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Teacher-student relationships and adult outcomes: Developmental cascades via

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Abstract

Longitudinal data were examined to test associations between teacher-student relationships and adult outcomes, as well as mechanisms underlying these associations. Results from the NICHD-SECCYD (N=1364; 52% male; 76% White; 13% Black; 6% Hispanic; 5% other; data collection took place in the U.S. beginning in 1991) revealed a complex set of findings. First, teacher-student conflict and closeness during early elementary school were associated with educational attainment, occupational prestige, arrest record, and risky behavior at age 26 (r=-.21-.17, ps<.01). Next, behavioral dysregulation during middle elementary school, but not executive function, mediated associations between teacher-student conflict and age 26 outcomes. Finally, behavioral dysregulation and end of high school functioning serially mediated associations between teacher-student conflict and adult outcomes. These findings showcase the relevance of teacher-student relationships for outcomes spanning two decades of development.

Keywords: Teacher-Student Relationships, Executive Function, Behavioral Dysregulation, Developmental Cascades

Lay Summary: Although previous research has shown the importance of early teacher-student relationships for children's short-term development, the present study extends these associations to adulthood. Specifically, using data from the NICHD Study of Early Child Care and Youth Development (NICHD-SECCYD), we found that teacher-student closeness and conflict during early elementary school were related to children's educational attainment, occupational prestige, arrest record, and risky behavior almost two decades later during adulthood. We also found that children's behavioral dysregulation in middle elementary school and their academic and behavioral functioning at the end of high school linked teacher-student conflict to adult outcomes. These results shed light on the persistent association between student-teacher relationships and several important developmental outcomes across childhood, adolescence, and adulthood.

Teacher-Student Relationships and Adult Outcomes: Developmental Cascades via Childhood Executive Function and Behavioral Dysregulation

Children's relationships with the adults in their lives play an important role in their development and well-being. Early relationships, typically studied in the family context, have been shown to shape children's social, emotional, and cognitive development during early childhood and beyond (Lamb & Lewis, 2011). As children transition to school, their relationships with teachers grow in salience, providing another important developmental context in which children can socialize and interact with adults. Research has shown that children's relationships with their teachers during early elementary school are related to several developmental outcomes across childhood and adolescence (e.g., Hamre & Pianta, 2001; Ansari et al., 2020). However, much less is known about long-term associations between early teacher-student relationships and important life outcomes during adulthood. Additionally, the developmental mechanisms underlying long-term associations between teacher-student relationships and adult outcomes have not been previously explored.

Therefore, in the present study, we examined longitudinal associations between teacher-child relationships during early elementary school and a host of educational, socioeconomic, and behavioral outcomes during early adulthood. We also tested a developmental cascade model spanning over twenty years of development to understand how two dimensions of teacher-student relationships (i.e., closeness and conflict) relate to adult outcomes. The developmental cascades framework seeks to understand how one domain of development (e.g., relationships) can influence distal outcomes through their sequential and cumulative effects on other proximal processes (e.g., cognition and behavior; Masten & Cicchetti, 2010). As such, we examined the mechanisms linking teacher-student relationships and adult outcomes, centering our analysis on

executive function and behavioral dysregulation during middle elementary school as well as academic and behavioral functioning at the end of high school using the NICHD Study of Early Child Care and Youth Development.

Teacher-Student Relationships, Executive Function, and Behavioral Dysregulation

Children's ability to regulate their thoughts and behavior is considered critical for their successful development and sets the stage for school-based learning and social functioning. These skills make up what is commonly referred to as self-regulation, which is a multidimensional construct that integrates the cognitive, emotional, and behavioral dimensions of control (Liew, 2012; Zelazo et al., 2016). The cognitive skills involved in self-regulation are commonly referred to as executive function (EF) and include working memory, inhibition (which includes both inhibitory control and sustained attention), and cognitive flexibility (Diamond, 2013). EF is theorized to support goal-directed thought and action by coordinating, sustaining, and shifting attention; suppressing reflexive responses to environmental stimuli; storing and processing verbal and visual information; and mentally projecting and manipulating complex information. These cognitive skills typically work together to support higher-order cognitive functions such as planning, reasoning, and problem solving (Diamond, 2013; Zelazo et al., 2016).

The behavioral dimensions of self-regulation, on the other hand, are the observable ways in which children control their behavior in everyday settings. (Liew, 2012). These skills enable children to manage their behavior and include the ability to resist engaging in inappropriate behavior, control impulses, follow rules, and override frustration to persist in challenging social and learning tasks (Blair & Raver, 2015). Despite the conceptual distinctions, the cognitive and behavioral dimensions of self-regulation are closely related. First, EF skills play an important

role in supporting children's outward behavior during early childhood. Specifically, theoretical models of self-regulation suggest that EF skills exert a "top-down" influence on children's ability to regulate their behavior, especially in stressful situations (Blair & Urshache, 2011). At the same time, children's temperamental reactivity plays an important role and is thought to exert a "bottom-up" influence on children's behavioral control (Duncan et al., 2011; Liew, 2012). Specifically, children's emotional reactivity can place demands on their EF capacity, which can affect their ability to regulate their behavior in demanding social and learning contexts. Behavioral dysregulation, therefore, is characterized by disruptions in both cognitive ("top-down") and emotional ("bottom-up") processes that underlie observable behavior (Blair & Raver, 2015; Duncan et al., 2017).

Extant research suggests that the quality of children's relationships with teachers is related to both EF and behavioral dysregulation during early elementary school (see Emslander al., 2025, and Xu et al., 2024, for recent meta-analyses). Like parent-child relationships, positive interactions with teachers are thought to serve a regulatory and scaffolding purpose for children's cognitive and behavioral development (Pianta, 1999). Specifically, positive relationships with teachers can help children manage their behavior, teach them coping skills in frustrating situations, and promote their cognitive development by providing a supportive classroom learning environment (Hamre & Pianta, 2001). This is particularly important as children progress through the early years of schooling, a developmental period marked by dramatic changes in cognitive and behavioral skills. In fact, research has shown that features of teacher-student relationships such as closeness (e.g., sensitivity, positive affect, responsiveness) and conflict (e.g., negative interactions, lack of warmth) are associated with the development of EF and behavioral dysregulation across elementary school. For example, McKinnon and Blair (2019)

found that teacher-student conflict during kindergarten was negatively associated with children's EF in first grade. Teacher-student closeness has also been shown to predict children's EF development and can also serve as a protective factor for children from disadvantaged backgrounds (Suntheimer & Wolf, 2020). Additionally, several recent studies, using nationally representative data, have linked both teacher-student conflict and closeness to measures of children's behavioral dysregulation during early elementary school (e.g., Ansari et al., 2025; Hajovsky et al., 2023).

Childhood Executive Function, Behavioral Dysregulation, and Developmental Outcomes

A large body of observational and experimental research spanning multiple disciplines has demonstrated the role of childhood EF and behavioral dysregulation for a range of important outcomes across the lifespan.

Childhood EF and Adult Outcomes: Although EF continues to develop into adulthood, there has been particular interest in childhood EF, given its rapid development during this period (e.g., Best & Miller, 2010). Several notable studies have linked childhood EF to developmental outcomes during adulthood. For example, McClelland and colleagues (2013) found that preschool sustained attention predicted adult educational attainment. Additionally, Ahmed et al., (2021) found that relative to other developmental periods, childhood EF was the strongest predictor of college attainment and behavioral control measured at age 26. EF has also been found to mediate associations between early sociodemographic risk factors and educational outcomes during adolescence and adulthood (Schmitt et al., 2023). In addition to this observational research, experimental studies have suggested that interventions targeting early EF development might impact long-term developmental outcomes. For example, Watts and colleagues (2018) reported positive long-term treatment effects of the Chicago School Readiness

program, a preschool EF intervention, on cognitive and academic outcomes during adolescence, providing some evidence of the causal links between childhood EF development and later outcomes.

Childhood Behavioral Dysregulation and Adult Outcomes: There is an equally large body of literature linking behavioral dysregulation during childhood and long-term developmental outcomes. For example, Koepp and colleagues (2023) found that attention and behavioral problems were associated with several important adult outcomes such as educational attainment, financial well-being, physical health, substance use, and time spent in jail, even after controlling for child and family characteristics. Recent experiments have provided some evidence that childhood behavioral dysregulation might also be causally related to long-term developmental outcomes. For example, Algan and colleagues (2022) found that children who participated in a childhood intervention that improved their behavioral regulation skills had higher educational attainment and employment, increased social group membership and marriage rates, and were less likely to engage in criminal activity during middle adulthood.

Developmental Cascades Linking Teacher-Student Relationships and Adult Outcomes

The developmental cascades framework posits that early experiences can influence distal outcomes via their cumulative and transactional effects on more proximal processes (Masten & Cicchetti, 2010). An important feature of this framework is that processes within one area of development can influence development in other domains to shape children's trajectories across the lifespan. These processes begin early in life, span multiple developmental systems, and accumulate over time to shape children's development (Ahmed et al., 2023). Researchers have applied developmental cascades to understand how adult-child relationships relate to important developmental outcomes across the lifespan. For example, Goodman et al. (2019) found that

parent–child relationships during childhood and adolescence were associated with antisocial behavior and depressive symptoms during adolescence, which in turn predicted romantic relationship problems during adulthood. Additionally, Paige and colleagues (2022) found that mother-child relationship quality mediated associations between maternal depression during childhood and adolescent substance use.

The developmental cascades framework has also been used to study associations between early childhood peer relationships and developmental outcomes via their cascading effects on child behavior and mental health (e.g., LoParo et al., 2023). In addition to parent-child and peer relationships, researchers have begun to apply this framework to study teacher-student relationships, however, few studies exist to date, and none that span multiple developmental stages. One recent study found that teacher-child relationships during adolescence mediated associations between aggression and internalizing problems in a prospective longitudinal sample of Swiss youth (Murray et al., 2021). However, the extent to which teacher-child relationship quality during childhood is associated with adult outcomes and the cascading mechanisms linking these constructs across childhood and adolescence is less understood. Here, we apply a developmental cascades framework to examine how two dimensions of teacher-student relationships during early elementary school (i.e., closeness and conflict) relate to outcomes during early adulthood.

Our adult outcomes of interest were educational attainment, occupational prestige, arrest record, risky behavior, and tobacco use, which were chosen for several reasons. First, a large body of research has shown that teacher-student relationships are associated with various academic outcomes (e.g., test scores, school grades, academic motivation, belonging and engagement; see Emslander et al., 2025, for meta-analysis) that can foster persistence in higher

education. There is also evidence that supportive teacher-student relationships can promote the development of children's interpersonal skills, adaptability, and prosocial behavior with peers, all of which can promote future success in the labor market (Hajovsky et al., 2023; Magro et al., 2025). Additionally, research has suggested that conflictual relationships with teachers are related to antisocial peer relationships, irresponsible behavior, and risk-taking (Rudasill et al., 2010; Wentzel, 2009). For example, Voisin and colleagues (2006) found that teacher-student closeness was associated with risky sexual behaviors among detained adolescents and Rudasill et al. (2010) reported early teacher-student conflict was linked to a host of risky behaviors during adolescence, including tobacco use, stealing, and gang involvement.

Finally, we focus on EF and behavioral dysregulation as developmental mechanisms linking teacher-student relationships to adult outcomes. Research has shown that that the quality of teacher-student relationships is related to EF skills and behavioral dysregulation across elementary school and into high school (Ansari et al., 2020; Emslander al., 2025). From a theoretical perspective, EF and behavioral regulation are considered skills that can help individuals plan and monitor the complex behavior involved in successful adult functioning. The ability to regulate one's attention, inhibit automatic responses to the environment, and engage in higher order planning may be important for success in higher education (Zelazo et al., 2016), can enable individuals to plan and consider the consequences of their behavior (Syngelaki et al., 2009), and can promote participation in a range of health related behavior, including substance use abstinence during adulthood (e.g., Gustavson et al., 2016). Behavioral dysregulation might also play an important role in these outcomes during adulthood. Specifically, research has linked attention and behavioral problems during childhood to a host of educational, socioeconomic, and behavioral outcomes during adulthood, (e.g., Koepp et al., 2023).

Current Study

The goals of the current study are to examine associations between teacher-student relationships during early elementary school and age 26 outcomes, as well as the cognitive and behavioral mechanisms underlying these associations across development. Specifically, we apply a developmental cascades framework to understand how close relationships with teachers are associated with children's EF skills and behavioral dysregulation during middle elementary school and the extent to which they are associated with outcomes at the end of high school and early adulthood. Based on previous research, we hypothesize that teacher-student closeness and conflict during early elementary school will be associated with children's EF and behavioral dysregulation in middle elementary school (Ansari et al., 2020; Emslander al., 2025), which in-turn will predict academic and behavioral functioning at the end of high school (Ahmed et al., 2019) and during early adulthood (Koepp et al., 2023; Schmitt et al., 2023). Aligned with the developmental cascades framework (Masten & Cicchetti, 2010), we hypothesize that EF and behavioral dysregulation, as well as end of high school functioning, will independently and serially mediate associations between teacher-student relationships and age 26 outcomes.

The present study builds on the existing research base by examining the direct and cascading effects of teacher-child relationships on adult outcomes as well as focusing on outcomes across five important domains of functioning during early adulthood: educational attainment, occupational prestige, arrest record, risky behavior, and tobacco use. We further build on the literature by testing both cognitive and behavioral mechanisms linking teacher-child relationships and developmental outcomes using a multi-informant approach (direct child assessments, and teacher, parent, and youth ratings) and modeling this developmental process using a large, national, and prospective longitudinal sample of participants. These research

questions were confirmatory in nature, and our hypotheses were guided by developmental cascades theory.

Method

Participants

Data were drawn from the NICHD Study of Early Child Care and Youth Development (SECCYD; 52% male; 76% White; 13% Black; 6% Hispanic; and 5% other). In 1991, researchers recruited mothers from 10 geographically diverse sites across the U.S, who were over the age of 18, spoke English, and delivered full-term, healthy babies. For a more thorough description of the full recruitment procedures, see NICHD Early Child Care Research Network (2002). Although the full sample of the SECCYD data set consisted of 1,364 children, attrition occurred over time (see table 1 for sample size across all study variables). After the end of NICHD sponsorship of the SECCYD, study investigators located study participants at the end of high school and then again at age 26 via email, telephone, and land mail.

Using these methods, the researchers were able to contact 875 of the original study participants who agreed, at age 15 years, to be contacted for follow-up studies. Of these, 779 agreed to participate during the end of high school follow-up study and 857 agreed to participate in the age 26 follow-up study. Two participants died, 4 participants were incarcerated, and 37 participants did not complete the survey for unknown reasons, resulting in 814 participants completing the Age 26 surveys. Age 26 participation rates by site were as follows: Wisconsin (99%), Massachusetts (98%), Washington (98%), Pittsburgh PA (96%), California (95%), North Carolina (95%), Arkansas (94%), Philadelphia PA (94%), Kansas (92%), and Virginia (89%). The SECCYD Phases I – IV (IRB HS#2006–5347), the End-of-High-School follow-up (IRB HS#2009-6811), and the Age 26 follow-up protocol (IRB HS#2017–3847) were reviewed and

approved by the Institutional Review Board at the University of California, Irvine. Data from Phases I – IV of the Study of Early Child Care and Youth Development (i.e., birth to 15 years of age) are publicly available at https://www.icpsr.umich.edu/icpsrweb/ICPSR/studies/21940/summary. Data from the end of high school and age 26 follow-up studies are not publicly available. The materials necessary to attempt to replicate the findings presented here are not publicly available. The analyses presented here were not preregistered.

Measures

Teacher-Student Relationships.

Teacher perceptions of their relationship quality with the study children were measured using the Student Teacher Relationship Scale (STRS; Pianta & Nimetz, 2001) every year between kindergarten and second grade (i.e., 3 reports). This scale asked teachers to rate their current relationship with the study participants on a 5-point Likert scale (1 = definitely does not apply to 5 = definitely applies). The STRS captured two dimensions of relationship quality: closeness and conflict. The closeness subscale measured warmth and positive communication between teachers and students using eight items (e.g., "I share an affectionate, warm relationship with this child"). The conflict subscale included seven items measuring negative teacher-student interactions (e.g., this child and I always seem to be struggling with one another"; Pianta & Nimetz, 2001). Both subscales have demonstrated high internal consistency and test-retest reliability (Pianta & Nimetz, 2001) and we observed excellent reliability for both conflict (alpha = .88 to .90) and closeness subscales (alpha = .85 to .86) across waves in the present sample. Like previous studies examining associations between teacher-student relationships and child outcomes (e.g., Ansari et al., 2020), we took an average of the closeness subscales between

kindergarten and second grade and the average of the conflict subscale reports between kindergarten and second grade to index the positive and negative aspects of teacher-student relationships across early elementary school. Although the ratings came from different teachers across waves, teacher-child conflict showed moderate stability across school years and teachers (inter-wave correlation r = .40 to .46, ps < .001). Teacher-child closeness also showed a similar degree of stability, albeit slightly weaker (r = .26 to .37, ps < .001). In instances where reports were missing for certain children in a given year, we took the average of available years.

Executive function.

Children's EF skills were measured in middle elementary school (i.e., 3rd and 4th grade). Participants were assessed in-person during the SECCYD lab visits. EF skills measured included short-term memory, inhibitory control, and sustained attention.

Short-term Memory. Short-term memory was assessed using the Woodcock-Johnson Psycho-Educational Battery—Revised Memory for Sentences task (Woodcock & Johnson, 1989) when children were in 3rd grade (M = 101.93, SD = 15.36). This task requires participants to store, maintain, and recall verbal information (Woodcock & Johnson, 1989). Specifically, children listened to words, phrases, and sentences and were asked to recall them in the same order in which they were presented. As children progressed through the task, the demand on their memory increased. Participants earned 2 points for accurately recalling an item, 1 point for partially correct responses (i.e., one error), and 0 points for responses with two or more errors (α = .90).

Inhibitory Control. The commission error rate from The Continuous Performance Task (CPT: Mirsky et al., 1991) was used to assess participant's inhibitory control during the 4th grade laboratory visits (M = 0.02, SD = 0.03). Participants were asked to press a button each time a

target stimulus (a chair) appeared and to not respond when non-target stimuli (e.g., butterfly, flower) appeared. This task included 22 blocks, each with 10 objects, and target stimuli were randomly presented twice within each block. The proportion of incorrect responses (errors of commission) to non-target stimuli was used to measure children's inhibitory control (e.g., Ahmed et al., 2019). The ability to override the automatic urge to respond to non-targets engages inhibitory control skills (e.g., Epstein et al., 2003; Mirsky et al., 1991). The CPT demonstrates sufficient test–retest reliability (r = .65–.74) and excellent construct and predictive validity (Epstein et al., 2003), and predicts measures of academic achievement and cognitive functioning during elementary school (Halperin et al., 1991).

Sustained attention. The omission error rate from The Continuous Performance Task (CPT: Mirsky et al., 1991) was used to index sustained attention during the 4th grade laboratory visits (M = 4.19, SD = 5.72). The omission error rate of the CPT task measures how well participants can deliberately focus their attention on stimuli, the inability of which (i.e., omission errors) measures lapses in sustained attention (Epstein et al., 2003). Commission errors (incorrect responses to non-target stimuli) and omission errors (failure to detect to target stimuli) have been shown to differentially predict important developmental outcomes (e.g., Ahmed et al., 2019), load onto distinct latent factors representing inhibitory control and attention (Epstein et al., 2003) and differentiate between inhibitory control and attentional deficits in children (e.g., Epstein et al., 2003).

Behavioral Dysregulation.

Behavioral dysregulation was measured using teacher and parent-reported items when children were in middle elementary school (i.e., third grade). Specifically, the items asked parents and teachers to rate their children/students' impulsive aggression *(*e.g., *"impulsive or*

acts without thinking"), hyperactivity/impulsivity *(*e.g., *"can't sit still")*, and *inattention/lack of persistence (*e.g., *"fails to finish things s/he starts")"*and were drawn from the Child Behavior Checklist (Achenbach, 1991) and an index of disruptive behaviors reflecting symptoms of Attention Deficit/Hyperactivity Disorder as defined by the Diagnostic and Statistical Manual-IV (American Psychiatric Association, 1994). Parent and teacher ratings of behavioral dysregulation were moderately correlated (Impulsive aggression: $r = .42$; Hyperactivity/impulsivity, $r = .47$; Inattention/lack of persistence, $r = .51$). Each of the items were standardized before averaging across parent and teacher ratings. Then, we ran a principal components analysis and extracted the first axis to create the behavioral dysregulation composite variable ($\alpha = .93$).

End of High School Variables.

Participants filled out the end of high school questionnaire using a Qualtrics survey. This survey took approximately one hour, but participants had the option of completing the surveys across multiple sessions. Paper versions of the survey were provided to participants who did not have internet access.

Academic standing. Participants answered questions about their high school grades, advanced coursework, and class rank (Vandell et al., 2016). For grades, adolescents were asked to report their typical grades on an 8-point scale comprising of the following options: mostly As, about half As and half Bs, mostly Bs, about half Bs and half Cs, mostly Cs, about half Cs and half Ds, mostly Ds, or mostly below Ds. These were scored 1 (*mostly below Ds)* to 8 (*mostly As)*.

For advanced coursework, participants reported the total number of honors courses taken (0 = *no honors classe*s, 1 = *1 honors class*, 3 = *2 or 3 honors classes*, 4 = 4 or more classes), the total number of advanced placement classes (0 = *no AP classes*, 1 = 1 *AP class*, 3 = *2 or 3 AP classes*, and 4 = *4 or more AP classes*, and whether they had taken a college course while in high

school (0 = no college courses, 1 = at least one college course). We summed these three reports to create a total amount of *advanced coursework,* which ranged from 0-9.

Class rank was reported using a 5-point scale, with 1 = *bottom 24%*, 2 = *bottom 25–49%*, 3 = *top 50–74%*, 4 = *top 75–89%*, 5 = *top 10%*. Previous research has found strong reliability between self-reports of typical grades and class rank with actual grades using school records (correlation = .77-.82; Kuncel et al., 2005). Academic standing was treated as a composite variable consisting of typical grades ($\lambda = 0.77$, $p < 0.001$), advanced coursework ($\lambda = 0.63$, $p < 0.001$), and class rank during high school ($\lambda = 0.79$, $p < 0.001$) with loadings determined through factor analysis. Distributions of the Academic Standing items and composite variable can be found in the supplemental materials (Figure S1).

Tobacco use. Participants reported how many cigarettes they had smoked in their lifetime (1 = none; 2 = 1 or 2; 3 = 3-10; 4 = 11-20; 5 = more than 20). We created a dichotomous variable to indicate whether the participant reported having smoked 20 or more cigarettes in their lifetime (1 = yes, 0 = no). This cutoff was used to establish whether participants used tobacco beyond brief experimentation.

Risky behavior. Participants answered questions about the frequency with which they engaged in 27 different risky behaviors during the past year using a three-point Likert scale, with zero indicating never and 2 indicating more than two times. Items included a wide range of behaviors from driving a car without a seatbelt, skipping school without permission, selling drugs, and engaging in physical violence against other people (Halpern-Felsher et al., 2005). We created a total score by summing the responses to each item across the 27-item scale.

Age 26 outcomes.

Participants filled out the age 26 questionnaire using a Qualtrics survey. This survey took

approximately one hour, with participants provided the option of completing the surveys across multiple sessions. Five participants completed paper version of the survey, which was mailed to their home address, as they did not have internet access.

Educational attainment. Participants reported their highest level of education ranging from no high school diploma, General Equivalency diploma (GED), high school diploma, some college but no college degree, associate's degree, bachelor's degree, some graduate school but no graduate degree, master's degree, and doctoral degree of any kind (Ph.D., MD., JD, etc.). Educational attainment was treated as a continuous variable, with a value of one representing no high school diploma, and a value of nine representing a doctoral degree (M = 4.98, SD = 1.70).

Occupational Prestige. To assess occupational prestige, a measure developed by the Monitoring the Future Project was used. Participants were given a list of 16 types of occupations and marked the occupation type which best described their primary job. Choices ranged from "custodian, maid, landscape worker, fishery worker" (scored as 1) "Registered nurse, school teacher, accountant, architect, or similar" (scored as 15), and "Lawyer, physician, dentist, scientist, college professor, or similar" scored as 16. The *Monitoring the Future* 16-point rankings correlate .92 with a recently validated index of occupational prestige developed by Hughes and colleagues (2024) in which 3076 adult respondents assigned prestige scores to 1029 jobs listed in the U.S. Department of Labor O*Net database as well as 22 broad occupation families. Previous research that used the Monitoring the Future scale, reported relations between marijuana use at age 18 and occupational attainment at age 28 (Schuster et al., 2001). Others have found self-reports of occupations to predict outcomes in adulthood including income, physical health, and job satisfaction (Bloome & Furey, 2020).

Arrest Record. Participants reported if they have ever been arrested using a 4-point Likert scale from 0 indicating never to 3 indicating three or more times. This variable was dichotomized for all analyses to indicate whether the participant had ever been arrested (1 = yes, 0 = no).

Tobacco use. Participants reported whether the participants currently use tobacco, including e-cigarettes (1 = yes, 0 = no).

Risky behavior. At age 26, participants were asked to answer questions about their risky behavior during the past year. Like the end of high school survey, this scale was on a three-point Likert scale and included a wide range of behaviors from driving a car without a seatbelt to engaging in physical violence. This measure of risky behavior was developed for the SECCYD, draws on research by Conger & Elder (1994), and reflects constructs included in many national, representative studies, including Monitoring the Future (Johnston, O'Malley, & Bachman, 2003), National Survey on Drug Use and Health, and the National Longitudinal Study of Adolescent Health (Resnick et al., 1997).

Analytic Strategy

The sample had varying amounts of missing data across the study waves, ranging from 0%-44% (see Table 1). Of the 1,364 children in the original sample, 814 (60%) participants reported their educational attainment at age 26, 806 participants (59%) reported their occupations, 806 participants (59%) reported their tobacco use, 804 (59%) reported their arrests, and 804 (59%) reported their engagement in risky behavior at age 26. Participants who participated in the age 26 follow-up study were more likely to come from families with higher maternal education, higher income, higher overall HOME scores, higher maternal sensitivity, more maternal work hours, and had higher scores on the Bayley Mental Development Index

during infancy and standardized measures of math and reading achievement during preschool. Participants who participated in the age 26 follow-up study also had lower prevalence during childhood of single parenthood and maternal depression. To account for this differential attrition, we employed full information maximum likelihood (FIML) estimation, which allows for the use of all available data and auxiliary variables. The demographic variables that significantly predicted missingness were entered in our models as auxiliary variables to reduce potential bias and to adhere to MAR assumptions (Enders, 2013).

To test our developmental cascade model, we fit a serial mediation model using Mplus version 8.10 (Muthén & Muthén, 1998–2017). Serial mediation permits the examination of direct and indirect effects through multiple, sequential mediators and assumes that associations between a set of independent and dependent variables operate through a chain of mediators across time (Preacher et al., 2007). As such, a series of direct and indirect paths from teacher-student closeness and conflict to age 26 outcomes via sequential mediators measured during middle elementary school (i.e., EF and behavioral dysregulation) and end of high school (i.e., academic standing, risky behavior, and tobacco use) were tested simultaneously in the same model. Teacher-student closeness and conflict were treated as separate composite variables, each of which included scores averaged from kindergarten through second grade. Behavioral dysregulation was treated as a mean composite variable consisting of adult ratings measured during third grade. EF was treated as separate and correlated components consisting of direct assessments of short-term memory, inhibitory control, and sustained attention measured during third and fourth grade.

End of high school academic standing was treated as a composite variable consisting of typical grades, advanced coursework, and class rank. End of high school tobacco use was treated

as a dichotomous variable and risky behavior was treated as a continuous variable. Age 26 educational attainment, occupational prestige, and risky behavior were treated as continuous variables, and age 26 arrests and tobacco use were both treated as dichotomous outcome variables. Indirect effects were estimated using the MODEL INDIRECT command in Mplus (Muthén & Muthén, 2017) using bias-corrected bootstrapping with 10,000 resamples (Hayes, 2009). The analysis described above were confirmatory in nature and our hypotheses were guided by developmental cascades theory.

Covariates.

Children's biological sex assigned at birth, children's race and ethnicity (White, Black, Hispanic, and Other), and their mother's total years of education when the child was 1 month of age were included as control variables in our serial mediation model. These covariates were chosen based on previous research demonstrating associations with children's developmental outcomes, particularly for EF and behavioral dysregulation (e.g., Ahmed et al., 2019; Korous et al., 2018; Matthews et al., 2009). We also included teachers' level of education and years of teaching experience, given their relevance for classroom practice (Early et al., 2007; Graham et al., 2020; Klassen & Chiu, 2010). Additionally, we addressed the clustering of data by controlling for study site using fixed effects. Specifically, we created dummy indicators and entered them into our path models to estimate fixed effect of study site. Finally, we adjusted the paths between teacher-student relationships and behavioral dysregulation and EF skills by including children's prior behavioral dysregulation measured during preschool as a covariate. This was done to address the possibility that ratings of teacher-child conflict reflected stable features of children's behavioral dysregulation across childhood (Hamre et al., 2008).

Results

Means, standard deviations, and number of observed participants for all study variables are displayed in Table 1. Bivariate correlations among the primary study indicators are presented in Table 2. Teacher-student closeness in early elementary school was significantly associated with college attainment ($r(781) = .12$, $p < .001$), occupational prestige ($r(773) = .13$, $p < .001$), risky behavior ($r(771) = -.11$, $p < .01$), and arrest record ($r(771) = -.10$, $p < .01$), but not with tobacco use ($r(773) = -.05$, $p > .05$), at age 26. Teacher-student conflict measured during elementary school was associated with lower educational attainment ($r(781) = -.19$, $p < .001$), and occupational prestige ($r(773) = -.21$, $p < .001$), as well as with more risky behaviors ($r(771) = .17$, $p < .001$), arrests ($r(771) = .12$, $p < .01$), and tobacco use ($r(773) = .11$, $p < .01$) at age 26.

Developmental Cascades Linking Teacher-Student Relationships and Adult Outcomes.

To test our developmental cascade model, we fit a serial mediation model to estimate the direct and indirect effects from teacher-student closeness and conflict to age 26 outcomes via separate and sequential mediators measured during middle elementary school (i.e., EF and behavioral dysregulation) and the end of high school (i.e., academic standing, risky behavior, and tobacco use). Standardized beta coefficients and standard errors of all significant direct effects are displayed in Figure 1. Standardized beta coefficients, standard errors, and 95% confidence intervals of all significant indirect effects are displayed in Table 3. Standardized beta coefficients, standard errors, and 95% confidence intervals of all direct effects are displayed in the supplemental materials (Table S1).

Direct Effects of Teacher-student Relationships on Developmental Outcomes

Higher teacher-student conflict during early elementary school was associated with higher behavioral dysregulation ($\beta = 0.33$, SE = 0.04, $p < .001$) and lower inhibitory control during middle elementary school ($\beta = -0.13$, SE = 0.05, $p < .001$) over and above children's

prior behavioral dysregulation in preschool and independent of child, family, and teacher-level covariates. Additionally, teacher-student closeness was directly associated with participants' academic standing at the end of high school (β = 0.10, *SE* = 0.03, p = .005). Finally, teacher-student conflict was negatively associated with occupational prestige (β = -0.13, *SE* = 0.04, p = 0.005) at age 26.

Indirect Effects of Teacher-Student Relationships on Age 26 Outcomes

Teacher-Student Relationships and Educational Attainment. We found that behavioral dysregulation during middle elementary school and academic standing at the end of high school sequentially mediated associations between teacher-student conflict during early elementary school and age 26 educational attainment (β = -0.023, *SE* = 0.007, $p < 0.001$). We also found that behavioral dysregulation during middle elementary school and risky behavior at the end of high school sequentially mediated associations between teacher-student conflict and age 26 educational attainment (β = -0.006, *SE* = 0.003, p = 0.040). Finally, we found that behavioral dysregulation and tobacco use at the end of high school sequentially mediated associations between teacher-student conflict and age 26 educational attainment (β = -0.010, *SE* = 0.004, p = 0.006). Additionally, academic standing at the end of high school mediated associations between teacher-student closeness during early elementary school and age 26 educational attainment (β = 0.032, *SE* = 0.012, p = 0.009).

Teacher-Student Relationships and Age 26 Occupational Prestige. We found that behavioral dysregulation during middle elementary school and academic standing at the end of high school sequentially mediated associations between teacher-student conflict during early elementary school and age 26 occupational prestige (β = -0.018, *SE* = 0.006, p = 0.001). Academic standing at the end of high school mediated associations between teacher-student

closeness during early elementary school and age 26 occupational prestige ($\beta = 0.025$, $SE = 0.010$, $p = 0.015$).

Teacher-Student Relationships and Age 26 Arrest Record. We found that behavioral dysregulation during middle elementary school mediated associations between teacher-student conflict during early elementary school and age 26 arrests ($\beta = 0.042$, $SE = 0.017$, $p = 0.016$). We also found that behavioral dysregulation during middle elementary school and risky behavior at the end of high school sequentially mediated associations between teacher-student conflict during early elementary school and arrests at age 26 ($\beta = 0.010$, $SE = 0.005$, $p = 0.030$). Additionally, found that behavioral dysregulation during middle elementary school and tobacco use at the end of high school sequentially mediated associations between teacher-student conflict and age 26 arrests ($\beta = 0.012$, $SE = 0.005$, $p = 0.021$).

Teacher-Student Relationships and Age 26 Risky Behavior. We found that behavioral dysregulation during middle elementary school and risky behavior at the end of high school sequentially mediated associations between teacher-student conflict and age 26 risky behavior ($\beta = 0.011$, $SE = 0.005$, $p = 0.020$).

Teacher-Student Relationships and Age 26 Tobacco Use. We found that behavioral dysregulation during middle elementary school and tobacco use at the end of high school sequentially mediated associations between teacher-student conflict and age 26 tobacco use ($\beta = 0.013$, $SE = 0.005$, $p = 0.017$). We also found that behavioral dysregulation during middle elementary school and academic standing at the end of high school sequentially mediated associations between teacher-student conflict and age 26 tobacco use ($\beta = 0.011$, $SE = 0.004$, $p = 0.007$). Additionally, we found that academic standing at the end of high school mediated teacher-student closeness and age 26 tobacco use ($\beta = -0.015$, $SE = 0.007$, $p = 0.031$).

Sensitivity Analysis. We conducted a sensitivity analysis in which we excluded the teacher-reported CBCL data from adult ratings of children's behavioral dysregulation to help rule out shared method variance between the teacher reports of teacher-student relationships and children's behavioral dysregulation. The strength of associations between teacher-student relationships and children's developmental outcomes was attenuated and the indirect pathway from teacher-student conflict to adult arrest record via childhood behavioral dysregulation became non-significant ($\beta = 0.018$, $SE = 0.010$, $p = 0.075$). However, all the other findings were interpretively unchanged (see Figure S2, for direct effects and Table S2, for indirect effects).

Discussion

The goals of the present study were to examine longitudinal associations between teacher-student relationships during early elementary school and age 26 outcomes directly and through their cascading effects on children's cognitive and behavioral development during middle elementary school and end of high school. Three main findings emerged: 1) significant bivariate associations between teacher-student closeness and conflict during early elementary school and educational attainment, occupational prestige, arrests, and risky behavior at age 26, 2) behavioral dysregulation in middle elementary school consistently mediated associations between teacher-student conflict during early elementary school and age 26 outcomes, 3) behavioral dysregulation in middle elementary school as well as academic and behavioral functioning at the end of high school serially mediated associations between teacher-student conflict and age 26 outcomes. Together, these findings shed light on the short-and long-term associations between teacher-student relationships and a host of important developmental outcomes across childhood, adolescence, and early adulthood.

Teacher-Student Relationships and Adult Outcomes

Teacher-student conflict and closeness measured during early elementary school showed small-to-medium associations (ranging from r = -.21-.17, ps < .01) with age 26 educational attainment, occupational prestige, risky behavior, and arrest record. These long-term associations build on the existing research base in several ways. First, although longitudinal research has shown that teacher-student relationships during early elementary school are related to child outcomes through adolescence (Ansari et al., 2020; Hamre & Pianta, 2001; O'Connor et al., 2011), the present findings extend these associations into early adulthood. Secondly, although much of the literature has linked positive relationships with teachers to students' academic and social adjustment (see Emslander et al., 2025, for meta-analysis), our findings extend these links to consequential socioeconomic and behavioral outcomes during early adulthood. Even in our cascade model with the inclusion of behavioral dysregulation, EF, end of high school variables, as well as child and family-level covariates, teacher-student conflict during early elementary school continued to directly predict age 26 occupational prestige, pointing to the unique association between early teacher-student relationships and important long-term developmental outcomes. These persistent main effects corroborate a large body of literature pointing to the detrimental effects of conflictual relationships with teachers during early elementary school for later academic and behavioral development (e.g., Ansari et al., 2020; 2024; Emslander et al., 2025; Hamre & Pianta, 2001).

Teacher-Student Relationships and Adult Outcomes: The Role of Childhood Behavioral Dysregulation

Next, we estimated a serial mediation model to understand the developmental mechanisms underlying associations between teacher-student relationships and age 26 outcomes. We found that behavioral dysregulation in middle elementary school uniquely mediated

associations between teacher-student conflict and arrest record measured at age 26. These results add to prior work linking childhood behavioral dysregulation to a range of adult outcomes, including involvement in crime and arrest record (Koepp et al., 2023). Although we did not investigate mechanisms linking teacher-student conflict and behavioral dysregulation, both social and physiological mechanisms are plausible explanations. First, the experience of conflict with teachers may shape children's sense of themselves as "good" or "bad" students. With regular conflictual interactions in the classroom, children may begin to adopt an identity of a "troublemaker" (Shalaby, 2017) and then enact more of those behaviors. This may in turn lead teachers to treat children more harshly, creating a negative feedback loop.

Another possibility is that interpersonal conflict creates stress that gets "under the skin" to influence behavioral dysregulation (Blair & Raver, 2015). Children spend a great deal of their waking hours in classrooms with teachers. The typical US third grader spends 1,000 hours in classroom instruction during the year (NCES, 2018). It may be that stress from interpersonal conflict accumulates, with deleterious effects on neural systems involved in the control of behavior (i.e., prefrontal cortex; Blair & Raver 2015; McEwen & Morrison, 2013). Notably, both the social-identity and physiological-stress pathways could create cycles or feedback loops in which greater conflict leads to higher behavioral dysregulation, compounding the associations over time. However, there is some research that suggests that these pathways may be reversible through changes in experience (McEwen & Morrison, 2013).

Although teacher-student conflict was uniquely predictive of behavioral dysregulation, teacher-child closeness was not. Moreover, behavioral dysregulation did not significantly mediate associations between teacher-student closeness and any of the age 26 outcomes. This pattern of findings was somewhat surprising because warm, supportive relationships with adults

are thought to support behavioral adjustment and have been shown to be associated with several outcomes across development (Ansari et al., 2020; Sanders et al., 2014). However, there is some research to suggest that teacher-student conflict is more strongly associated with behavioral and self-regulation skills more broadly, whereas teacher-student closeness might be more promotive of interpersonal skills and academic achievement during early childhood (e.g., Hajovsky et al., 2023; Mason et al., 2017). Our pattern of results partially supports this notion, given the unique and persistent associations between teacher-student closeness and academic standing at the end of high school. However, future research should examine whether children's interpersonal skills with peers are differentially associated with dimensions of teacher-student relationships, and importantly, the extent to which they mediate long-term associations with important adult outcomes.

Teacher-Student Relationships and Adult Outcomes: The Role of Childhood Executive Function

We found that teacher-student conflict was uniquely associated with children's inhibitory control during middle childhood. This is aligned with studies linking teacher-student relationships high in conflict with lower inhibitory control during elementary school (Berry, 2012). Like its effects on behavioral dysregulation, it is possible that stress arising from conflictual relationships with teachers might affect children's neural and physiological systems involved in inhibitory control (Berry, 2010; Lupien et al., 2007). Specifically, research has shown that stress can impair inhibitory control via its effects of the parasympathetic nervous system (e.g., Roos et al., 2017). However, neither teacher-student conflict nor closeness were associated with children's short-term memory nor sustained attention in our developmental cascade model. Additionally, none of the EF measures during middle elementary school

mediated associations between teacher-student relationships and age 26 outcomes. Although we observed significant bivariate associations between both dimensions of teacher-student relationships, all three components of EF, as well as age 26 outcomes, when entered in our cascade model simultaneously, pathways from teacher-student relationships to age 26 outcomes operated entirely through children's behavioral dysregulation. The lack of association with children's EF skills ran counter to our hypotheses and was a departure from the literature, as recent studies and meta-analyses have linked teacher-student relationships with EF development across elementary school (McKinnon & Blair, 2019; Suntheimer & Wolf, 2020; Xu et al., 2024) and a large body of research have reported robust associations between childhood EF and a host of adult outcomes (e.g., Ahmed et al., 2021; Schmitt et al., 2023).

There are theoretical, measurement, and potentially methodological reasons for this pattern of findings. From a theoretical perspective, it is possible that teacher-student relationships are more relevant for the management of emotion and outward behavior compared to the neurocognitive skills measured by direct EF assessments. However, it is more likely that differences in measurement between EF and behavioral dysregulation are driving this pattern of results. Specifically, there has been a growing concern that direct EF assessments do not fully capture how children use EF skills in real world social contexts (Doebel, 2020) potentially obscuring the ways in which teacher-student relationships support EF skills in classroom settings. Moreover, given that teachers rated their students' behavioral dysregulation as well as their relationships with them, it is also possible that shared method variance partially explain the observed results. Future research directly comparing similar measures of EF and behavioral dysregulation could clarify the effects of teacher-student relationships on the behavioral and cognitive dimensions of self-regulation.

Developmental Cascades Linking Teacher-Student Relationships and Adult Outcomes

By virtue of following children for over two decades, we were able to test a developmental cascade model linking teacher-student relationships during early elementary school and age 26 outcomes. In doing so, we found that behavioral dysregulation during middle elementary school as well as academic and behavioral functioning at the end of high school serially mediated associations between teacher-student conflict during early elementary school and educational attainment, occupational prestige, arrest record, risky behavior, and tobacco use measured at age 26. These findings illustrate how academic success and broader adjustment at the end of high school set the stage for adjustment in early adulthood. In fact, we found that behavioral dysregulation was not directly associated with many of the age 26 outcomes but rather operated through academic and behavioral functioning at the end of high school. These findings are also in line with a broad literature linking behavioral dysregulation to academic outcomes (Blair & Raver, 2015) and risk-taking in adolescence (Schmitt et al., 2023) and draw a throughline to early adult outcomes. We found a slightly different pattern of results for teacher-student closeness. Specifically, academic standing at the end of high school significantly mediated associations between teacher-student closeness and age 26 educational attainment, occupational prestige, and tobacco use. However, neither behavioral dysregulation nor EF during middle elementary linked teacher-student closeness to later developmental outcomes. Although these findings suggest that teacher-student closeness is promotive of long-term developmental outcomes, it might not operate through children cognitive or behavioral dysregulation skills. Therefore, future research would benefit from examining the child-level characteristics that might link close relationships with teachers to long-term adaptation.

Taken together, the current findings provide additional empirical support for the

developmental cascades framework, which predicts that experiences during childhood can promote or hinder the development of later competencies to influence future outcomes (Masten & Cicchetti, 2010). In the present study, we found that teacher-student conflict was the strongest and most consistent predictor of age 26 outcomes via children's behavioral dysregulation and academic and behavioral functioning at the end of high school. It could be that conflict with teachers in the early years of schooling not only undermine behavioral dysregulation during early elementary school but also spill over to children's academic engagement and behavioral management in high school. This is consistent with research reporting associations between teacher-student relationship quality in elementary school and academic and behavioral adjustment during the transition to high school (Davidson et al., 2010).

These findings are also aligned with a large body of research demonstrating negative associations between teacher-student relationships high in conflict (e.g., discord, frustration, and anger) and a host of academic, social, and behavioral outcomes across childhood and adolescence (e.g., Ansari et al., 2020; Rudasill et al., 2010; Hamre & Pianta 2001; Voisin et al., 2006; Wentzel, 2009). Importantly, the present findings extend these associations to outcomes more than two decades later, spanning multiple important domains of adult functioning. Additionally, relative to EF, children's behavioral dysregulation consistently mediated longitudinal associations, suggesting that teacher-student relationships, conflict in particular, might be especially relevant for children's behavioral dysregulation during early elementary school, which has important theoretical and educational implications.

Limitations and Future Directions

There are important limitations to consider when interpreting the present study's findings. First, although the SECCYD is a prospective longitudinal sample, it lacked the experimental

manipulation needed to establish causal links between the study variables. Despite controlling for important child, family, and teacher-level covariates, it is possible that other unmeasured variables, such as children's general intelligence, or the home learning environment, confounded the short-and long-term associations between teacher-student relationships and the developmental outcomes examined in the present study (e.g. Niklas & Schneider, 2017; Schneider & Niklas, 2017; Schneider et al., 2014). Although longitudinal mediation is sometimes used to draw causal inferences, the present study is based on correlational data and the results should be interpreted in that light (see Rohrer et al., 2022, for review). Similarly, although the goal of the present study was to examine how early teacher-student relationships were associated with children's developmental outcomes, there is a growing body of evidence that suggests child-level characteristics (e.g., behavioral dysregulation), might also influence relationships with teachers across development and vice versa (e.g., Magro et al., 2025). As such, important future directions include examining how children's behavioral dysregulation and teacher-student relationships co-develop over time to influence children's outcomes and exploring how children's behavioral dysregulation at school entry might moderate associations between teacher-student relationships and adult functioning. Moreover, recent research has suggested that there might be sensitive periods during which relationships with teachers could be more or less consequential for children's development (e.g., Lee & Bierman, 2018). Therefore, another promising future direction of this research would be to examine whether fluctuations in teacher-student relationships relate to children's short and long-term outcomes.

Another limitation of the present study is the small-to-medium correlations between teacher-student relationships across measurement occasions. This might have been, in part, due to different teachers rating relationships with students across school years. This heterogeneity

between different raters likely introduced additional measurement error into our cascade models, reducing statistical power and the precision of our estimates. Thus, leveraging repeated teacher ratings across a single school year or ratings from the same teacher across grades is an important future direction of this research. Similarly, teachers rated children's behavioral dysregulation as well as their relationships with them which could have biased the results. Although the sensitivity analysis helped rule out issues related to shared method variance, future research would benefit from leveraging a more diverse set of teacher and child assessments (e.g., objective measures of behavioral dysregulation) to help reduce potential reporter bias and strengthen the generalizability of the findings across different assessment types.

Additionally, although this rich data set allowed us to follow children into adulthood, the child measures available to researchers more than three decades ago were limited. Specifically, despite being extensively validated, the EF and behavioral dysregulation measures used in the present study are dated. Moreover, the EF measures used in the present study were direct child assessments, whereas the behavioral dysregulation measures were adult ratings, which might have influenced the pattern of observed results. Future research should leverage more contemporary measures to clarify distinctions between EF and behavior dysregulation, as well as differential associations with teacher-student relationships and developmental outcomes. Relatedly, although the present study focused on a wide range of adolescent and adult outcomes, they were self-reported measures which are prone to social desirability and memory biases. Another limitation of the present study is the relatively young age at which adults were surveyed (age 26). It is likely that participants' educational, socioeconomic, and behavioral outcomes will continue to develop, which could have masked some of the longer-term effects of teacher-child relationships. Therefore, following participants into middle and late adulthood could provide

additional insight into the lifespan effects of positive teacher-child relationships during early childhood.

Finally, as with any longitudinal study spanning decades, there was attrition over time. Importantly, this longitudinal attrition was non-random and was predicted by several important demographic and home-level variables. Despite using modern missing data methods (FIML; Enders, 2013) to adjust for this non-random attrition and reduce bias, it is possible that other, unobserved characteristics might relate to missingness in the present sample. Although it is not possible to directly test this assumption, we acknowledge that the FIML methods used here cannot adjust for missing data attributable to unobserved characteristics and that the high rates of attrition can reduce statistical power, result in less stable parameter estimates, and impact the validity of the study's conclusions.

Conclusion

Taken together, we found persistent relations between teacher-student conflict, behavioral dysregulation, and a host of consequential life outcomes during early adulthood. Moreover, relative to EF, teacher-student relationships appeared more strongly related to children's behavioral dysregulation, suggesting that early relational aspects of the school context might be particularly important for supporting children's behavioral development, which in turn, was associated with several outcomes at the end of high school and at age 26. These findings have important implications for school-based interventions. Although there remains strong interest in designing classroom-based interventions that directly target children's EF skills and behavioral dysregulation (see Mattera et al., 2021), future studies might benefit from exploring interventions designed to support teacher-student relationships and their potential effects on children's cognitive and behavioral development during elementary school.

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Table 1
Means, Percentages, Standard Deviations, Range, and Missing Rate for Study Variables

Variable	*N*	M/%	SD	Min	Max	% Missing
Control Variables						
Female at birth	1,364	48%				0%
White	1,364	76%				0%
Black	1,364	13%				0%
Hispanic	1,364	6%				0%
Other	1,364	5%				0%
Maternal education	1,363	14%	2.51	7	21	0%
Preschool Behavioral Dysregulation						
Impulsive Aggression	1,060	0.01	0.55	-0.41	4.58	21%
Hyperactivity/Impulsivity	1,060	0.01	0.60	-0.65	2.72	21%
Inattention/Lack of Persistence	1,060	0.00	0.73	-0.90	2.86	21%
Early Elementary School Variables						
K-2 Teacher-Student Relationships						
Conflict						
Kindergarten	1,006	10.60	5.36	7	34	25%
First grade	1,007	10.92	5.17	7	35	25%
Second Grade	935	10.94	5.41	7	35	30%
Closeness						
Kindergarten	1,006	34.23	5.34	15	40	25%
First grade	1,006	33.96	5.04	12	40	25%
Second Grade	936	33.67	5.17	8	40	30%
Middle Elementary School Variables						
Executive function						
Working memory	1,013	494.85	14.48	409.00	539.00	24%
Sustained attention	928	4.19	5.72	0.00	58.00	31%
Inhibitory control	928	0.02	0.03	0.00	0.30	31%
Behavioral Dysregulation						
Impulsive aggression	1,060	0.01	0.55	-0.41	4.58	21%
Hyperactivity/impulsivity	1,060	0.01	0.60	-0.65	2.72	21%
Inattention/Lack of Persistence	1,060	0.00	0.73	-0.90	2.86	21%
End of High School Variables						
Typical grades	775	5.42	1.47	1	7	43%
Advanced coursework	770	3.62	2.83	0	9	44%
Class Rank	758	3.46	1.04	1	5	44%
Risky Behavior	768	7.67	6.32	0	46	44%
Tobacco Use	766	0.21	0.41	0	1	44%
Age 26 Variables						
College Attainment	814	5.24	1.63	1	9	40%

Occupational Prestige	806	9.62	5.3	1	17	41%
Arrest Record	804	0.2	0.4	0	1	41%
Risky Behavior	804	3.38	3.89	0	36	41%
Tobacco Use	806	0.08	0.27	0	1	41%

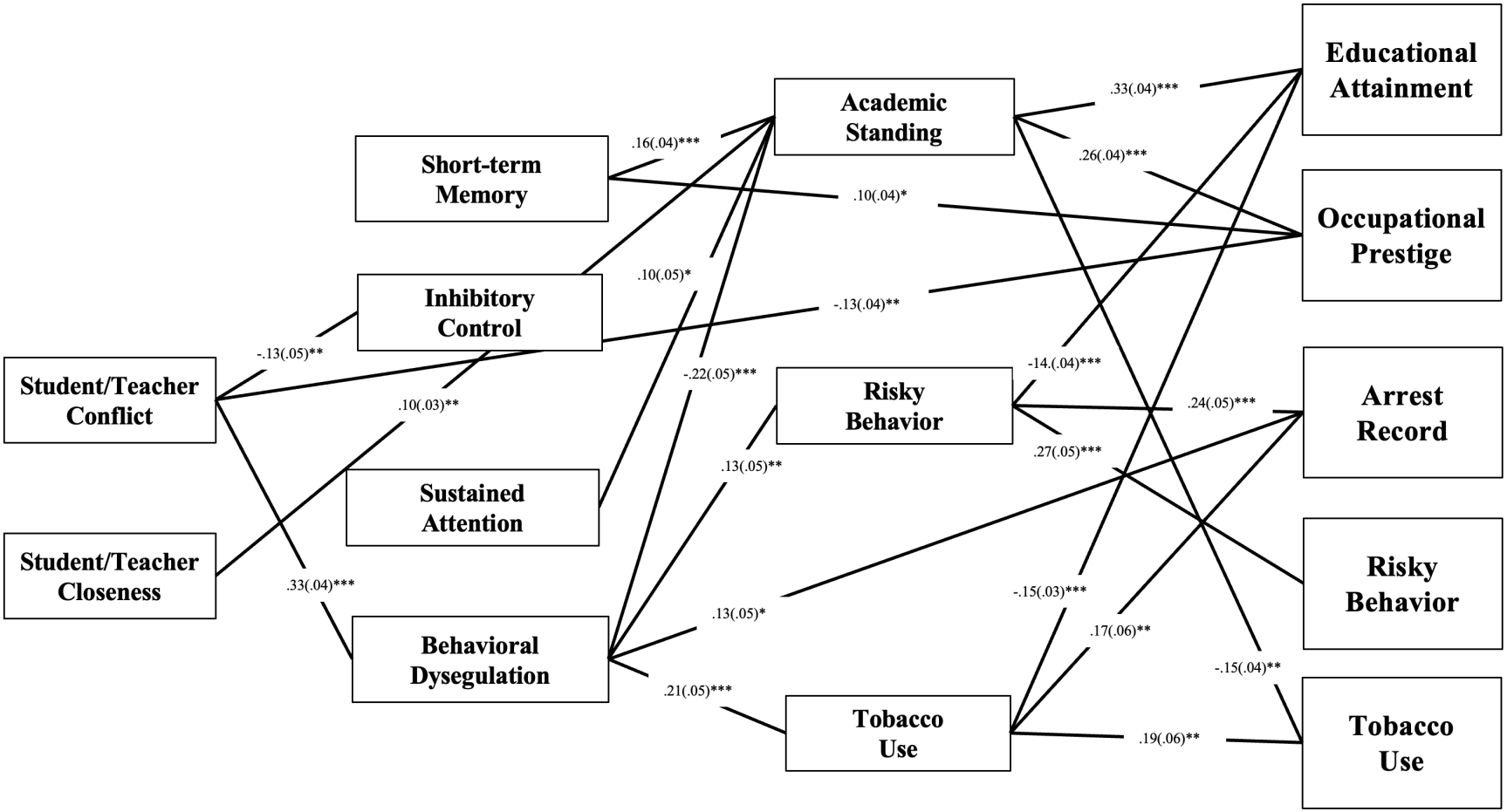
Note. N = the number of participants with observed data per variable

Table 2.
Correlations among Main Model Indicators

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Teacher-student conflict (Early Elementary)													
2. Teacher-student closeness (Early Elementary)	-.28***												
3. Short-term memory (Middle Elementary)	-.18***	.09**											
4. Inhibitory control (Middle Elementary)	.21***	-.08*	-.18***										
5. Sustained attention (Middle Elementary)	.19***	-.09**	-.25***	.36***									
6. Behavioral Dysregulation (Middle Elementary)	.52***	-.17***	-.21***	-.22***	-.19***								
7. Academic standing (End of High School)	-.21***	.20***	.31***	-.18***	-.24***	-.34***							
8. Tobacco use (End of High School)	.10**	-.04	-.04	.12**	.08*	.22***	-.27***						
9. Risky behaviors (End of High School)	.18***	-.11**	-.02	.14***	.04	.22***	-.30***	.45***					
10. Educational attainment (Age 26)	-.19***	.12***	.28***	-.22***	-.23***	-.34***	.54***	-.34***	-.35***				
11. Occupation prestige (Age 26)	-.21***	.13***	.26***	-.11**	-.15***	-.21***	.38***	-.15***	-.15***	.55***			
12. Risky behavior (Age 26)	.17***	-.11**	-.10**	.06	.13***	.17***	-.22***	.20***	.33***	-.24***	-.15***		
13. Arrest record (Age 26)	.12**	-.10**	-.06	.10**	.03	.24***	-.18***	.30***	.34***	-.31***	-.21***	.26***	
14. Tobacco use (age 26)	.11**	-.05	-.03	.04	.00	.12***	-.18***	.22***	.16***	-.17***	-.11**	.15***	.19***

Note. *$p < 05$. **$p < .01$, ***$p < .001$; Academic standing treated as a composite variable consisting of typical grades ($\lambda = 0.77$, $p < 0.001$), advanced coursework ($\lambda = 0.63$, $p < 0.001$), and class rank at the end of high school ($\lambda = 0.79$, $p < 0.001$). Behavioral dysregulation was treated as a composite variable consisting of adult ratings measured during 3rd grade. Short-term memory was measured during 3rd grade. Inhibitory control and sustained attention were measured during 4th grade. TS Closeness and TS Conflict = Separate composite variables consisting of teacher-student closeness and conflict subscales averaged across kindergarten through 2nd grade

Figure 1. Serial mediation model from teacher-student relationships to age 26 outcomes



Model fit Statistics: χ^2 (8) = 13.589, p = .093; CFI = .998; TLI = .928; RMSEA = .023; SRMR = .005

Note: *p < 05, **p < .01, ***p < .001; Solid lines represent significant direct effects. Displayed results are standardized regression estimates and standard errors. Teacher-student relationships were measured from kindergarten-2nd grade; Inhibitory Control, Sustained Attention and Behavioral Dysregulation were measured during 3rd grade and Short-term Memory was measured during 4th grade; College attainment, Occupational prestige. Arrest Record, Risky Behavior, and Tobacco Use were measured at age 26. Academic standing was treated as a composite variable consisting of typical grades, advanced coursework, and class rank at the end of high school. Missing data were handled using FIML. Covariates include preschool behavioral dysregulation, child's biological sex, child's race/ethnicity, maternal education, teacher education, teacher years of experience, and study site. Indirect effects were fit using bias-corrected bootstrapping with 10,000 resamples.

Table 3
Summary of Significant Indirect Effect Estimates for Models Predicting Age 26 Outcomes (N = 1,364)

		95% CI	
Predictor → Mediator(s) → Dependent Variable	***β (SE)***	***LB***	***UB***
TS Conflict → Behavioral Dysregulation →Academic Standing →Educational Attainment	-0.023(0.007)***	-0.039	-0.013
TS Conflict → Behavioral Dysregulation → Risky Behavior → Educational Attainment	-0.006(0.003)*	-0.013	-0.002
TS Conflict → Behavioral Dysregulation → Tobacco Use → Educational Attainment	-0.010(0.004)**	-0.020	-0.005
TS Closeness →Academic Standing → Educational Attainment	0.032(0.012)**	0.010	0.057
TS Conflict → Behavioral Dysregulation →Academic Standing →Occupational Prestige	-0.018(0.006)**	-0.032	-0.010
TS Closeness →Academic Standing →Occupational Prestige	0.025(0.010)*	0.007	0.048
TS Conflict → Behavioral Dysregulation → Risky Behavior → Age 26 Risky Behavior	0.011(0.005)*	0.004	0.024
TS Conflict → Behavioral Dysregulation → Academic Standing →Age 26 Tobacco Use	0.011(0.004)**	0.005	0.021
TS Conflict → Behavioral Dysregulation → Tobacco Use → Age 26 Tobacco Use	0.013(0.005)*	0.005	0.027
TS Closeness → Academic Standing → Age 26 Tobacco Use	-0.015(0.007)*	-0.032	-0.004
TS Conflict → Behavioral Dysregulation → Arrest Record	0.042(0.017)*	0.009	0.078
TS Conflict → Behavioral Dysregulation → Risky Behavior → Arrest Record	0.010(0.005)*	0.003	0.022
TS Conflict → Behavioral Dysregulation → Tobacco Use → Arrest Record	0.012(0.005)*	0.004	0.026

Note. *$p < 05$, **$p < .01$, ***$p < .001$. Reported *p-values* are for standardized regression estimates. CI = Confidence Interval, LB = Lower Bound, UB = Upper Bound. Indirect effects were fit using bias-corrected bootstrapping with 10,000 resamples.