediated the effect of resiliency on reading, but not math, achievement. Teacher-student relationships were not found to be a mediator between resiliency and achievement. Findings suggest that for children with early academic adversity, resiliency is a protective factor against future academic problems with peer competence facilitating children's academic engagement and achievement.

Keywords

Resiliency; teacher-student relationships; peer status; achievement

Introduction

Children enter primary school with unique temperaments that influence how they engage in or respond to their learning or school environments. As children progress through grades and transition across classrooms, they must adapt to new experiences or challenges with their teachers and peers. Ego-resiliency is considered a temperamental or personality resource that allows individuals to be flexible and resourceful in adapting to external and internal stressors (Block and Block, 1980; Caspi & Silva, 1995; Luthar, Cicchetti, & Becker, 2000), and can be viewed as temperament-based adaptability. Adaptability or ego-resiliency assessed as early as in infancy has been found to predict social and academic outcomes in third grade (Brock & Curby, 2016). Furthermore, ego-resiliency in childhood has been linked to social and peer competence (Eisenberg et al., 1997; Howes, Matheson, & Hamilton, 1994) that may contribute to subsequent academic competence or achievement (Buhs, Ladd, & Herald, 2006; Hamre & Pianta, 2001).

Given that ego-resiliency is linked to social and peer competence and also to school competence or academic achievement, the purpose of the present study was to examine which qualities of children's interpersonal relationships at school serve as mechanisms through which ego-resiliency and future academic achievement are linked in a sample of children assessed as at-risk for early literacy problems. We targeted children exhibiting early risk for reading problems to study factors that support or promote academic resilience, because children's early literacy skills are foundational for future academic engagement and academic progress (Alexander, Entwisle, & Horsey, 1997). In this study, we hypothesized that ego-resiliency at Year 1 of primary school would predict qualities of interpersonal relationships with teachers and with peers at Year 2, which would then predict academic achievement at Year 3. Despite early academic adversity, we expect that children high on ego-resiliency are likely to accrue psychosocial resources through developing positive relationships at school that would positively impact future achievement (e.g., Masten et al., 1999). Furthermore, if ego-resiliency is indeed temperament-based adaptability, we expect to observe year-to-year consistency or continuity across Years 1 to 3 in ego-resiliency.

Adaptability and Resiliency

Human adaptability is important across the lifespan and it could be argued that every person has some capacity for adapting to their environments. However, individual differences exist in people's capacities for adaptation or resiliency. It is important to distinguish resiliency from resilience, because *resiliency* refers to temperament or personality traits associated with adaptability, whereas *resilience* refers to a dynamic developmental process of maintaining positive adaptation or adjustment in the context of substantial threat or adversity (Luthar, Cicchetti, & Becker, 2000; Masten, 1994). *Ego-resiliency* refers to capacities for "resourceful adaptation to changing circumstances and environmental contingencies...and flexible invocation of the available repertoire of problem-solving strategies" (Block & Block, 1980, p. 48). Ego-resiliency has been linked to effortful control, which is a temperament-based aspect of self-regulation (e.g., Bridgett, Burt, Edwards, & Deater-Deckard, 2015; Eisenberg et al., 2003; Liew, McTigue, Barrois, & Hughes, 2008; Taylor, Eisenberg, Spinrad, & Widaman, 2013). Henceforth, the construct of ego-resiliency will be

referred to as resiliency for brevity. And in the present study, we consider academic achievement despite early academic risk or adversity as one indicator of *academic resilience*.

Studies have shown that resiliency in early childhood is linked to preschool competence or school readiness skills. According to Arend, Gove, and Sroufe (1979), a child who is high on resiliency is “enthusiastically involved with school tasks and peers; is (affectively) expressive in situationally appropriate ways; and is organized, persistent and flexible when encountering problems and stress” (p. 958). In a longitudinal study on children from 42 to 84 months of age, Taylor et al. (2014) found that change in children’s resiliency across 42 to 84 months predicted their social competence at 84 months. There is also evidence that resiliency is associated with interpersonal or social competence into adulthood. For example, Block and Kremen (1996) found that young adults who scored high on resiliency tended to be more interpersonally or socially competent. Thus, resiliency appears to play a contributing role in human adaptability and interpersonal or social-emotional competence. In the present study, it is expected that children’s resiliency in their first year of primary school will contribute to or predict qualities of relationships with their teachers and peers.

Resiliency and Interpersonal Relationships

Primary education is compulsory for children in nearly every country in the world, and the first-grade transition has been viewed as a major developmental milestone or a “rite of passage” in early childhood, with some children finding this transition challenging or even traumatic (Entwisle & Alexander, 1998). The Ecological and Dynamic Model of Transition (Rimm-Kaufman & Pianta, 2000) has been proposed to describe and explain children’s transitions to formal schooling and transitions across school grades, and how such transitions have long-term impacts on children’s schooling outcomes. According to this model, it is important to examine the child in contexts across time (e.g., in the school and with teachers or with peers) in order to understand how children’s early school transitions have long-term impact on academic competence and achievement. Because children enter schools with their temperament or personality traits, individual differences can be observed in the ways children respond or react to the first-grade transition experience. Using the Ecological and Dynamic Model of Transition as a theoretical framework for this study, we examine resiliency as a child characteristic that is expected to facilitate a smooth transition into primary school as well as to facilitate the formation and maintenance of interpersonal ties or bonds with teachers and peers.

Teacher-student relationships.—Teacher-student relationships are important for children’s school adjustment, and have long-term impact on students’ academic outcomes such as school grades and standardized test or achievement scores (e.g., Hamre & Pianta, 2001; Portilla et al., 2014). The quality of teacher-student relationships depends on the transactions between the teacher and the student, and characteristics of students and teachers’ perceptions or evaluation of students’ characteristics are linked to the quality of teacher-student relationships. For example, children’s temperament traits such as effortful control predicted teacher-student relationships with low levels of conflict and high levels of closeness (Rudasill & Rimm-Kaufman, 2009). Recall that empirical evidence shows that effortful control and resiliency are distinct but related constructs, and both reflect aspects of

the broader construct of self-regulation (e.g., Eisenberg et al., 2003; Liew et al., 2008; Taylor et al., 2013). Other studies have found similar patterns of relations between effortful control and quality of teacher-student relationships such as high levels of closeness or low levels of conflict (e.g., Myers & Morris, 2009; Silva et al., 2011; Valiente, Swanson, & Lemery-Chalfant, 2012). To our knowledge, no published study has documented the relation between resiliency and the quality of teacher-student relationships. In the present study, we explored whether resiliency predicts qualities of teacher-student relationships because positive or supportive teacher-student relationships may serve as an asset or resource for children's learning and academic achievement, particularly for students experiencing early risks or adversities (Hamre & Pianta, 2005; Murray & Malmgren, 2005).

Peer relationships.—While prior studies have yet to document a direct relation between resiliency and teacher-student relationships, several published studies have shown direct relations between resiliency and peer relationships (e.g., friendship quality) or social status in the classroom. In a sample of 5- to 7-year-old boys, Cillessen, van IJzendoorn, van Lieshout, and Hartup (1992) found that boys who were low on resiliency tended to be rejected by their peers and also seen by their peers as aggressive or as shy. Furthermore, in a cross-sectional study on children in kindergarten through third grade, Eisenberg et al. (1997) found that resiliency (assessed with parent and teacher reports) predicted social status (consisting of teachers' ratings of popularity and peers' ratings of likability) as well as socially appropriate behavior (consisting of teachers' ratings of social competence and peers' nominations for being helpful and nice). In a different study on the same sample of children but using a longitudinal design with follow-up measures collected 2 years (Time 2) and 4 years (Time 3) after the initial assessment (Time 1), Eisenberg et al. (2003) found that resiliency predicted social status and socially appropriate behavior at Time 2 and at Time 3. Thus, there is reason to expect that resiliency would predict various aspects of peer competence and qualities of peer relationships concurrently and possibly longitudinally.

Resiliency and Academic Achievement

Individual differences in early adaptability or resiliency have been linked to children's school readiness and early school competence that have implications for future academic learning and adjustment (Arend et al., 1979; Brock & Curby, 2016). Not surprisingly, children's resiliency has also been linked to academic achievement. In an earlier study on the present longitudinal sample, Kwok, Hughes, and Luo (2007) found that a latent construct of resiliency (consisting of teacher ratings of children's resiliency, agreeableness, and conscientiousness) predicted standardized reading and math achievement test scores one year later, after accounting for child IQ, SES, and achievement scores from one year earlier. With the same sample of first grade students, Liew, McTigue, Barrois, and Hughes (2008) examined whether adaptive and effortful control (consisting of teacher ratings of child resiliency and observations of child inhibitory control) predicts achievement two years after transition to primary school, and found that adaptive and effortful control at first grade predicted reading (but not math) achievement two years later. To date, studies documenting links between resiliency and academic achievement remain relatively scarce, but findings from Kwok et al. (2007) and Liew et al. (2008) suggest that childhood resiliency has short- and long-term linkages to learning and achievement. In addition, the present study is unique

in that it is one of the first to examine academically at-risk students' academic resilience using a bio-social-ecological systems perspective to test the roles of resiliency traits and interpersonal relationship processes on achievement in the schools.

Interpersonal Relationships and Academic Achievement

While resiliency is a temperament or personality construct that helps explain individual differences in resilience, positive interpersonal relationships partly reflect individuals' social ecologies that predict successful development and adjustment under adversity.

Bronfenbrenner's bio-social-ecological systems model of human development has been applied to the theory of resilience that explains human resilience from traits as well as person-environment reciprocal processes in social and physical ecologies (Ungar, Ghazinour, & Richter, 2013). In the context of schools, a relatively large body of studies has shown that the quality of school-based interpersonal relationships contribute to academic achievement. The majority of the work on interpersonal relationships at school has focused on teacher-student relationships and the affective dimensions between teachers and students (e.g., teacher empathy, warmth, and support), with substantially fewer studies on peer relationships and academic achievement. Overall, extant literature on school-based interpersonal relationships and achievement shows that students' learning and achievement is often a socially mediated process where both teachers and peers contribute to students' academic engagement and achievement (e.g., León and Liew, 2017; Wang & Eccles, 2013; Wentzel, Battle, Russell, & Looney, 2010).

Interpersonal Relationships as Mediating Mechanisms

As noted by Ladd, Kochenderfer-Ladd, Visconti, and Ettekal (2012, p. 12), "Because education is a social enterprise, it is surprising that investigators have tended to overlook interpersonal challenges and competencies as predictors of children's classroom learning and achievement." To date, we know of no published study that has examined interpersonal relationships at school as mediating mechanisms by which resiliency at the transition to primary school influences academic achievement in subsequent years. However, because resiliency and effortful control are conceptually and empirically related, we draw on the literature on effortful control that has documented school-based interpersonal relationships as mediating the influence of effortful control on achievement.

Teacher-student relationships.—A growing body of research suggests that children's school-based interpersonal ties are associated with their learning and achievement, and personal or individual factors such as effortful control or self-regulation impact achievement through these socioemotional and interpersonal processes (Graziano et al., 2007; Ladd et al., 2013; Montroy, Bowles, Skibbe, & Foster, 2014; Valiente et al., 2008; 2012). For example, Valiente et al. (2008) found that teacher-student relationships partially mediated the relations between effortful control and changes in academic achievement. In a different study on third- through fifth-grade children, Swanson, Valiente, and Lemery-Chalfant (2012) found that conflictual teacher-student relationships mediated the link between effortful control and academic achievement. A similar mediation effect was found by Hernández et al. (2016), where close teacher-student relationships mediated the link between effortful control in kindergarten and academic achievement in first grade. In summary, results from several

studies on effortful control and achievement suggest that teacher-student relationships serve as mediating mechanisms. However, it is unclear whether similar mediation effects from teacher-student relationships will be found for resiliency and whether they are different for reading versus math achievement, as scores on these very different academic domains are often combined in prior research (see Harlaar et al., 2012).

Peer relationships.—To date, there appears to be no published studies that explicitly examined quality of peer relationships as a mediating mechanism between resiliency and academic achievement. However, a number of studies have found that children's social or peer competence mediate the relation between child effortful control and academic achievement, although results have been inconsistent and appear to depend on how peer functioning or peer competence was measured. For example, Valiente et al., (2008) found that, in a sample of 7- to 12-year olds in the United States, social competence (assessed as socially appropriate behaviors and popularity) partially mediated the relation between effortful control and school grades. In a 6-year longitudinal study, Valiente et al. (2011) also found that effortful control predicted social functioning 2 years later, and social functioning predicted academic achievement 4 years later. Social functioning, indexed by socially appropriate behaviors, popularity, and low externalizing problem behaviors, mediated the relation between effortful control and academic achievement. This pattern of results has also been found in school children in China. In a sample of elementary school students living in China, Zhou et al. (2010) found that social competence (indexed by socially appropriate behaviors and sociability-leadership) mediated the relations between effortful control and academic achievement; a similar pattern of results was also found for externalizing problems as a mediating mechanism between effortful control and academic achievement.

Taken together, there is some evidence for social and peer competence as one mediating mechanism in the link between effortful control and academic achievement. Because effortful control and resiliency are both considered part of self-regulation, and are correlated with one another, we hypothesize that qualities of school-based interpersonal relationships, such as teacher-student and peer relationships, will serve as mediating mechanisms between resiliency and academic achievement in the present study.

Present Study

In the present study, we tested a three-wave longitudinal model of mediation that examined whether teacher-student relationships or peer relationships mediated the link between child resiliency and reading or math achievement in a sample of children assessed as experiencing early academic adversity (specifically in reading or literacy). Children's early literacy skills forecast academic outcomes throughout their school years (Alexander, Entwisle, & Horsey, 1997). Furthermore, children who enter school with low literacy skills experience more relational stressors and fewer relational supports than are children with more developed literacy skills (Ladd, Birch, & Buhs, 1999; Reynolds & Bezruczko, 1993). For these reasons, students with low literacy skills represent a population of considerable importance with respect to identifying mechanisms and processes that promote academic resilience and achievement.

We tested for mediation using three-waves of data for all constructs, which allowed us to control for baseline levels of constructs and provided greater confidence in the inferences made about the directionality of influences amongst the constructs. Guided by the Ecological and Dynamic Model of Transition (Rimm-Kaufman & Pianta, 2000) and Bronfenbrenner's bio-social-ecological systems model as theoretical frameworks for this study, we expect that in this sample of children who faced early academic risk or adversity, those high on resiliency will experience positive interpersonal relationships at school with teacher and with peers, which will then have impacts on their academic achievement (i.e., exhibit academic resilience by overcoming early academic adversity). In addition, we explore year-to-year consistency in the measure of resiliency across the first three years of primary school in order to evaluate whether its measurement is consistent with the conceptualization of the construct as a relatively stable temperament or personality trait associated with adaptability.

Method

Participants

Participants were 784 ethnically diverse students (mean age at Year 1 = 6.57, $SD = 0.39$; 52.6% male; 34.1% white, 37.4% Hispanic, 23.2% African American, and 5.3% other), who were recruited for and participated in a longitudinal study examining the impact of grade retention on academic achievement. Based on school records, 37% of these students qualified by income for free reduced lunch and 14% were enrolled in bilingual classes. Of the 784 students, 12% of their parents had not completed high school, 39% had completed high school or a GED, 30% had attended some college but had not graduated, 11.8% had completed a 4-year degree, and 7.4% had completed graduate or professional degrees. A total of 18% lived in a single parent home, and 85% lived in a home in which at least one adult with full-time employment. No evidence of selective attrition was found based on a large number of demographic and school academic variables measured in the first grade.

Procedures

Participants were recruited when they were in first grade from three school districts in Texas (one urban and two small cities) across two consecutive cohorts of students during the fall of 2001 and 2002. To be eligible to participate, children must have scored below the median on a state-approved measure of literacy that was administered by their school district (average z score for this sample = -0.64 ($SD = .59$)). In addition, children needed to be verbally proficient in either English or Spanish, not receiving special education services, and not previously retained in first grade. Based on eligibility criteria, 1,374 children were identified through school records as eligible to participate. Teachers distributed consent forms to parents via children's weekly folders, and 1,200 consent forms were returned with 784 (65%) of those with parental consent for their child to participate in the study; see Hughes, Kwok, & Loyd (2008) for details on participant recruitment for the larger longitudinal study. For this study, data collection and assessments were conducted annually for 3 years, starting when participants were in first grade. All measures in this study were collected between November and May of each school year, with at least 8 months separating each annual assessment. Teachers completed questionnaires (including those on child resiliency and

teacher-student relationships) in the spring of each year, and teachers received \$25 for completing and returning the questionnaires. Standardized reading and math achievement tests were individually administered to students at school at varying times during the school year, but the three annual achievement tests were administered at least 8 months apart from each other.

Measures

Primary study measures included child resiliency, positive teacher-student relationships, positive peer relationships, and academic achievement in reading and in math. Teachers provided information on child resiliency and on teacher-student relationships, peers (classmates) provided information on peer relationships, and state-approved standardized achievement tests were used to assess academic achievement in reading and in math. Internal consistency reliabilities (α s) for the major variables ranged from 0.84 to 0.95 for Year 1 through Year 3.

Resiliency.—Resiliency was assessed using teacher ratings of students' agreeableness, conscientiousness, and ego-resiliency on a 5-point scale. Items for Agreeableness and Conscientiousness were from the scales of the same name of the Big Five Inventory (John & Srivastava, 1999), and items for Ego-resiliency were from the California Child Q-Sort (Caspi, Block, Block, & Klopp, 1992). Sample items for Agreeableness include "is helpful and unselfish with others" and "likes to cooperate with others", sample items for Conscientiousness include "does a thorough job" and "is a reliable worker", and sample items for Ego-resiliency include "resourceful in initiating necessary activities" and "falls to pieces under stress" (reverse scored). Scale α s ranged from .84 to .96 across three time waves. Previous confirmatory factor analysis performed on first grade students participating in the larger longitudinal study supported a second-order measurement model of Resiliency defined by three first-order factors of Agreeableness, Conscientiousness, and Ego-resiliency. A composite score for resiliency was computed as a standardized score of the three scales (Kwok, Hughes, & Luo, 2007).

Positive teacher-student relationships.—Positive teacher-student relationships were assessed using teacher ratings of provision of warmth and the level of conflict in their relationship with a given student. Teachers completed the 22-item Teacher Network of Relationships Inventory (TNRI) on a 5-point scale, which was developed from the child version of the Network of Relationships Inventory (Furman & Buhrmester, 1985). Scores on the TNRI have demonstrated good construct, factorial, and predictive validity across the elementary and middle school grades (Hughes, 2011; Hughes, Luo, Kwok, & Loyd, 2008; Li, Hughes, Kwok, & Hsu, 2012; Wu & Hughes, 2012). The TNRI yields three factors: Warmth (13 items), Conflict (6 items) and Intimacy (3 items) (Hughes, Gleason, & Zhang, 2005; Wu & Hughes, 2012). Because the Intimacy Scale is less consistently predictive of students' school adjustment than are the Warmth and Conflict Scales (Wu & Hughes, 2014), the present study used only the Warmth and Conflict Scales. Sample Warmth scale items include "I enjoy being with this child," and "This child gives me many opportunities to praise him or her." Scale α for Warmth was .94 at Years 1 and 2 and .93 at Year 3. Sample Conflict scale items include "This child and I often argue or get upset with each other," and

“I often need to discipline this child.” Scale α for Conflict was .92 at Years 1, 2, and 3. Measurements of warmth and conflict (reverse coded to indicate low conflict) were highly positively correlated with each other at each of the three time points (r s ranged from .56 to .67).

Positive peer relationships.—Positive peer relationships were assessed using sociometric interviews to arrive at peer ratings of like and social preference scores. All students with permission to participate in the sociometric interviews were asked to rate how much they liked each child in the classroom on a 5-point scale (1 = Don’t like at all and 5 = Like very much). A child’s mean liking score was the average rating received by classmates. Consistent with Coie, Dodge, and Coppotelli (1982)’s approach, social preference scores were computed as the standardized “liked most” nomination scores minus the standardized “liked least” nomination scores. To avoid asking children to nominate disliked children, a rating of “1” on the roster rating of liking was considered equivalent to a “liked least” nomination score (Asher & Dodge, 1986) for purposes of calculating derived social preference scores. All sociometric scores were standardized within classrooms, and the mean ratings of peer liking and social preference scores were highly correlated with one another ($r = .74$) and were used as indicators for the latent construct of positive peer relationships. Both mean ratings of peer liking and scores on peer social preference have been found to have good test–retest reliabilities and stability across the elementary school years (Hughes, 1990; Hughes, Zhang, & Hill, 2006).

Academic achievement in reading and math.—Reading and math achievement was assessed using the Woodcock–Johnson III (WJ-III) Tests of Achievement (Woodcock, McGrew, & Mather, 2001), an individually administered measure of academic achievement for individuals 2 years of age to adulthood. The WJ-III Broad Reading W scores (Letter–Word Identification, Reading Fluency, and Passage Comprehension subtests) and the WJ-III Broad Math W scores (Calculations, Math Fluency, and Math Calculation Skills subtests) were used. Extensive research documents the reliability and construct validity of scores on the WJ-III and its predecessor (Woodcock & Johnson, 1989; Woodcock et al., 2001). Spanish language-dominant children were administered the Bateria III, the equivalent Spanish version of the WJ III (Woodcock, Munoz-Sandoval, McGrew, Mather, & Schrank, 2004) by bilingual examiners.

Analytic Approach

Descriptive statistics were conducted prior to testing of the hypothesized three-wave longitudinal mediation models. In testing for mediation, we applied modeling techniques proposed by Cole and Maxwell (2003) in *Mplus* version 7.2 (Muthén & Muthén, 1998–2014) with the TYPE = COMPLEX function to take into account the potential data dependency in our data (i.e., students nested within schools). All models included students being nested within classrooms and baseline covariates (i.e., ethnicity, socio-economic status, gender) as control variables in analyses, and also included control of baseline levels of constructs. Robust maximum likelihood estimation method was applied to estimate appropriate standard error if the normality assumptions were violated. The missingness in the dataset was missing at random (MAR) and was handled with full information likelihood

estimation (FIML), which uses all of the available information for parameter estimation (Enders, 2010). FIML works by estimating a likelihood function for each individual based on the variables that are present so that all the available data are used. FIML is often used in estimating structural equation models and longitudinal growth models and has been found to produce unbiased parameter estimates and standard errors under MAR and MCAR (Graham, 2006).

Results

Descriptive Statistics

All variables were checked for skewness and kurtosis, and none of the variables showed violation of the normality assumption based on commonly used cutoff values (i.e., skewness < 2 and kurtosis < 7 ; West, Finch, and Curran, 1995). Table 1 shows the descriptive statistics and the correlations amongst the variables in the longitudinal mediation models. Results from correlations show that resiliency had year-to-year consistency or continuity across 3 years (year-to-year correlations were .58 and .57). Measures of warmth and conflict (reverse coded to indicate low conflict) in teacher-student relationships were related to one another concurrently (range = .65 to .67) and across time (range = .28 to .56). Correlations between preference and average peer rating across Year 1 to Year 3 were positive moderately correlated (range = .27 to .69). Similarly, scores on standardized achievement tests in reading and in math were related to one another concurrently and across time (range = .44 to .80). Within each year, the correlations between resiliency and warmth and conflict in teacher-student relationships, as well as between resiliency and peer preference and average peer rating, were moderately correlated in the expected directions (see Table 1). The missing rates of the observed variables ranged from 3% to 30%. Three variables at wave 3 had missingness at 30%, but analyses revealed no statistically significant differences between students with and without complete data on major study variables and the data was missing at random (MAR). Thus, the hypothesized models in the study were tested using full information maximum likelihood for data missing at random (FIML; Enders, 2010).

Longitudinal Mediation Models

Using four longitudinal mediation models, we tested the hypothesis that positive interpersonal relationships with teachers or with peers in Year 2 mediated the effect of resiliency in Year 1 on reading or math achievement in Year 3. The hypothesized three-wave longitudinal mediation model is shown in Figure 1. In Figure 1, X represents the predictor (i.e., child resiliency); M represents the mediators (i.e., teacher-student or peer relationships), and Y represents the outcomes (i.e., standardized achievement test scores in reading or math). Note that the mediator is represented by a latent factor, with warmth and conflict between teachers and students as indicators for the latent factor for teacher-student relationships and with peer preference and average peer rating as indicators for the latent factor for peer relationships. In sum, four models were tested in this study: Model 1: Resiliency $\rightarrow$ Positive teacher-student relationships $\rightarrow$ Reading achievement; Model 2: Resiliency $\rightarrow$ Positive teacher-student relationships $\rightarrow$ Math achievement; Model 3: Resiliency $\rightarrow$ Positive peer relationships $\rightarrow$ Reading achievement; Model 4: Resiliency $\rightarrow$ Positive peer relationships $\rightarrow$ Math achievement. The time-specific indirect effect was of

primary interest and was tested with the Sobel test with *Mplus* version 7.2 (Muthén and Muthén 1998–2014).

Results for the tests of the mediation models are summarized in Table 2. All four models resulted in good model fit, and CFIs ranged from 0.96 to 0.99, RMSEAs ranged from 0.03 to 0.08, and SRMRs ranged from 0.03 to 0.07 (Hu & Bentler, 1999). The strength of the two path coefficients for warmth (ranged from 0.78 to 0.84, all $p < .01$) and conflict (ranged from 0.71 to 0.79, all $p < .01$) as indicators of the latent construct of positive teacher-student relationships were similar for the models with Reading and with Math as the outcomes. For latent construct of positive peer relationships, the strength of the two path coefficients for social preference (ranged from 0.81 to 0.89, all $p < .01$) and mean roster rating of liking (ranged from 0.78 to 0.86, all $p < .01$) as indicators were also similar for the models with Reading and with Math as the outcomes.

For the models with positive teacher-student relationships as the mediator between resiliency and academic achievement, we describe results for reading followed by results for math achievement. For reading achievement, Year 1 within-wave correlations were $r_{M1X1} = 0.87$, $r_{M1Y1} = 0.20$ and $r_{X1Y1} = 0.33$, all $p < 0.01$; Year 2 within-wave correlations between resiliency and mediator was significant ($r_{M2X2} = 0.78$, $r_{M3X3} = 0.85$, $p < 0.01$), and correlation between resiliency and reading was significant ($r_{M3X3} = 0.08$, $p < 0.05$) but not statistically significant for others. For math achievement, Year 1 within-wave correlations between resiliency and mediator and achievement were statistically significant (i.e., $r_{M1X1} = 0.87$, $r_{M1Y1} = 0.16$ and $r_{X1Y1} = 0.21$, all $p < 0.01$); Year 2 and Year 3 within-wave correlation between resiliency and mediators shared similar patterns, that is, correlation between resiliency and mediator was significant ($r_{M2X2} = 0.79$, $r_{M3X3} = 0.84$, $p < 0.01$), but not statistically significant for others.

Similarly, for the models with positive peer relationships as the mediator between resiliency and academic achievement, we describe results for reading followed by results for math achievement. For reading achievement, Year 1 within-wave correlations between resiliency and mediators and outcomes were statistically significant (i.e., $r_{M1X1} = 0.52$, $r_{M1Y1} = 0.14$ and $r_{X1Y1} = 0.33$, all $p < 0.01$); Year 2 and Time 3 within-wave correlation between resiliency and mediators shared similar pattern, that is, correlation between resiliency and mediator was significant ($r_{M2X2} = 0.29$, $r_{M3X3} = 0.17$, $p < 0.01$), but not statistically significant for others. For math achievement, Year 1 within-wave correlations between resiliency and mediator and achievement were statistically significant (i.e., $r_{M1X1} = 0.52$, and $r_{X1Y1} = 0.22$, all $p < 0.01$) but not significant between mediator and math; Year 2 and Year 3 within-wave correlation between resiliency and mediators shared similar pattern, that is, correlation between resiliency and mediator was significant ($r_{M2X2} = 0.29$, $r_{M3X3} = 0.17$, $p < 0.01$), but not statistically significant for others.

In sum, model results showed that teacher-student relationships did not mediate the link between resiliency and reading achievement ($ab_{X1 \rightarrow M2 \rightarrow Y3} = -0.003$, $SE = 0.004$, $p = .46$) or math achievement ($ab_{X1 \rightarrow M2 \rightarrow Y3} = -0.002$, $SE = 0.003$, $p = .45$). By contrast, model results showed that the positive peer relationships mediated the effect of resiliency on reading achievement ($ab_{X1 \rightarrow M2 \rightarrow Y3} = 0.02$, $SE = 0.01$, $p < .01$), but not on math

achievement ($ab_{X_1 \rightarrow M_2 \rightarrow Y_3} = 0.01$, $SE = 0.01$, $p = .36$). Figure 2 highlights the mediation paths that were tested, including those that were significant with path coefficients.

Discussion

To our knowledge, this is one of the first studies to empirically test school-based interpersonal (teacher-student and peer) relationships as potential mediating mechanisms through which early resiliency and future achievement or academic resilience are linked. Children in this sample were selected to participate in this study based on early academic risk (i.e., scoring below the median on a state-approved measure of literacy that was administered by their school districts). For these students who exhibited early risk for reading difficulties, our findings showed that positive peer relationships mediated the influence of early resiliency in the first year of primary school on reading (but not math) achievement in the third year of primary school. By contrast, positive teacher-student relationships (i.e., warmth and low conflict) did not serve as a mediating mechanism between resiliency and reading or math achievement.

Year-to-year Consistency in Resiliency

Consistent with the conceptualization of resiliency as a measure of temperament or personality traits associated with self-regulation and adaptability (Bridgett et al., 2015; Block and Block, 1980; Caspi & Silva, 1995; Luthar, Cicchetti, & Becker, 2000), we found year-to-year consistency in measures of child resiliency across the first 3 years in primary school. While all children in this study exhibited early risk for reading difficulties, there were individual differences amongst these children in resiliency during their first year in primary school that appear relatively stable across the early primary grades.

Our findings are consistent with Roberts and DelVecchio (2000)'s meta-analysis that examined trait consistency and stability across the lifespan, with adaptability (e.g., resiliency) as one of the core types of temperament or personality traits. They found that the highest consistency amongst temperament or personality traits examined in the 152 longitudinal studies was exhibited by scales categorized as measuring trait adaptability (estimated population correlation controlling for time interval of the longitudinal study and age of sample = .52). In the present study, the rank-order consistency for resiliency from the first to the second year, and from the second to the third year, of primary school were .58 and .57. Thus, our findings are in line with those of Roberts and DelVecchio's 2000 meta-analytic study.

Resiliency and Positive Interpersonal Relationships at School

Results from correlations show that resiliency was associated with all indices of positive interpersonal relationships at school in the expected directions concurrently and longitudinally (see Table 1). Our findings show that children high on resiliency are likely to have teacher-student relationships characterized by warmth and low conflict, as well as peer relationships characterized by social preference and liking by peers. This pattern of results is consistent with the view that flexibility of interpersonal problem-solving skills, including being able to produce a number of different relevant strategies or solutions to a given

problem, is considered one aspect of resiliency (Arend, Gove, & Sroufe, 1979). Thus, it is likely that children high on resiliency may experience positive interpersonal relationships at school because they are able to flexibly problem-solve, work with others, and navigate their social worlds.

Our results are also consistent with findings from a substantial body of research showing that resiliency is linked to interpersonal or social competence in childhood and adulthood (e.g., Block & Kremen, 1996; Taylor et al., 2014; Van den Berg, Deutz, Smeekens, & Cillessen, 2017). Of note is Taylor et al. (2014)'s finding, in a longitudinal study of children from 3.5 to 7 years, that it was the direction of change in resiliency, not the starting or early levels of resiliency, which predicted children's social competence at 7 years of age. Thus, while resiliency is a trait that is influential in interpersonal or social-emotional competence and there is relatively high consistency in resiliency or adaptability across the lifespan (Roberts & DelVecchio, 2000), there also appears to be *phenotypic plasticity* in resiliency, or the ability to adapt phenotype over time to the conditions of specific environments (Belsky & Pluess, 2013; Belsky & Pluess, 2009; Taylor et al., 2014). In other words, trait resiliency changes or develops in different ways for different individuals in different environments or contexts.

From Resiliency to Academic Resilience through Interpersonal Relationships

In our sample of primary school students who scored below the median on a state approved district-administered literacy exam when they started primary school, our findings suggest that peers tend to like and prefer to associate and work with children who are high on resiliency and who are interpersonally or socially competent. In addition, positive peer relationships mediated the influence of early resiliency on future academic resilience, or performance on a standardized reading (but not math) test in the third year of primary school. It is likely that children high on resiliency are able to flexibly problem-solve and work effectively with others in the classroom. Thus, our findings offer some support for the Ecological and Dynamic Model of Transition (Rimm-Kaufman & Pianta, 2000) and Bronfenbrenner's bio-social-ecological systems model. In this sample of children who began school as struggling readers (or as weak on reading skills relative to their peers), those high on resiliency in first grade were likely to transition to the next grade and establish positive peer relationships, which then contributed to their academic resilience and success on the school subject that they were originally struggling with or relatively weak on two years earlier.

Peer relationships.—These findings are compatible with the view that peer relationships in the classroom could serve as effective learning resources such as motivation and support (Wentzel et al., 2010), and have implications for educational or classroom practices. For example, peer-mediated learning (PML) is a classroom-based practice where students work in pairs or in small groups to support one another and collaboratively learn with and from one another (Ladd et al., 2013). PML is commonly used in schools to enhance students' academic motivation, engagement, learning, and achievement, but the degree to which children benefit from PML may partly depend on their interpersonal skills to work collaboratively with others (Ladd et al., 2014). Future studies can examine whether children

high on resiliency are likely to benefit from PML practices and explore whether resiliency promote positive peer relationship that then offer students with social-emotional and academic support and benefits for academic motivation, learning, and achievement. It could also be that in order for PML practices to be effective or optimized, they need to be preceded by efforts to increase children's interpersonal or social-emotional skills.

It is unclear why positive peer relationships did not mediate the link between early resiliency and future math achievement. We speculate that it is likely because these students were identified as exhibiting early risk for reading (but not necessarily math) difficulties, and thus their range of improvement could be larger for reading than math. Our results suggest that peer support is the mechanism by which resiliency support children in overcoming early literacy risk and exhibiting academic resilience as evidenced by achieving in reading, a school subject that they were initially assessed as below average or relatively weak on. Additionally, a finding that peer relationships mediated the effect of resiliency on reading but not on math may reflect differences in the context in which reading and math are taught in the early primary grades. Not only is more time spent in the primary grades in reading than in math instruction, reading instruction typically involves more opportunities for classmates to interact with each other around reading than around math. Thus peer support may be more important to children's engagement in reading than in math (Blanton, Wood, & Taylor, 2007; Hughes, Dyer, Luo, & Kwok, 2009). Future research needs to examine whether positive peer relationships mediate the link between early resiliency and future achievement in math for children who are identified as exhibiting early risk for difficulties in math. Furthermore, the differential effects found for reading versus math underscore the importance of considering them as unique academic outcomes resulting from different individual and social processes, rather than combining reading and math measures as is often done in prior research (see Harlaar et al., 2012).

Teacher-student relationships.—The fact that no mediation effect was found with positive teacher-student relationships as a mediator between early resiliency and academic achievement was not entirely surprising. In a different study on this sample of children, positive teacher-student relationships moderated (not mediated) the relation between measures of child self-regulation (i.e., task accuracy) and both reading and math achievement (Liew, Chen, & Hughes, 2010); positive teacher-student relationships could be compensatory and offer children with difficulties with self-regulation an external source of motivation and regulation that facilitates their learning and achievement. In the present study, resiliency was related to measures of positive teacher-student relationships (i.e., warmth and low conflict); however, teacher-student relationships did not explain the associations between resiliency and reading or math achievement. Instead, positive peer relationships explained the link between early resiliency and future reading achievement. For children with early academic risk in reading, positive peer relationships likely enhanced their engagement in school and supported academic resilience or future achievement in reading. It is important to note that supportive teacher-student relationships in the elementary grades improve students' peer acceptance (Hughes & Im, 2016). Furthermore, classroom interventions that target teachers' positive interactions with children with poor self-regulation improve their peer acceptance (Mikami et al., 2013). In the Mikami et al. study,

teachers were coached in developing positive, one-on-one relationships with all children, but especially children with poor behavioral compliance, and to communicate “to the child and to peers that the teacher valued and enjoyed interacting with the child” (p. 105). Teachers were also encouraged to provide corrective feedback privately and to publicly praise children for strengths unrelated to problematic behaviors. Through such interventions, teachers can positively impact children’s peer relationships, which could give children more opportunities to practice and further improve their interpersonal skills. Vice versa, peer relations might affect teacher-student relationships, especially positive affect of the teacher for the student (Kiuru et al., 2015). Future studies need to continue exploring the roles that both teachers and peers play in children’s academic resilience and achievement and to develop and test interventions that enhance supportive classroom relationships.

Study Limitations and Future Directions

While this study had multiple strengths, including the use of longitudinal data across three years, teacher and peer informants on assessments of school-based interpersonal relationships, and psychometrically valid and reliable assessments of academic achievement, there were also several study limitations. One limitation is the fact that measures of child resiliency and teacher-student relationships were both assessed with teacher reports. Thus, the intercorrelations among measures of resiliency and teacher-student warmth and conflict are likely somewhat inflated because of shared- or common-method variance. The shared- or common-method variance between resiliency and positive teacher-student relationships makes the likelihood of finding mediation between resiliency and achievement through teacher-student relationships statistically difficult (even if such a mediation effect exists). Further, it should be noted that measures of teacher-student and peer relationships were taken at one point in time, and alternative explanations for the associations between resiliency and those relationships or between those relationships and achievement cannot be ruled out. While it is challenging to conduct naturalistic observations in the classroom, samplings of observed student-teacher and peer interactions, particularly during reading and math learning periods, may improve measurement of the qualities of those interpersonal relationships. Furthermore, while our tests of mediation were conducted on a longitudinal dataset with three waves of data, causal relations or directionality of influences cannot be determined and bidirectional influences could also exist. Nonetheless, our study results demonstrate the importance of early resiliency and peer relationships in overcoming early academic risk and exhibiting academic resilience and future academic achievement.

In conclusion, study results highlight that for children with early academic risk or adversity in reading, resiliency is a protective factor against future difficulties in reading and social-emotional competencies with peers play an important role in facilitating academic engagement and achievement in reading. Findings have implications for intervention and prevention of academic failure or school dropout for children at risk for academic difficulties through finding ways to improve or support children’s positive peer relationships at school or in the classroom. For example, strengthening children’s self-regulatory and social-emotional skills along with structuring children’s school or classroom environments to support positive peer relationships may be promising approaches for students with academic vulnerabilities. Because extant research shows that teachers and peers play different roles in

children's achievement, further research is needed to understand how interpersonal relationships and social-emotional competencies contribute to academic resilience, learning, and achievement.

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Figure 1.

Hypothesized longitudinal mediation model. X represents resiliency, M represents positive interpersonal relationships with teachers or peers, Y represents reading or math achievement. The bolded path is the time-specific indirect effect $ab_{X_1 \rightarrow M_2 \rightarrow Y_3}$. The dash lines are the within-wave correlations and adjacent correlations between resiliency and mediator and outcomes in the analyses.

Figure 2.

Illustration of longitudinal mediation models. Solid lines represent significant paths and dotted lines represent nonsignificant paths. Resiliency1 is resiliency in Year 1, Positive Teacher/Peer relation2 is teacher-student and peer relationships in Year 2, Read3 or Math3 is reading and math achievement in Year 3. From Resiliency1 to Positive peer relation2, two coefficients (i.e., 0.25 and 0.25) are listed, and they are for the Reading and Math models, respectively. * $p < .05$, ** $p < .01$.

Table 1.

Descriptive statistics and correlations amongst variables of major study variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
<i>Correlations</i>																					
1 Resiliency1	1																				
2 Warmth1	.73*	1																			
3 Conflict1 ^a	.67*	.65*	1																		
4 Peer Preference1	.41*	.28*	.27*	1																	
5 Peer Liking1	.46*	.35*	.31*	.69*	1																
6 Read1	.33*	.18*	.17*	.12*	.12*	1															
7 Math1	.20*	.13*	.15*	.07	-.05	.54*	1														
8 Resiliency2	.58*	.46*	.49*	.35*	.34*	.26*	.25*	1													
9 Warmth2	.41*	.41*	.38*	.22*	.24*	.12*	.15*	.73*	1												
10 Conflict2	.47*	.44*	.56*	.27*	.31*	.19*	.13*	.68*	.67*	1											
11 Peer Preference2	.38*	.29*	.31*	.35*	.37*	.10*	.08*	.42*	.28*	.31*	1										
12 Peer Liking2	.39*	.30*	.32*	.35*	.45*	.15*	.02	.42*	.26*	.30*	.72*	1									
13 Read2	.31*	.19*	.17*	.12*	.18*	.78*	.45*	.25*	.12*	.16*	.08	.11*	1								
14 Math2	.24*	.14*	.16*	.10*	.01	.49*	.76*	.27*	.18*	.15*	.10*	.02	.55*	1							
15 Resiliency3	.50*	.33*	.41*	.28*	.32*	.24*	.27*	.57*	.42*	.50*	.31*	.36*	.18*	.26*	1						
16 Warmth3	.37*	.28*	.31*	.19*	.23*	.15*	.16*	.43*	.37*	.39*	.17*	.22*	.07	.15*	.72*	1					
17 Conflict3	.45*	.38*	.52*	.18*	.22*	.18*	.15*	.46*	.37*	.56*	.22*	.19*	.13*	.19*	.67*	.56*	1				
18 Peer Preference3	.33*	.23*	.27*	.31*	.33*	.16*	.16*	.41*	.28*	.30*	.39*	.39*	.15*	.13*	.40*	.28*	.27*	1			
19 Peer Liking3	.35*	.23*	.25*	.25*	.42*	.16*	-.04	.35*	.22*	.27*	.36*	.50*	.16*	-.04	.35*	.27*	.21*	.69*	1		
20 Read3	.32*	.15*	.15*	.13*	.15*	.74*	.44*	.28*	.14*	.18*	.12*	.14*	.84*	.52*	.25*	.10*	.16*	.19*	.16*	1	
21 Math3	.29*	.17*	.22*	.09*	.02	.56*	.72*	.29*	.17*	.19*	.10*	.02	.56*	.80*	.27*	.14*	.19*	.15*	-.03	.59*	1
<i>Descriptive Statistics</i>																					
Mean	0.001	4.01	3.12	-0.10	3.40	96.49	100.79	0.00	3.93	3.16	-0.11	3.30	96.86	100.40	0.00	3.94	3.21	-0.15	3.17	95.44	100.62
SD	0.86	0.81	1.02	0.93	0.71	18.05	14.34	0.88	0.85	1.00	0.98	0.70	17.07	12.82	0.87	0.85	0.95	0.98	0.64	14.15	12.38

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	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Skewness	-0.19	-0.78	-1.22	-0.21	-0.37	0.25	-0.16	-0.34	-0.76	-1.28	-0.24	-0.16	-0.08	0.00	-0.30	-0.80	-1.26	-0.28	-0.09	-0.40	-0.01
Kurtosis	-0.46	0.24	0.67	-0.29	0.37	0.46	0.64	-0.21	0.07	0.77	-0.03	-0.32	0.17	0.68	-0.39	0.17	0.72	-0.31	-0.19	1.58	0.13
% Missing	10	11	10	24	23	3	4	21	21	21	26	26	12	12	30	30	30	21	21	15	15

Note:

^a Conflict is reverse coded.

* $p < .05$.

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Table 2.

Standardized Direct and Indirect Path Estimates of Resiliency to Academic Achievement

	Reading		Math	
	Est.	SE	Est.	SE
<i>Mediator (M): Teacher-student relationships</i>				
$a_{X_1 \rightarrow M_2}$	-0.10	0.12	-0.11	0.13
$a_{X_2 \rightarrow M_3}$	0.11	0.15	0.07	0.16
$b_{M_1 \rightarrow Y_2}$	0.09 [*]	0.02	0.12 [*]	0.03
$a_{M_2 \rightarrow Y_3}$	0.03	0.03	0.02	0.03
$ab_{X_1 \rightarrow M_2 \rightarrow Y_3}$	-0.003	0.004	-0.002	0.003
χ^2/df	102.19/32		141.27/32	
CFI	0.98		0.98	
RMSEA	0.05		0.07	
SRMR	0.06		0.07	
<i>Mediator (M): Peer relationships</i>				
$a_{X_1 \rightarrow M_2}$	0.25 ^{**}	0.05	0.25 ^{**}	0.05
$a_{X_2 \rightarrow M_3}$	0.23 ^{**}	0.05	0.23 ^{**}	0.05
$b_{M_1 \rightarrow Y_2}$	0.09 ^{**}	0.03	0.07 [*]	0.03
$a_{M_2 \rightarrow Y_3}$	0.07 ^{**}	0.02	0.03	0.03
$ab_{X_1 \rightarrow M_2 \rightarrow Y_3}$	0.02 ^{**}	0.01	0.01	0.01
χ^2/df	50.63/32		173.65/32	
CFI	0.99		0.96	
RMSEA	0.03		0.08	
SRMR	0.03		0.06	

Note:

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