Stereotype Threat in High School Classrooms:

How It Links to Teacher Mindset Climate, Mathematics Anxiety, and Achievement

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Author Note

The authors declare that they have no conflict of interest.

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Authors' Contributions

ES conceived the study**,** designed the theoretical model, performed the statistical analyses, interpreted the results, and drafted the manuscript; YL contributed to study design, provided the interpretation of the results, and edited the manuscript. All authors read and approved the final manuscript.

Data Sharing Declaration

The data that support the findings of this study are available at https://doi.org/10.3886/ICPSR37353.v3.

Conflicts of Interest

The authors report no conflict of interest.

Compliance with Ethical Standards

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Ethical approval

The current study is a secondary data analysis of the National Study of Learning Mindset. The approval for the National Study of Learning Mindset was obtained from the Institutional Review

Board at Stanford University (30387), ICF (FWA00000845), and the University of Texas at Austin (#20160310). All procedures performed in the study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent

All participating schools were given a choice to decide the level of parental communication among active permission, passive permission, and FERPA exception. All parents were informed of the study and provided the opportunity to withdraw their children from the study. Informed student assent was obtained from all participants. Detailed information about the data collection procedure is available at https://doi.org/10.3886/ICPSR37353.v3.

Abstract

As stereotype threat was initially examined in experimental settings, the effects of such threats have often been tested by temporarily manipulating social identity threats. This study expands the literature by examining 9th-grade adolescents' naturalistic stereotype threat, using data from the National Study of Learning Mindsets in the United States (n ~= 6,040, age: 13–17, M_{age} = 14.31, 6.9% Black boys, 6.5% Black girls, 13.1% Latinos, 12.3% Latinas, 31.5% White boys, 29.7% White girls). The results indicate that Black and Latinx students experience higher levels of stereotype threat in high school mathematics classrooms than do their White peers. When students perceive that their teachers have created fixed mindset climates, they experience greater stereotype threat. Stereotype threat, in turn, negatively Black and Latino boys and White girls' later achievement via anxiety. These findings highlight the importance of creating mathematics classrooms that cultivate a growth mindset and minimize social identity threat.

Keywords: stereotype threat, mindset, implicit theories, classroom climate, anxiety, mathematics achievement

Introduction

During adolescence, individuals tend to establish strong identities (French et al., 2006), while experiencing an increase in social and academic difficulties (Benner, 2011). These changes make adolescents especially vulnerable to environments that pose a threat to their social identities, such as stereotype threats (Aronson & Good, 2002). Despite the importance of adolescents' high school classroom experiences in shaping their long-term educational choices (Riegle-Crumb, 2006) and career decisions (Seo et al., 2019), previous studies often utilize a relatively small sample of college students (e.g., Ahlqvist et al., 2013). Very few studies have examined adolescents' naturalistic stereotype threats (e.g., Mendoza-Denton et al., 2008). Furthermore, stereotype threat research has mostly focused on comparisons between Black or Latinx participants and their White counterparts, or comparisons between White female participants and their White male counterparts (see Nguyen & Ryan, 2008 for a review). Almost no studies have compared Black or Latina female participants to Black or Latino male participants, even though naturalistic stereotype threats may have different implications depending on students' gender and racial/ethnic identities (Cole, 2009). To address these gaps in the literature, the current research examines adolescents' naturalistic stereotype threat dependent on race/ethnicity and gender, using a sample that represents the U.S. population of 9th-grade students in regular public high schools.

Manipulated Stereotype Threat and Achievement

Stereotype threat refers to a situational predicament in which individuals are at risk of affirming negative stereotypes associated with their social positions (Spencer et al., 1999). Stereotype threat research has shown that members of a negatively stereotyped social group may underperform on diagnostic tasks due to situational cues that cause them to worry they will confirm negative stereotypes about their group (Steele & Aronson, 1995). Several meta-analyses have found that stereotype threat impairs women's performance in mathematics test tasks (d = -.36, Nguyen & Ryan, 2008; d = -.24, Picho, 2013; g = -.22, Flore & Wicherts, 2015), while also harming the performances of Black and Latinx participants in academic or intellectual tasks (d = -.43, Nguyen & Ryan, 2008). Most of these studies have

been conducted in a setting in which participants' stereotype threats were experimentally manipulated.

Experimental manipulations of stereotype threats have an indisputable advantage in terms of internal validity. However, the prevalent use of manipulation-based designs limits the external validity of the results, when trying to understand the implications of adolescents' naturalistic stereotype threats. The experience of a naturalistic stereotype threat in a high school classroom setting can be vastly different from that of a manipulated stereotype threat in an experimental setting. For example, a large proportion of high school mathematics grades usually reflect performance in low-stake practice assignments, such as homework or exercises, rather than in high-stake diagnostic tests. However, stereotype threat effects have often been observed with diagnostic tasks (e.g., Huguet & Régner, 2007) or high-stake exams (e.g., Danaher & Crandall, 2008). Thus, it is unclear whether adolescents' experience of naturalistic stereotype threats translates into real-life outcomes, or outcomes that are meaningful to individuals, such as school grades (Stoet & Geary, 2012).

Naturalistic Stereotype Threat

Expanding upon initial laboratory work on temporary stereotype threats, a few field studies have examined individuals' naturalistic concerns about negative stereotypes, based on the rejection sensitivity model (Mendoza-Denton et al., 2002). The rejection sensitivity model posits that individuals with greater sensitivity to or concern over rejection based on their group membership may experience decreased motivation and performance in the relevant domain. Based on the rejection sensitivity model, previous field studies have examined the negative impact of rejection sensitivity on students' attitude toward education as well as on individual achievement among female undergraduate and graduate students, including undergraduate students majoring in science, technology, engineering, or mathematics (Ahlqvist et al., 2013), undergraduate students majoring in computer science (Cheryan et al., 2020), and students from a top law school (London et al., 2012, Study 5); other studies have been conducted using samples of Black and Latinx college students (Mendoza-Denton et al., 2002, 2008; Woodcock et al., 2012). The results showed that women (in math-related domains) and students of color (in math-related domains and/or predominantly White universities) experienced greater rejection sensitivity (Cheryan et al., 2020),

which in turn caused them to experience diminished motivation (Woodcock et al., 2012), a decreased sense of belonging (Mendoza-Denton et al., 2008), avoidance of opportunities (London et al., 2012), and poorer grades (Mendoza et al., 2002).

However, the aforementioned studies focus only on college students. Adolescents' experiences in high school mathematics classrooms are significant because they can set the trajectories for young individuals' educational choices (Riegle-Crumb, 2006) and career decisions (Seo et al., 2019). Additionally, high school mathematics classrooms are vastly different from college classrooms in terms of teacher–student relationships, teaching methods, and classroom culture (Venezia & Jaeger, 2013). These varying environmental characteristics can distinctively shape an individual's s experience of stereotype threat (Murphy & Taylor, 2011). Only a few studies have delved into how adolescents experience stereotype threats in quasi-ordinary (e.g., Huguet & Régner, 2007) or authentic mathematics classrooms (e.g., Danaher & Crandall, 2008). However, these studies manipulated stereotype threat rather than observing naturalistic experiences. The current literature on stereotype threat suggests a need to examine adolescents' naturalistic stereotype threats in high school classrooms.

The Mechanisms of Naturalistic Stereotype Threat: Anxiety

Many studies have examined the potential mechanisms underlying the effect of stereotype threats on task performance in laboratory studies (see Pennington et al., 2016 for a review). The current study focuses on mathematics anxiety as a potential mediator of the association between stereotype threat and mathematics achievement. Anxiety is one of the most studied mechanisms of stereotype threat effects (Aronson & McGlone, 2009). Stereotype threat elicits anxiety mainly because individuals worry about becoming a living confirmation of a negative stereotype about their ethnic group (Steele & Aronson, 1995), and turn their focus to avoiding failure rather than achieving success (Aronson & McGlone, 2009), which ultimately may increase anxiety levels (Putwain & Symes, 2012). Furthermore, anxiety is one of the core dimensions of mental health (Headey et al., 1993), and mathematics anxiety, in particular, is closely linked to career achievement potential in mathematics-related domains (Foley et al., 2017).

Several empirical studies have found that stereotype threats elicit physiological reactance

(Osborne, 2007), somatic anxiety (Laurin, 2013), and affective anxiety (Chung et al., 2010). However, other studies have failed to find evidence of anxiety as a mediator (Mayer & Hanges, 2014; Tempel & Neumann, 2003). Spencer et al. (1999), for example, found that anxiety was not a statistically significant mediator of the effect of stereotype threat on test scores. Rather than concluding that anxiety was not a mediator, however, the researchers pointed out the limited statistical power of their study due to having a sample of only 34 female undergraduate students, while recommending that future efforts replicate the findings with a larger sample

The Antecedent of Naturalistic Stereotype Threats: Teacher Mindset Climate

If stereotype threat is associated with mathematics anxiety and impaired performance, one important question to ask is: which characteristics of the high school classroom predispose adolescents to experiencing stereotype threats? Previous studies have often manipulated task descriptions to elicit stereotype threat among participants, such as by telling participants that "women obtain lower scores than [men]" (Cadinu et al., 2003, p. 272). In naturalistic classrooms, these messages may be delivered via the beliefs and behaviors of others. Research documents that individuals with less power tend to look for cues from the powerful who determine their outcomes (Fiske, 1993). In classrooms, teachers play the most powerful and authoritative role as they lead and evaluate students. Although teachers are not the only source of feedback, students rely heavily on their teachers' remarks and behaviors to determine whether they are "cut out" to perform a certain task (Muenks et al., 2020).

The current study focuses on the teacher-mindset climate, among other aspects of teacher beliefs and behaviors. A fixed (contrary to growth) mindset refers to the belief that personal traits are fixed (instead of malleable) (Dweck, 1999). Compared to adolescents with a fixed mindset, those with growth mindsets tend to have stronger motivation and persistence (Lee & Seo, 2019; Seo et al., 2019), especially in the face of challenges (Burnette et al., 2013). Furthermore, Good et al. (2003) demonstrated that 7th-grade female students who were encouraged to view intelligence as malleable scored significantly higher in mathematics standardized tests compared to their peers.

In school, mathematics teachers may create a climate that promotes a fixed mindset by displaying

certain beliefs (e.g., acknowledging that some children are smart and others are not) and behaviors (e.g., giving special treatment to a few students who are good at math) that send students signals that mathematical ability is unchangeable (Meyer et al., 2015). Imagine a female student in a fixed mindset climate where innate ability is valued. The student would be more likely to become concerned with the stereotypes associated with her gender identity (e.g., "girls are inherently bad at math"). By contrast, if the student perceives the climate as growth mindset-oriented (e.g., teachers believe all students have the potential to succeed), the negative stereotypes associated with her gender identity would not have as much of a negative effect.

No research has directly examined the link between the teacher mindset climate and stereotype threat experiences in high school mathematics classrooms, but there has been indirect evidence of an association. For example, Reich and Arkin (2006) showed that when participants believed that their evaluators had a fixed mindset, they experienced greater self-doubt. Similarly, Muenks et al. (2020) found that college students' perceptions of their professors' mindset predicted their psychological vulnerability. Finally, Canning et al. (2019) found that when faculty members firmly believed that intelligence is fixed, their classroom showed greater racial achievement gaps favoring Asian and White students over Black, Latinx, Native American, Native Alaskan, Native Hawaiian, and Pacific Island students. Together, the extant empirical evidence indicates that teacher-mindset climates could be linked to students' experiences of stereotype threat.

The Joint Consideration of Race/Ethnicity and Gender

Stereotype threat research has long focused on comparing Black or Latinx participants to their White counterparts, or comparing White female participants to their White male counterparts (see Nguyen & Ryan, 2008 for a review). Studies have rarely compared Black/Latina[1] female participants to Black/Latino male participants. However, naturalistic stereotype threats may have different implications at the intersection of students' gender and their racial or ethnic backgrounds (Cole, 2009). For example,

[1] In the current research, Black/Latinx refers to individuals with a Black or Latinx identity, not those with both Black and Latinx identities.

male identity is not associated with negative stereotypes in mathematics (Walton & Cohen, 2002), but Black/Latino male students are more negatively stigmatized than Black/Latino female students in naturalistic settings (Chavous et al., 2004). As such, Black/Latino male students may be more vulnerable to stereotype threat and identity-threatening classroom environments. However, due to the lack of empirical evidence, it is unclear how multiple social identities influence adolescents' experience of stereotype threat in high school mathematics classrooms. Thus, the current study examined adolescents' experiences of stereotype threat in their high school mathematics classrooms based on race/ethnicity and gender.

Current Study

This study answers three main research questions. First, do students experience different levels of stereotype threat in their mathematics classrooms based on their social identity? Regarding racial/ethnic differences, it was hypothesized that Black/Latinx youth would experience greater stereotype threat than White youth. Regarding gender differences, it was hypothesized that Black/Latino boys would experience greater stereotype threat than Black/Latina girls based on research evidence showing the prevalent negative stereotypes surrounding young men of color in the United States. For White students, it was expected that girls would experience greater stereotype threat than boys. Supplemental analyses also compared other groups (e.g., Black/Latino boys vs. White girls); however, due to the lack of prior empirical evidence and theoretical discussion, this analysis is explorative.

The second research question is: to what extent is the teacher mindset climate associated with students' experience of stereotype threat in classrooms? Students were expected to experience greater stereotype threat in their high school mathematics classrooms when they perceived their teachers believed mathematical ability was fixed. Furthermore, the teacher mindset climate was expected to play a more significant role in the experience of stereotype threat among adolescents with negatively stereotyped social identity (e.g., Black/Latino boys) than those with positively stereotyped social identity (e.g., White boys).

The final research question was: does adolescents' naturalistic stereotype threat in high school

mathematics classrooms predict their mathematics achievement, and is this association mediated by mathematics anxiety? Based on the rejection sensitivity model, it was hypothesized that naturalistic stereotype threat would positively relate to mathematics anxiety, which, in turn, would negatively predict future mathematics achievement. It was also expected that the negative association between stereotype threat and mathematics anxiety would be stronger among adolescents with negatively stereotyped social identity (e.g., White girls) than among those with positively stereotyped social identity (e.g., White boys).

Methods

Data Source and Participants

The sample was culled from the National Study of Learning Mindsets (NSLM; Yeager, 2019). During the 2015–2016 academic year, 9th-grade students from one of the 65 public high schools in the United States participated in the study. Initially, 139 regular public schools were randomly sampled and invited to participate in the study. Regular U.S. public high schools included schools serving grades 9–12 and excluded charter and private schools, schools with specialized missions or populations (e.g., "suspension" schools or schools for people who are visually impaired), schools with fewer than 25 9th graders, and schools that do not have the 9th grade as their lowest grade. These regular public high schools educate more than 80% of 9th grade students in the United States. Among the invited schools, 65 schools agreed to provide student records. Gopalan and Tipton (2018) found that the sample was representative of 9th-grade students in the U.S. regular public high schools in terms of socioeconomic status, achievement level, and proportion of female students and students of color.

Students were randomly assigned to either an intervention group or a control group. The session took approximately thirty minutes (median = 26.21 minutes). Demographic information and baseline psychological characteristics were collected 1–4 weeks before the intervention or control activities. The present study included a subsample from the NSLM, which consisted of Black, Latinx, and White participants in the control group who were not exposed to the intervention. The present research focuses on participants in the control group because it aims to assess the effects of naturalistic stereotype threats that were not influenced by intervention messages (i.e., neural plasticity), and NSLM assessed

mathematics stereotype threats after administering intervention or control activities. Participants in the control condition learned about the localization of brain functions (e.g., occipital, frontal, parietal, and temporal lobes) in their school computer labs and completed the surveys immediately after the activity.

This study also focuses on Black, Latinx, and White participants because the proportions of other racial/ethnic groups in the dataset were too small (< 5%) for multi-group analyses. The three racial/ethnic groups have historically represented the three largest racial/ethnic groups in the United States (United States Census Bureau, 2019) and are the most commonly studied in stereotype threat literature (Nguyen & Ryan, 2008). The inclusion criteria resulted in a sample size of approximately 6,040 students (6.9% Black boys, 6.5% Black girls, 13.1% Latinos, 12.3% Latinas, 31.5% White boys, and 29.7% White girls). All sample sizes were rounded to the nearest tenth digit in this study to prevent deductive disclosure.

Measures

The key variables, namely, teacher mindset climate, stereotype threat, and mathematics anxiety, were all measured–2–13 weeks after the semester began. The preferred target date of the survey completion was 2–7 weeks after the semester began. Students' grade point averages (GPAs) were collected via institutional records at the end of each semester (see Yeager, 2019, for details).

Teacher mindset climate. The current research focused on adolescents' perceptions of the teacher mindset climate based on previous research that suggests classroom climates that influence students' experience are the students' subjective experiences of their classrooms, rather than some objective reality (Patall et al., 2018). Students' perceptions of the teacher mindset climate were measured using three[2] items ("*My math teacher thinks that some kids are smart and others are not*," "*My math teacher seems to believe that only a few students will understand the hardest problems*," and "*My math teacher seems to like you better if you are good at math*"). These items reflect the climate-level entity theory of intelligence

[2] There were two additional items available in the dataset: 1) "My math teacher believes that everybody in my class can be very good at math" (reverse-coded), and 2) "My math teacher seems to believe students can't really change how smart they are." These two items were removed from the analysis after examining their measurement properties but before analyzing the data to test the hypotheses. These items lowered overall reliability and had a relatively low standardized factor loading in a confirmatory factor analysis ($\beta s < .50$). Compared to the three included items, the two excluded items may be difficult for students to judge.

and encompass teachers' attitudes and behaviors that value inherent ability (Murphy et al., 2018). All items had standardized factor loadings above .60. Students answered these questions based on a five-point scale ranging from *not at all true* (1) to *extremely true* (5). Values were coded so that higher scores indicated stronger perceptions of a fixed mindset climate. The overall reliability of the three items was $\alpha_{total} = .75$ ($\alpha_{Black\ girls} = .74$, $\alpha_{Black\ boys} = .75$, $\alpha_{Latina} = .75$, $\alpha_{Latino} = .75$, $\alpha_{White\ girls} = .76$, $\alpha_{White\ boys} = .75$).

To ensure the measurement invariance of the latent variable (i.e., teacher mindset climate), configural (invariant form), metric (invariant factor loadings), and scalar (invariant intercepts) invariance tests were performed using model constraints and the Satorra and Bentler (2001) scaled chi-square difference test. The results of measurement invariance showed that the three items of the teacher mindset climate showed adequate measurement invariance across (1) Black girls and Latinas; (2) Black boys and Latinos; (3) White girls; and (4) White boys (configural vs. metric: Satorra & Bentler $\Delta\chi^2(6) = 11.63$, $p = .07$; metric vs. scalar: Satorra & Bentler $\Delta\chi^2$ (6) = 10.80, $p = .10$). The final scalar invariance measurement model's fit indices were $\chi^2(12) = 22.37$, $p = .03$, comparative fit index (CFI) = .98, root mean square error of approximation (RMSEA) = .03 [90% confidence interval, CI: .01, .04].

Mathematics stereotype threat. Students self-rated their worries and concerns about mathematics stereotypes, using two items: *"In math class, how much do you worry that people's judgments of you will be affected by your gender?" In math class, how much do you worry that people's judgments of you will be affected by your race or ethnicity?"* The items were similar to those used in prior research (e.g., "In testing situations, I worry that people will draw conclusions about me based on what they think about my ethnic group," Chung et al., 2010; see also Marx et al., 2005). These items were asked based on a five-point scale ranging from *1 (not at all*) to 5 *(an extreme amount*). The current research used the average scores of the two items to assess the overall experience of stereotype threat in mathematics classrooms. It is important to consider both gender and racial/ethnic stereotypes when examining Black and Latinx students' experience in classrooms, because being a "boy" or "girl" has a significantly different meaning for Black and Latinx students as compared to White students (Cole, 2009). In support of the decision to use the aggregated scores, the two items were highly correlated ($r_{total} = .67$; $r_{Black\ boys} = .71$, $r_{Black\ girls} = .66$,

r_{Latino}= .70, r_{Latina} = .65, $r_{White\ boys}$ = .72, $r_{White\ girls}$ = .56), and the reliability across the two items was adequate (α_{total} = .79; $\alpha_{Black\ boys}$ = .79, $\alpha_{Black\ girls}$ = .81, α_{Latino}= .83, α_{Latina} = .77, $\alpha_{White\ boys}$ = .84, $\alpha_{White\ girls}$ = .71). Supplementary analyses utilized the scores for each item separately.

Mathematics anxiety. Students' mathematics anxiety was assessed using the item, "*In general, how much does the subject of mathematics in high school make you feel nervous, worried, or full of anxiety*?" based on a five-point scale from *1 (not at all*) to 5 (*an extreme amount*). Anxiety has often been measured with a single item with evidence of adequate validity and reliability in the extant literature (e.g., Goetz et al., 2016; Seo & Patall, 2020). Research has also suggested that asking participants to respond to a longer measure of emotion could induce unnecessary reflections and result in the measurement of emotions toward answering the questionnaire (Goetz et al., 2010). Accordingly, the NSLM used a single item to assess students' mathematics anxiety.

Mathematics achievement. Students' mathematics achievement was measured using the institutional records of students' mathematics course GPA. GPA in the entire 9th grade was included as an outcome for students who participated in the study in the fall semester. Some schools completed the stereotype threat survey in the fall semester of the 9th grade, and other schools completed the survey in the spring semester. For students who participated in the study during their spring semester, only the spring semester mathematics course GPA was included as an outcome to ensure temporal precedence of the focal variables. This is in line with the pre-registration of a previous study that utilized the same data (Yeager et al., 2019).

Covariates. To control for potential confounding effects, previous mathematics achievement, mathematics course level, and family socioeconomic status were included as covariates. *Previous mathematics achievement* was measured based on the institutional records of students' mathematics grades in the 8th grade. *Mathematics course level* was also assessed based on the institutional records of mathematics courses students took in the 9th grade. Course level was coded so that higher values represented more challenging courses (1 = basic mathematics, 2 = pre-algebra, 3 = algebra 1, 4 = geometry, 5 = algebra 2, 6 = other advanced math, 7 = pre-calculous/calculus). Finally, *family*

socioeconomic status was measured based on the mother's highest education level (1 = did not finish high school, 2 = finished high school, 3 = took some college courses, 4 = Associate's degree, 5 = Bachelor's degree, 6 = Master's degree, 7 = Doctorate degree) and free or reduced lunch status (0 = not receiving free or reduced lunch, 1 = receiving free or reduced lunch).

Data Analyses

The current research utilized structural equation modeling (SEM) in Mplus 8 (Muthén & Muthén, 2017). To answer the first research question, race/ethnic and gender identity (i.e., Black/Latina girl, Black/Latino boy, White girl, White boy) were included as predictors of the experience of stereotype threat in high school mathematics classrooms.

To answer the second and third research questions, teacher mindset climate was included as a predictor of stereotype threat, and mathematics anxiety was included as a mediator of the link between stereotype threat and mathematics achievement. Finally, previous mathematics achievement, mathematics course level, mother's education, and free or reduced lunch status were included as control variables. This model is depicted graphically in Figure 1.

To compare path coefficients across gender and racial/ethnic identity groups, Satorra and Bentler's (2001) scaled chi-square difference tests were performed. To maximize statistical power while preventing inflated type I error rates due to multiple group comparisons, the present study combined Black and Latinx students and created four different race/ethnicity and gender groups, including (1) Black and Latina girls; (2) Black and Latino boys; (3) White girls; and (4) White boys. The correlations were relatively similar among Black and Latinx students (e.g., correlations between stereotype threat and mathematics anxiety were .16 for both Black and Latina girls).

The model fit was evaluated using the CFI (values $\geq .95$ for adequate fit; Hu & Bentler, 1999) and RMSEA (values $\leq .06$ for adequate fit). A robust maximum likelihood estimator (MLR) was used to account for the non-normal distribution of mathematics anxiety. Missing data were estimated using the full information maximum likelihood (FIML) estimation (Peugh & Enders, 2004). The nested structure of the data (i.e., students nested within each mathematics class) was handled using cluster-robust standard

errors (McNeish et al., 2017). Given the use of the MLR estimator, indirect effects were tested using the delta method (Muthén, 2015). Finally, to adjust for over- or under-sampling of a subpopulation, a weighting variable was also utilized.

Results

The Experience of Stereotype Threat Based on Social Identity

Descriptive statistics and intercorrelations of focal variables are presented for each race/ethnicity in Tables 1 and 2. The first model found that Black/Latino boys experienced the highest level of stereotype threat (Black/Latino boys vs. Black/Latina girls: β = .06, *b* = .14, *SE* = .08, *p* = .09; Black/Latino boys vs. White girls: β = .22, *b* = .40, *SE* = .09, *p* < .001; Black/Latino boys vs. White boys: β = .16, *b* = .30, *SE* = .09, *p* = .001), followed by Black/Latina girls (Black/Latina girls vs. White girls: β = .14, *b* = .26, *SE* = .06, *p* = < .001; Black/Latina girls vs. White boys: β = .08, *b* = .15, *SE* = .06, *p* = .01), White boys (White boys vs. White girls: β = .06, *b* = .11, *SE* = .04, *p* = .01,), and White girls. There was no statistically significant difference between Black/Latino boys and Black/Latina girls.

Analyses of individual items showed that the results regarding Black/Latino boys' experience of high levels of stereotype threat were driven by both racial/ethnic and gender identities: Black/Latino boys experienced a higher level of racial/ethnic stereotype threat (β = .16, *b* = .32, *SE* = .10, *p* = .002) as well as gender stereotype threat than did White boys (β = .13, *b* = .27, *SE* = .09, *p* = .003). Black/Latino boys also reported a higher level of racial/ethnic stereotype threat (race/ethnicity: β = .28, *b* = .55, *SE* = .09, *p* < .001) and gender stereotype threat than did White girls (β = .12, *b* = .25, *SE* = .09, *p* = .01). There were no statistically significant differences between Black/Latino boys and Black/Latina girls in their experience of racial/ethnic stereotype threat (β = .06, *b* = .16, *SE* = .09, *p* = .08) and gender stereotype threat (β = .05, *b* = .12, *SE* = .08, *p* = .14).

Teacher Mindset Climate, Stereotype Threat, Anxiety, and Achievement

The overall model fit was adequate, $\chi^2(68) = 122.62$, *p* < .001, CFI = .97, RMSEA = .02 [90% CI: .02, .03]. All the standardized path coefficients of the models are presented in Figure 1.

Across all groups, a fixed teacher mindset climate had a statistically significant positive

association with stereotype threat (Black/Latino boys: $b = .54$, $SE = .08$, $p < .001$; Black/Latina girls: $b = .49$, $SE = .09$, $p < .001$; White boys: $b = .44$, $SE = .05$, $p < .001$; White girls: $b = .28$, $SE = .05$, $p < .001$). This association was weaker for White girls (White boys vs. White girls: Satorra-Bentler $\Delta\chi^2(1) = 5.38$, $p = .02$; Black and Latino boys vs. White girls: Satorra-Bentler $\Delta\chi^2(1) = 38.78$, $p < .001$; Black and Latina girls vs. White girls: Satorra-Bentler $\Delta\chi^2(1) = 3.51$, $p = .06$).

Additionally, a fixed teacher mindset climate had a statistically significant direct association with anxiety (Black and Latino boys: $b = .34$, $SE = .15$, $p = .02$; Black and Latina girls: $b = .27$, $SE = .13$, $p = .04$; White boys: $b = .47$, $SE = .10$, $p < .001$), except in the case of White girls ($b = .14$, $SE = .18$, $p = .42$). There were no significant differences in the path coefficients of fixed teacher mindset climate on anxiety across the three groups (Satorra-Bentler $\Delta\chi^2(3) = 4$, $p = .26$).

Stereotype threat was significantly associated with mathematics anxiety among Black/Latino boys ($b = .23$, $SE = .08$, $p = .01$) and White girls ($b = .26$, $SE = .10$, $p = .01$). However, the association between stereotype threat and mathematics anxiety was not statistically significant for Black/Latina girls ($b = .14$, $SE = .11$, $p = .19$) and White boys ($b = .09$, $SE = .09$, $p = .32$). For White boys, stereotype threat was directly associated with mathematics achievement ($b = -.11$, $SE = .04$, $p = .01$). For Black/Latina girls, stereotype threat was associated with neither anxiety nor achievement ($b = .03$, $SE = .06$, $p = .57$). Together, the total indirect effect of fixed teacher mindset climates on mathematics anxiety was statistically significant for Black/Latino boys ($\beta = .09$, $b = -.12$, $SE = .05$, $p = .01$) and White girls ($\beta = .04$, $b = .07$, $SE = .03$, $p = .01$), but not for Black/Latina girls ($\beta = .05$, $b = .07$, $SE = .05$, $p = .19$) and White boys ($\beta = .03$, $b = .04$, $SE = .04$, $p = .32$).

Mathematics anxiety was negatively associated with mathematics achievement across all groups (Black/Latino boys: $b = -.27$, $SE = .09$, $p = .003$; Black/Latina girls: $b = -.11$, $SE = .05$, $p = .03$; White boys: $b = -.18$, $SE = .04$, $p < .001$; White girls: $b = -.14$, $SE = .04$, $p < .01$). There was no significant difference in the path coefficients across the groups (Satorra-Bentler $\Delta\chi^2(3) = 3.83$, $p = .28$).

Finally, the analyses of gender and racial/ethnic stereotype threat items showed consistent findings, except for the associations between stereotype threat and anxiety (see Figure 2). When including

only gender stereotype threat, the association between stereotype threat and anxiety became statistically significant for Black/Latina girls (b = .18, SE = .09, p = .04), but was not significant for Black and Latino boys (b = .06, SE = .10, p = .57), White boys (b = .06, SE = .07, p = .38), and White girls (b = .14, SE = .09, p = .10); when only racial/ethnic stereotype threat is included, the findings remain consistent.

Discussion

Adolescents' experiences in high school mathematics classrooms play a crucial role in their persistence in advanced mathematics courses (Riegle-Crumb, 2006) and college major choice (Seo et al., 2019). However, no prior studies have investigated adolescents' naturalistic experiences of stereotype threat in high school mathematics classrooms using nationally representative data. The current research utilized nationally representative data of 9th-grade students in the United States, and offers a nuanced understanding of adolescents' experience of stereotype threat in authentic high school mathematics classrooms at the intersection of their gender and race/ethnicity.

The findings showed that adolescents experienced stereotype threat differently in their mathematics classroom based on their social identity. Black and Latinx students, regardless of their gender, experienced the highest level of stereotype threat. These results are consistent with recent studies reporting Black and Latinx adolescents' experience of significant systematic racism (Badger et al., 2018) and discrimination (Pérez et al., 2008; Seaton et al., 2008). Accumulation of these negative experiences may further elicit worries about whether their mathematical ability is judged based on their social identity rather than individual performance. Regardless of whether this threat experience is linked to impaired academic performance, the experience of stereotype threat itself has a detrimental effect on individuals' physical and mental well-being (Paradies et al., 2015), and it would be advisable to mitigate the youths' experiences of stereotype threat in high school mathematics classrooms.

Interestingly, for Black and Latino boys, it was racial/ethnic stereotype threat that was the salient identity threat linking the threat experience to mathematics anxiety. Negative stereotypes surrounding Black and Latinx adolescents are exceptionally prominent for boys in the United States (Rowley et al., 2014). As such, an environment that elicits racial/ethnic stereotypes might lead to Black and Latino boys

feeling anxious in their mathematics classrooms. For Black and Latina girls, gender stereotype threat was associated with mathematics anxiety. The findings suggest that different social identities may need to be encouraged among Black/Latinx boys and girls to mitigate their mathematics anxiety and help them reach their full potential in their mathematics classroom. Further, the findings illustrate the importance of considering both the gender and racial/ethnic identities of students when examining their classroom experiences.

It is notable that Black and Latina girls' gender stereotype threat was associated with mathematics anxiety, whereas White girls' racial/ethnic stereotype threat, not their gender stereotype threat, was associated with mathematics anxiety. This finding may explain why several prior studies utilizing a sample of predominantly (> 80%) Asian and White female participants failed to find gender stereotype threat effects (e.g., Finnigan & Corker, 2016). Recent studies as well as the current study's data show that girls tend to outcompete boys in scholarly achievements, including mathematics GPA (Parker et al., 2018), which might have significantly reduced the negative implications of girls' gender stereotype threat. However, this explanation offers a partial picture that is only pertinent to White girls. Teachers tend to hold low expectations toward Black girls from families facing economic disadvantage (Pringle et al., 2012), and many still hold an implicit bias that Black girls and mathematical ability are incompatible (Gholson et al., 2016). The current findings resonate with this reality by showing that Black and Latina girls' gender stereotype threat may still have an effect on their high school experience.

It is interesting that White girls' racial/ethnic stereotype threat was associated with their mathematics anxiety. Previous studies have found that adolescents tend to strongly endorse racial/ethnic stereotypes about Asian students' mathematical ability as they mature (Cvencek et al., 2014). Furthermore, a study found that people tend to hold negative stereotypes surrounding White girls, such as being "ditsy" or "shallow" (Conley, 2013, p. 45). With the present study's data, it is unclear whether White girls' racial/ethnic identity-based worries were associated with their relative performance compared to their Asian peers, or to negative stereotypes about White female youth (being "ditsy" and "shallow," Conley, 2013). Nevertheless, the current findings suggest that classroom climates that increase

students' racial/ethnic identity threat may be detrimental to not only Black and Latinx youth but also White girls. It would be helpful for future research to qualitatively examine students' experience of stereotype threat and teacher mindset climate in high school mathematics classrooms to further shed light on this issue.

The current findings also show that White boys' stereotype threat was not linked to mathematics anxiety. In line with this, there exists evidence showing that an evaluative, competitive environment does not impair intrinsic motivation in those who have a tendency toward male-stereotype behaviors (Conti et al., 2001). Without the burden of disapproving negative stereotypes associated with their gender and racial/ethnic identities, White male students might not feel anxious about mathematics despite the concern that their mathematical ability may be evaluated based on their social identities. Notably, however, their stereotype threat still negatively predicted White boys' mathematics achievement. The burden of proof hypothesis (Brown & Josephs, 1999) suggests that White boys also experience identity threat due to the positive stereotype associated with their academic ability, but it manifests differently from Black and Latinx youth's experience of stereotype threat. Under stereotype threat, White boys may feel pressure to confirm the positive stereotype associated with their identities, especially if the environment emphasizes the task's purpose to diagnose "exceptionally strong" ability (Brown & Josephs, 1999, p. 246). This pressure to meet positive expectations may have a positive impact up to a certain point, after which performance might decrease (i.e., Yerkes-Dodson law; Yerkes & Dodson, 1908). In fact, previous research has suggested other potential mechanisms that may function as a mediator in the link between stereotype threat and underperformance, such as reduced working memory or self-handicapping (Pennington et al., 2016). Future research should examine other potential mechanisms underlying the link between stereotype threat and achievement among adolescents with diverse social identities.

As one way to explain the variability in students' experience of stereotype threat, the present research focused on adolescents' perceptions of the teacher mindset climate as a potential antecedent. The results showed that when students perceived their mathematics teachers to value inherent mathematical ability (i.e., fixed teacher mindset climate), the students were more likely to experience stereotype threat.

The results support the notion that stereotype threat arises from the "threat in the air' (Steele, 1997, p. 613), such as situational cues and organizational cultures (Murphy & Taylor, 2011). If a school wants to reduce students' stereotype threat experience, it is essential to identify various teacher attitudes, behaviors, and practices that are linked to students' perceptions of a fixed mindset climate.

Another interesting result was that the teacher mindset climate was less strongly associated with the experience of stereotype threat and feelings of anxiety among White girls. In line with this result, Putnick et al. (2020) showed in their study of European American children that teachers' beliefs about children's competence did not predict later performance, whereas parents' assessments of child competence did. Although the study did not differentiate result patterns by children's gender, the results were perhaps driven by the relative importance of teachers, parents, and peers for White female students. Indeed, Cole and colleagues (1997) showed that (mostly White) girls' self-perceptions relied on parents' appraisals of them in third grade, and peers' appraisals of them in sixth grade. This is not to say that teachers do not play a role in White girls' experiences of stereotype threat and mathematics anxiety. In fact, previous studies have shown that teachers play an important role in White female students' experience of stereotype threat (Tomasetto et al., 2011) and anxiety (see Gunderson et al., 2012 for a review). Furthermore, the current findings show that the teacher mindset climate affects female adolescents' experience of stereotype threat. Nevertheless, the relative importance of the teacher mindset climate may be less for White girls than for their peers.

One weakness of the current research is the aggregation of individuals based on their gender and two broad races/ethnicities. As such, the present study did not consider the various social identities adolescents have. Adolescents differ in numerous ways, such as their sexual orientation, socioeconomic status, and cultural background. Furthermore, some adolescents may have identities that do not fit well within the identity groups utilized in the present study. For example, some adolescents have multiple racial/ethnic identities, while others have a non-binary gender identity. As such, future research should examine the identity-threat experiences of adolescents with diverse social identities.

Finally, it is important to note that the correlational nature of the current data prevents any causal

claims about stereotype threat. The current research utilized correlational data given the current research's interest in naturally developed concerns regarding mathematics stereotypes among adolescents. Correlational research is useful because it allows for the prediction of future outcomes using naturalistic variables (Stanovich, 2007). Additionally, key variables that may have confounding effects (i.e., previous mathematics achievement, mathematics course level, family socioeconomic status) were included in all analyses, which enhanced the credibility of the findings. However, with correlational data, it is almost impossible to rule out all confounding variables and potential bidirectional associations among the variables. Thus, it is critical not to make any causal inferences until experimental and cross-lagged longitudinal evidence accumulates.

Conclusion

As stereotype threat was initially examined through experimental research, its effects have often been tested by temporarily manipulating social identity threat among college students. The current research extends the literature by examining adolescents' naturalistic experience of stereotype threat in authentic high school classroom environments and determining how the experiences were associated with classroom climate, anxiety, and potential achievement. The present findings show that Black and Latinx youth experience greater social identity threat than do their White peers. Furthermore, adolescents experience greater social identity threat in fixed mindset teacher climates, and the experiences of identity threat in their classrooms might prevent them from fully reaching their potential. The findings of this study contribute to the body of literature that sheds light on the negative outcomes of social identity threat for young individuals' potential achievement, and urges readers to acknowledge the need for change in these environments to lessen youth's concerns regarding mathematics stereotypes in high school classrooms.

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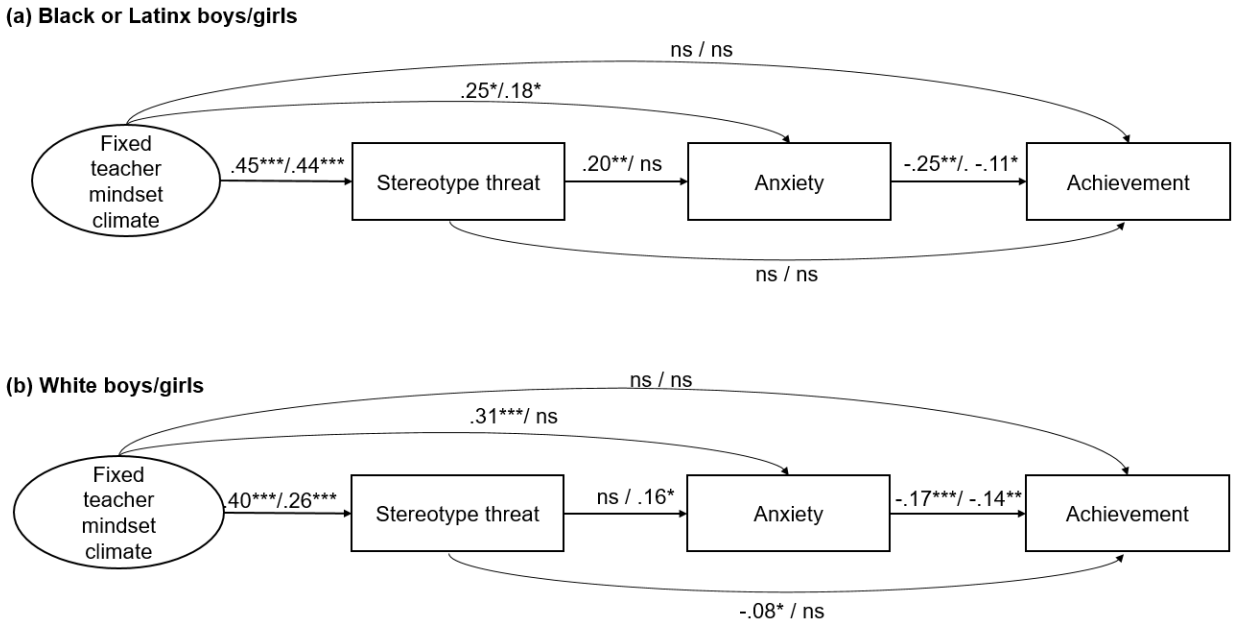

Figure 1. The associations of mathematics teacher mindset climate with overall stereotype threat, anxiety, and achievement among (a) Black or Latinx students and (b) White students. Standardized coefficients are shown. We included previous mathematics achievement, mathematics course level, mother's education level, and free or reduced lunch status as covariates. These covariates were omitted in the figure for graphical simplicity. ns = statistically not significant.

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

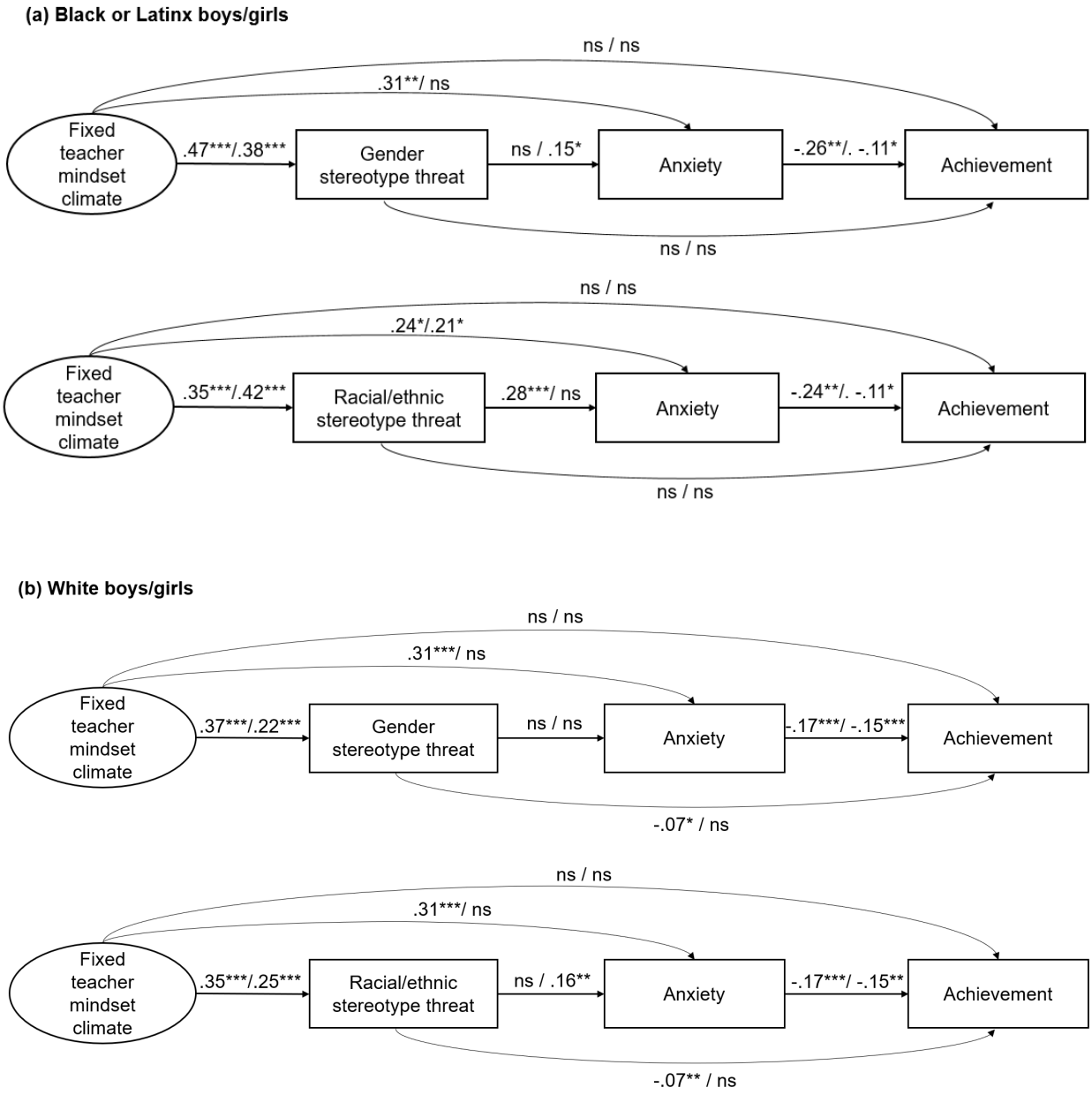

Figure 2. The associations of mathematics teacher mindset climate with gender or racial/ethnic stereotype threat, anxiety, and achievement among (a) Black or Latinx students and (b) White students. Standardized coefficients are shown. We included previous mathematical achievement, mathematics course level, mother's education level, and free or reduced lunch status as covariates. These covariates were omitted in the figure for graphical simplicity. ns = statistically not significant.

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

Table 1.
Descriptive Statistics and Bivariate Correlations for Black/Latinx Students

	Black /Latino boys	Black /Latina girls	1	2	3	4	5	6	7	8
1. Fixed mindset climate	2.27 (1.05)	2.07 (1.02)	---	.32***	.17***	-.12***	-.05	.00	.06	-.04
2. Stereotype threat	1.91 (1.02)	1.79 (0.98)	.37***	---	.16***	-.11**	-.04	-.03	.03	-.01
3. Anxiety	2.46 (1.11)	2.86 (1.19)	.19***	.26***	---	-.20***	-.08	.04	.04	-.01
4. Grade 9 GPA	1.79 (1.22)	2.17 (1.25)	-.04	-.19***	-.27***	---	.62***	.20***	.11**	-.21***
5. Grade 8 GPA	2.10 (1.13)	2.52 (1.13)	-.02	-.18***	-.11*	.56***	---	.28***	.09*	-.28***
6. Course level	2.91 (0.82)	2.87 (0.93)	-.01	-.03	-.09*	.16***	.16***	---	.15***	-.24***
7. Mother's education	3.02 (1.78)	3.00 (1.82)	-.05	-.11**	-.04	.17***	.13***	.12***	---	-.27***
8. Free/reduced lunch	0.66 (0.47)	0.64 (0.48)	.04	.11**	.10	-.15***	-.34***	-.22***	-.27***	---

Note. Means are shown in the second and the third columns. Standard deviations are shown in parentheses. The correlations for boys are presented below the diagonal. The correlations for girls are presented above the diagonal. GPA = grade point average

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

Table 2.
Descriptive Statistics and Bivariate Correlations for White Students

	White boys	White girls	1	2	3	4	5	6	7	8
1. Fixed mindset climate	2.16 (1.03)	2.08 (1.02)	---	.23***	.10**	-.12***	-.08**	-.02	.04	.00
2. Stereotype threat	1.58 (0.89)	1.51 (0.82)	.30***	---	.14***	-.16***	-.15***	-.12***	-.02	.08*
3. Anxiety	2.36 (1.16)	2.80 (1.28)	.27***	.20***	---	-.18***	-.11**	.03	.03	-.01
4. Grade 9 GPA	2.30 (1.27)	2.71 (1.21)	-.08***	-.17***	-.24***	---	.57***	.27***	.23***	-.22***
5. Grade 8 GPA	2.57 (1.17)	2.97 (1.06)	-.06*	-.10***	-.15***	.65***	---	.34***	.21***	-.35***
6. Course level	3.22 (0.94)	3.30 (0.90)	-.03	-.10***	-.04	.36***	.38***	---	.25***	-.27***
7. Mother's education	4.05 (1.68)	3.94 (1.66)	-.03	-.04	-.10**	.29***	.30***	.25***	---	-.40***
8. Free/reduced lunch	0.31 (0.46)	0.28 (0.45)	.03	.04	-.08	-.31***	-.38***	-.26***	-.34***	

Note. Means are shown in the second and the third columns. Standard deviations are shown in parentheses. The correlations for boys are presented below the diagonal. The correlations for girls are presented above the diagonal. GPA = grade point average
* $p < .05$, ** $p < .01$, *** $p < .001$.