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The development of in-group-favoring math stereotypes among adolescents across gender and race/ethnicity: Teacher influence and motivational consequences

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Abstract

The developmental processes underlying in-group-favoring math stereotypes (i.e., beliefs that favor one's own gender over another gender in math ability) and their associated motivational benefits in adolescence remain understudied. Guided by developmental intergroup theory and situated expectancy-value theory, the current study examined (a) the reciprocal relations between in-group–favoring math stereotypes and perceived math teacher support; (b) their associations with math motivational outcomes (i.e., math expectancies, math identity, and math GPA); and (c) gender differences in these associations among adolescents within each of four largest racial/ethnic groups in the United States (i.e., Asian, Black, Latine, and White). Using the High School Longitudinal Study of 2009 (N=18,419; M_{age}=14.53, SD=0.63 in 9th grade), we found that Asian and White girls' female-favoring math stereotypes and their perceived math teacher support reinforced one another from early to late adolescence, but not among other groups. In-group-favoring math stereotypes positively predicted math motivational beliefs among boys across all racial/ethnic groups, but only among Black and White girls. These stereotypes indirectly predicted math GPA via motivational beliefs only for White adolescents. Findings suggest that gender differences in the development of in-group-favoring math stereotypes and the benefits of stereotype lift are not the same across race/ethnicity. Rather, gender norms that vary across different racial/ethnic groups may shape who develops and benefits from in-group-favoring math stereotypes, underscoring the need to consider intersectionality to better capture motivational processes in real-world contexts.

Keywords: gender stereotypes, perceived teacher support, motivation, math, intersectionality

Public Significance Statement

Using nationally representative data, we identified reciprocal developmental processes between female-favoring math stereotypes and perceived math teacher support among Asian and White girls, as well as motivational benefits of in-group-favoring math stereotypes for boys across all racial/ethnic groups and for Black and White girls. Our study highlights the complexity of gender stereotypes about math across multiple layers of the social system (e.g., racial communities and broader society) and offers insights into how socializers can better support girls and racially minoritized adolescents in developing and leveraging in-group-favoring math stereotypes in math-intensive pathways.

Traditional, male-favoring stereotypes are well-documented barriers to women's pursuit of STEM (e.g., Lee et al., 2024). However, stereotypes are malleable beliefs; and, children typically exhibit in-group-favoring gender stereotypes about math ability (i.e., beliefs that one's own gender group is more competent in math than the other; hereafter referred to as in-group-favoring math stereotypes). Though these beliefs shift with age, prior research is inconclusive, as some research suggests that children's math stereotypes shift toward male-favoring stereotypes over time (Miller et al., 2024; Starr et al., 2023), whereas others report stable egalitarian beliefs (McGuire et al., 2020; Riegle-Crumb & Peng, 2021) or even slight female-favoring trends (Master et al., 2025a; Tang et al., 2024; Vuletich et al., 2020). These mixed findings suggest the need to further understand how in-group-favoring stereotypes develop in math. Moreover, though gender stereotypes have often been examined in terms of a barrier, stereotype lift perspectives (Walton & Cohen, 2003) suggest that in-group-favoring gender stereotypes may help promote both girls' and boys' pursuit of STEM. Further research is therefore needed to understand the developmental processes underlying adolescents' in-group-favoring gender stereotypes and to examine whether boys and girls of various racial/ethnic groups experience similar benefits of stereotype lift in math.

Developmental intergroup theory (Bigler & Liben, 2006) and situated expectancy–value theory (Eccles & Wigfield, 2020) posit that gender stereotypes develop through reciprocal processes in which adolescents interpret the world in stereotype-consistent ways, and these interpretations are subsequently internalized into stereotypes over time. Within adolescents' immediate environments, teachers are a primary socializer and convey social cues and information about who is perceived as competent in math through daily instructional support (Dicke et al., 2021; Lazarides et al., 2022; McKellar et al., 2019), underscoring the potential importance of general teacher instructional support in contributing to changes in individuals' math stereotype development. Building on existing evidence on the salience of in-group-favoring math stereotypes (Master et al., 2025a; Miller et al., 2024), we examine how these stereotypes develop reciprocally in relation to teacher instructional support and the extent to which these reciprocal processes vary across gender and racial/ethnic groups.

Social status theory (Rowley et al., 2007) suggests that gendered math stereotypes are embedded within intersecting gender and racial/ethnic hierarchies. In the United States, higher-status groups (e.g., Asian and White boys) are more likely to endorse male-favoring stereotypes, whereas lower-status groups (e.g., Black girls) are less likely to do so (Else-Quest et al., 2013; Skinner et al., 2021; Starr et al., 2023). These findings indicate that gendered patterns of stereotype endorsement are not uniform across racial/ethnic groups. Prior work documenting mean-level differences across gender and racial/ethnic groups further raises important yet understudied questions about whether such intersecting patterns extend to the processes and correlates of gendered math stereotypes. It is therefore important to examine whether boys and girls of various racial/ethnic groups develop in-group-favoring math stereotypes and experience similar benefits of stereotype lift. By addressing this gap, the current study advances the literature on in-group-favoring math stereotypes. Practically, it helps identify subgroups of adolescents who may experience the least stereotype lift benefits and informs how educators and policymakers can better support their success and persistence in math.

To achieve this goal, using the nationally representative data of High School Longitudinal Study of 2009 (HSLS), we examine *gender differences within specific racial/ethnic groups* in (a) the reciprocal associations between in-group-favoring math stereotypes and perceived math teacher support and (b) their associations with math motivational outcomes (i.e., math expectancies, identity, and GPA) among high school students from the four largest racial/ethnic groups in the United States—Asian, Black, Latine, and White.

Reciprocal Relations Between In-Group-Favoring Math Stereotypes and Perceived Math Teacher Support

According to developmental intergroup theory (DIT; Bigler & Liben, 2006), individuals develop gender stereotypes through social information. Although the theory has often been applied to understanding gendered cues that foster male-favoring stereotypes in STEM (e.g., group size, labeling; Master et al., 2025b), its broader premise is that individuals are not merely passive recipients of social information but rather actively generate information that supports in-group-favoring stereotypes once gender becomes salient. This perspective suggests that adolescents may categorize social information, whether explicitly gendered or not, encountered in every interaction based on their gender identity and use them to inform their in-group-favoring stereotypes (Bigler & Liben, 2006). Teachers' instructional support (e.g., asking questions, providing encouragement, and offering opportunities for participation) serves as an important competence cue for adolescents in daily classroom interactions (Eccles & Roeser, 2015; Lazarides et al., 2022; McKellar et al., 2019). For example, girls may internalize the belief that girls are good at math if their math teachers treat them as capable or make math accessible and easier to do well in. However, this remains untested. Examining whether these associations are significant and vary across adolescents with different social identities defined by gender and race/ethnicity may help us better understand how adolescents develop in-group-favoring math stereotypes through everyday instructional support in math.

Beyond influences from socializers, situated expectancy–value theory (SEVT; Eccles & Wigfield, 2020) and research on the self-fulfilling nature of stereotypes (e.g., Madon et al., 2018) suggest that adolescents interpret and respond to social contextual cues based on their existing gender stereotypes. Adolescents' gender stereotypes about math ability operate as cognitive lenses through which they selectively attend to, interpret, and recall aspects of teachers' behaviors and classroom climates that align with their beliefs, and guide them to behave in stereotype-consistent ways (Chatard et al., 2007; McKown et al., 2010; Wheeler & Petty, 2001) In this sense, girls who endorse female-favoring math stereotypes—and boys who endorse male-favoring math stereotypes—may be more likely to interpret teacher behaviors or interact with teachers in self-fulfilling ways that reinforce beliefs about their gender group's math competence.

Despite theorized reciprocal developmental processes through which adolescents actively interpret social information from teachers and internalize it into gender stereotypes, empirical evidence directly examining these processes remains limited. Thus, the present study advances understanding of stereotype development by examining feedback loops between adolescents' in-group-favoring math stereotypes and perceived math teacher support.

Math Motivational Outcomes of In-Group-Favoring Math Stereotypes and Perceived Math Teacher Support

According to SEVT (Eccles & Wigfield, 2020), individuals' perceptions of social experiences are key mechanisms through which objective sociocultural contexts shape motivational beliefs, choices, and performance within specific domains. Within this framework, expectancies for success (i.e., confidence in one's ability to succeed in math) and subjective task values (i.e., the value one assigns to engaging in math) are two central motivational beliefs that predict achievement and persistence in math. With respect to subjective task values, individuals perceive tasks (e.g., studying math) as interesting (intrinsic value), useful (utility value), personally important (attainment value), or costly to pursue (cost) depending on the extent to which engaging in the task provides opportunities to enact one's identity (e.g., becoming a "math person"). SEVT posits that identity (e.g., seeing oneself as a "math person") is a higher-order motivational construct that guides how individuals assign different aspects of subjective value to tasks or domains, with attainment value being most directly tied to identity (see Eccles, 2009, for discussion). This conceptualization aligns with core tenets of the relevant literature (e.g., identity-based motivation theory; Oyserman, 2015; possible selves; Markus & Nurius, 1986), which view identity as a central motivator of behavioral choices. Accordingly, the present study focuses on math expectancies and math identity.

From a SEVT perspective, individuals' in-group-favoring math stereotypes and perceptions of math teachers' instructional support constitute social-cognitive appraisals that inform math-related expectancies, identity, and achievement (Eccles & Wigfield, 2020). With respect to in-group-favoring math stereotypes, the stereotype lift literature indicates that favorable beliefs about one's social group can yield motivational and performance benefits via self-enhancement processes (Czopp et al., 2015; Shih et al., 2002; Walton & Cohen, 2003). It has been widely recognized that individuals with in-group-favoring beliefs can engage in downward comparisons with devalued out-groups, thereby strengthening their self-perceptions and self-worth (e.g., "Because girls are better at math than boys, as a girl, I may also be good at math"; Walton & Cohen, 2003). However, prior research has yielded mixed patterns in math. Plante et al. (2013) demonstrated that in-group-favoring math stereotypes produced stereotype lift effects for both boys and girls; these beliefs indirectly predicted math grades and math-related career intentions through math expectancies and subjective task values across gender. Others, however, have found the effect only emerged among one gender. Riegle-Crumb and Peng (2021) found that girls with female-favoring math stereotypes had higher odds of later majoring in the biological sciences compared with non-STEM fields. In contrast, Steffens and Jelenec (2011) found that boys' male-favoring math stereotypes were positively associated with boys' math ability self-concept, whereas girls' female-favoring math stereotypes were not. Evans et al. (2021) also found a similar male-favoring pattern among Black adolescents. More work is needed to disentangle these conflicting patterns and test the extent to which stereotype lift effects of in-group-favoring math stereotypes vary across boys and girls from different racial groups.

In addition, perceived math teachers' instructional support—defined as adolescents' perceptions of teaching practices that foster their interest in and understanding of math (Wentzel, 1997)—is well established as a positive correlate of math motivational beliefs and achievement (Diemer et al., 2016; Frenzel et al., 2010; McKellar et al., 2019; Wang, 2012; Yu & Singh, 2018). Although math teachers' instructional support is widely recognized as beneficial for both genders (Ober et al., 2021; Wang et al., 2020), there is evidence of gender differences: some studies found that boys perceive greater teacher support than girls, which is associated with more favorable math motivation and career aspirations (Lazarides & Watt, 2015; Rimm-Kaufman et al., 2015), whereas other studies showed that girls perceive greater support and higher math motivation (Gaspard et al., 2015; Robinson & Lee, 2023). By examining gender differences within racial/ethnic groups, our study helps clarify mixed patterns in the motivational benefits of perceived math teacher support.

Intersectionality of Gender and Race/Ethnicity

The intersection of gender with race/ethnicity is a critical consideration when examining the development of in-group-favoring math stereotypes and their motivational benefits (Miller et al., 2024). Gender is not a homogeneous construct; intersectional frameworks posit that individuals experience the world uniquely based on how multiple social identities—such as gender and race/ethnicity—simultaneously intersect to shape stereotypes and bias (Cole, 2009; Else-Quest & Hyde, 2016). Social status theory (Rowley et al., 2007) argues that Asian and White adolescents—who tend to hold relatively higher social status—are more likely to endorse traditional, male-favoring views of math ability to preserve the benefits of the existing social system (Skinner et al., 2021; Starr et al., 2023), whereas Black and Latine adolescents—who more often occupy socially marginalized positions—are more likely to endorse gender-egalitarian or female-favoring views to protect positive self-worth in response to societal bias and stigmatization (O'Brien et al., 2015; Skinner et al., 2021; Starr et al., 2023).

Moreover, intersectionality highlights how unique advantages and disadvantages associated with gender and race/ethnicity create distinct math learning experiences across social groups. Black and Latine girls often face a "*double bind*" at the intersection of racial and gender-based biases and discrimination (Ong et al., 2011), such that they receive less instructional support from teachers, including lower expectations, limited encouragement and feedback, and fewer learning opportunities (London et al., 2021; Rodriguez & Blaney, 2021). Nonetheless, gender-egalitarian beliefs about ability and strong family support within Black communities have been found to function as cultural sources of academic resilience, which often explain the minimal or no gender differences in math motivational beliefs among Black adolescents (Seo et al., 2019; Starr et al., 2022; Lee et al., 2026a; Lee & Simpkins, 2021). Although Asian and White girls often benefit from racial advantages (e.g., higher academic expectations, supportive instructional practices; Tenenbaum & Ruck, 2007), they also occupy a paradoxical position in STEM due to gender-based marginalization that yields differential motivational outcomes (Castro & Collins, 2020; Shih et al., 2019). Guided by intersectionality in motivational processes, we examined how in-group-favoring math stereotypes uniquely develop and relate to math motivation and success across gender within each racial/ethnic group.

Present Study

Guided by developmental intergroup theory (Bigler & Liben, 2006) and situated expectancy–value theory (Eccles & Wigfield, 2020), we examine (1) the reciprocal developmental processes between in-group-favoring math stereotypes and perceived math teacher support and (2) their motivational benefits (i.e., math expectancies, math identity, and math GPA) among high school students over four years (see Figure S1 for the baseline model). Using a nationally representative dataset, we examine variability in these associations across gender within each of the four largest racial/ethnic groups in the U.S. (i.e., Asian, Black, Latine, and White groups).

The current study makes unique contributions to the literature in three ways. First, our focus on in-group-favoring math stereotypes responds to calls for more research on unique stereotype developmental processes in math—a domain in which male-superiority stereotypes are relatively minimal. By assessing both female- and male-favoring math beliefs within corresponding gender groups, our findings complement prior research that has focused primarily on the correlates of math stereotypes that favor either females or males (Riegle-Crumb & Peng, 2021). Second, our focus on adolescents' perceptions of math teachers' instructional support as social information about math ability provides empirical support for developmental intergroup theory (Bigler & Liben, 2006) and situated expectancy–value theory (Eccles & Wigfield, 2020), which emphasize the dynamic interplay between individual agency and social information in the development of gender stereotypes. Importantly, the measure used in the current study captures perceived instructional support provided to the entire class (Wentzel, 1997), rather than support targeted toward specific groups (e.g., unsolicited support for adolescents whose abilities are negatively regarded; c.f., Graham & Taylor, 2016). This focus allows us to examine how general math instructional support may still relate to the development of in-group-favoring math ability beliefs. Finally, our intersectional approach advances understanding of how gender differences in the development and benefits of in-group-favoring math stereotypes for math motivational beliefs and achievement vary across racial/ethnic groups. Doing so provides practical implications for promoting the success of the most minoritized groups in math pathways. Specifically, we address two research questions and develop hypotheses based on prior evidence discussed earlier:

RQ1: To what extent are adolescents' in-group-favoring math stereotypes and perceived math teacher support reciprocally associated, and do these associations vary by gender within race/ethnicity?

> *H1a: Adolescents who endorse stronger in-group-favoring math stereotypes would be more likely to perceive their math teachers as supportive. Adolescents who perceive their math teachers as supportive would be more likely to develop stronger in-group-favoring math stereotypes over time.*

> *H1b: Given the limited prior evidence, patterns of gender differences within race/ethnicity are examined exploratorily.*

RQ2: To what extent do adolescents' in-group-favoring math stereotypes and perceived math teacher support predict math motivational outcomes (i.e., math expectancies, math identity, and math GPA), and do these associations vary by gender within race/ethnicity?

> *H2a: Adolescents who perceive higher levels of math teacher support and endorse stronger in-group-favoring math stereotypes will demonstrate higher math expectancies, math identity, and math GPA.*

H2b: Given the limited prior evidence, patterns of gender differences within race/ethnicity are examined exploratorily.

Method

Participants

Data were drawn from the High School Longitudinal Study (HSLS) of 2009. HSLS is a longitudinal study from the U.S. National Center for Education Statistics (NCES) that was designed to study adolescents' STEM education (Ingels et al., 2011). HSLS followed a nationally representative cohort of U.S. adolescents from 9th grade in 2009 (T1), through 11th grade in 2012 (T2), and into the postsecondary period in 2013 (T3), based on a random sample of approximately 940 schools located across 10 states. Approximately 28 adolescents within each school were randomly selected using stratified sampling based on race/ethnicity in the second stage, resulting in a total of 25,210 adolescents who were recruited for the base-year study. HSLS employed primarily school-based, in-person data collection during the high school waves and shifted to mixed modes, including web-based surveys, in the postsecondary follow-ups.

To ensure a large enough sample for multigroup modeling, the analytic sample included adolescents who self-identified as Asian, Black, Latine, or White—the four largest racial/ethnic subpopulations in the U.S. Of the 25,210 participants, we sequentially excluded (a) adolescents who had missing information on gender or race/ethnicity or who were not Asian, Black, Latine, or White (n = 2,554); (b) adolescents who had missing information on in-group-favoring math stereotypes and perceived math teacher support in both 9th and 11th grade (n = 2,149); and (c) adolescents who had missing information on all exogenous variables (n = 2,088). As a result, the analytic sample consisted of 18,419 participants (M_{age} = 14.53, SD = 0.63 in 9th grade; 10.0% Asian, 12.6% Black, 19.0% Latine, 58.4% White; 48.9% female) after excluding adolescents who met the exclusion criteria described above[1]. This study was approved by the university's Institutional Review Board.

Measures

The list of all items used in the study and their factor loadings is provided in the supplementary material (see Table S3). All scales measured in the current study demonstrated good to excellent internal-consistency reliability.

In-Group-Favoring Math Stereotypes. Ninth- and eleventh-graders' gender stereotypes about math abilities were assessed using a single item ("In general, how would you compare males and females in math?") based on a 5-point Likert scale (1=*Females are much better,* 2=*Females are somewhat better,* 3=*Females and males are the same,* 4=*Males are somewhat better,* and 5=*Males are much better*). This single item has been used to measure math gender stereotypes in relation to motivational beliefs in many other studies (e.g., Kurtz-Costes et al., 2014; Starr & Simpkins, 2021) and it is a core item for other scales measuring gender stereotypes about academic abilities (e.g., Passolunghi et al. 2014). In-group-favoring math stereotypes were coded to indicate the extent to which adolescents believed that individuals of their own gender are more capable in math than those of the opposite gender. Consistent with the original response scale, higher scores for boys indicate stronger endorsement of stereotypes favoring males over females in math (e.g., "Males are much better at math than females."). We reversed the scale for girls so that high scores for girls indicate a higher endorsement of stereotypes favoring females over males in math (e.g., "Females are much better at math than males.").

[1] Gender and race/ethnicity were assessed using HSLS-provided variables, respectively. Gender was measured using a binary male/female indicator, resulting in no exclusions due to non-binary gender identification. Race/ethnicity was measured using a single-category classification with an option for multiracial identification, thus participants identified as American Indian/Alaska Native, Native Hawaiian/Pacific Islander, or multiracial were excluded.

Perceived Math Teacher Support. Ninth- and eleventh-graders' perception of instructional support they have received from their math teachers were measured using two items (α = 0.82 at T1, 0.84 at T2; i.e., "Your [fall 2009/spring 2012] math teacher makes math easy to understand."; "Your [fall 2009/spring 2012] math teacher makes math interesting.") based on a 4-point Likert scale ranging from 1 (*Strongly agree*) to 4 (*Strongly disagree*). Items were reverse-coded; thus, high scores indicate a high endorsement of the construct. These items have been used to assess perceived teacher support in prior studies and have demonstrated good validity (Kelly & Zhang, 2016; Lee & Simpkins, 2021; Yu & Singh, 2016).

Math Expectancies for Success. Ninth- and eleventh-graders' math expectancies for success were assessed using four items (α = 0.90 at T1, 0.89 at T2; e.g., "You are confident you can do an excellent job on [fall 2009/spring 2012] math tests.") based on a 4-point Likert scale ranging from 1 (*Strongly agree*) to 4 (*Strongly disagree*). Items were reverse-coded; thus, high scores indicate high perceptions of their math abilities. These four items capture the core construct of math expectancies as outlined in SEVT (Eccles & Wigfield, 2020) and have been widely used in prior research on math motivational beliefs (Hsieh et al., 2021; Lee & Simpkins, 2021).

Math Identity. Ninth- and eleventh-graders' math identity were assessed using two items (α = 0.88 at T1, 0.85 at T2; i.e., "You see yourself as a math person." and "Others see you as a math person.") based on a 4-point Likert scale ranging from 1(*Strongly agree*) to 4 (*Strongly disagree*). Items were reverse-coded; thus, high scores indicate a high math identity. These two items capture the core construct of math identity as outlined in SEVT (Eccles & Wigfield, 2020) and prior work (Calabrese Barton et al., 2018), and have been widely used in prior research on math motivational beliefs (Hsieh et al., 2021; Starr & Simpkins, 2021).

Math Achievement. Math assessment scores in 9th grade were used as an indicator of prior achievement. This math assessment was designed to assess 9th graders' algebraic reasoning in content domains (e.g., nonlinear equations) and algebraic processes (e.g., solving algebraic problems), which were standardized by NCES. Adolescents' cumulative GPA of all high school math courses taken (X3TGPAMAT) was used as the final indicator of math achievement. Math GPA scores were derived from official high school transcript data that were collected after high school completion and standardized by NCES to ensure comparability across schools.

Demographic Characteristics. Adolescents were asked to provide their gender (0=*Male*, 1=*Female*) and race/ethnicity (1=*Indian/Alaska Native*, 2=*Asian/Asian American,* 3=*Black/African American,* 4=*Latino/a,* 5=*More than one race*, 6=*Native Hawaiian/Pacific Islander*, 7=*White*). We included participants who identified as Asian, Black, Latine, and White in this study (see the Participants section).

Covariates. Students' prior levels of motivational beliefs (i.e., math expectancies for success and math identity in 9th grade) were included in the model to assess how perceived teacher support and in-group-favoring gender stereotypes about math predict relative changes in math motivational beliefs from 9th to 11th grade. This approach aligns with established practices in developmental research and enhances the predictive validity of the two predictors, as it helps to rule out the possibility that observed associations are attributable to pre-existing individual differences (Lee et al., 2025; Selig & Little, 2012). Students' socioeconomic status was also accounted for in the model, as this individual characteristic is theorized to influence the study constructs (Eccles & Wigfield, 2020). We used the X1SES_U variable, which was calculated by NCES based on parents' or guardians' education, occupation, family income, and school urbanicity.

Plan of Analysis

Descriptive statistics were conducted using SPSS 29. We used multi-group structural equation models (SEM) to address primary research questions using Mplus 8.8 (Muthén & Muthén, 1998–2017). In all our analyses, we included sampling weights (W2W1STU) to account for the nonresponse rate in the sampling process, strata, and primary sampling unit to correct the standard errors from the stratified design of the data set. The final analysis syntax for the present study is available in the OSF project repository (Lee et al., 2026b).

First, we conducted confirmatory factor analysis (CFA) for three measures – perceived teacher support, math expectancies for success, and math identity – to validate the factor structure. Second, we conducted measurement invariance tests for all latent variables across gender groups, racial/ethnic (Asian, Black, Latino/a, and White) groups, and grade levels. Measurement invariance indicates that the construct hase similar measurement properties across groups and time; thus, it helps address if any observed differences are more likely due to true differences rather than measurement artifacts (Cheung & Rensvold, 2002). To validate this assumption, we tested for configural (factor structure), metric (factor loadings), and scalar (intercept) invariance across gender, race/ethnicity, and grade levels. Changes in CFI less than .01 and RMSEA less than .015 were considered evidence of measurement invariance of the latent constructs (Cheung & Rensvold, 2002). Third, we conducted missing data analysis to identify that any meaningful differences in effects exist between participants with complete data and participants with some missing data.

Finally, the full model was estimated through a multi-group SEM with gender as the grouping variable separately within each racial/ethnic group (see Figure S1 for the baseline model). In total, four separate multi-group models were estimated allowing us to examine gender differences independent of the influence of race/ethnicity. In each multi-group model, we tested if there were differences in the paths between boys and girls with the chi-square difference test. Chi-square difference tests were estimated to compare two nested models: one where the paths were constrained to be equal across boys and girls and one where the paths were allowed to vary across boys and girls (Satorra & Bentler, 2010). A significant chi-square difference test indicates that path coefficients significantly differ across gender. When a path did not evidence significant gender differences (i.e., the constrained nested model did not fit worse than the unconstrained model), we constrained the path to be equal across genders to improve parsimony and the stability of estimates. In addition to testing for gender differences, we also examined the statistical significance of each path and for indirect effects. When evaluating the significance of these indirect effects, we did not use bootstrap methods because the current data's complex structure does not support the independence of observations that is an assumption of the bootstrap methods for random sampling. Instead, we obtained the standardized estimates of indirect effects using MLR estimator, which is considered to provide valid inferences with a large sample size.

All SEMs were estimated with the sampling weights to account for the nonresponse rate in the sampling process, strata, and primary sampling unit to correct the standard errors from the stratified design of the dataset. Also, full-information maximum likelihood estimation with robust standard errors (FIML) was used to account for missing data and the non-normality in the data (Enders, 2022; Muthén & Muthén, 2017). The model fit was assessed via multiple fit indices. Specifically, we examined Tucker–Lewis Index (TLI; values ≥ .95 for excellent fit; values ≥ .90 for adequate fit), Comparative Fit Index (CFI; values ≥ .95 for excellent fit; values ≥ .90 for adequate fit), Root Mean Square Error of Approximation (RMSEA; values ≤ .06 for adequate fit), and Standardized Root Mean Square Residual (SRMR; values ≤ .08 for adequate fit) based on the Hu and Bentler (1999)'s recommendations.

Results

Preliminary Analyses

The bivariate correlation matrix and descriptive statistics are presented in Table 1. The correlations among study variables supported the current study's hypothesized relations. We calculated tolerance and variance inflation factors (VIFs) to assess potential multicollinearity among predictors (Table S1). All tolerance values were well above .20 and all VIF values were close to 1.0, indicating no evidence of problematic multicollinearity. Descriptive statistics of key study variables across gender by race/ethnicity are presented in Table 2. The CFA results with an entire sample indicated that the model fit the data well: χ^2 (153) = 1288.275, $p < 0.001$, CFI = 0.98, TLI = 0.97, RMSEA = 0.018 [0.017, 0.019]. Measurement invariance tests for gender, race/ethnicity, and grade level resulted in less than 0.01 change in CFI between models, which supports that the indicators had similar measurement properties across gender, race/ethnicity, and grade level (Table S2). The SEM with an entire sample displayed an excellent fit, $\chi 2$ (153) = 1188.867, $p <.001$, CFI = 0.98, TLI = 0.97, RMSEA =0.019 [90% CI = 0.018, 0.020], SRMR = 0.032. Regarding missing data analysis, the comparisons between students with complete data (N=12,896) and students who had at least one piece of missing data (N=5,523) demonstrated small or medium effects (ds = 0.05-0.21, see Table S4), which was deemed to not undermine statistical inferences.

Primary Analyses

Analyses revealed significant mean-level gender differences in adolescents' in-group-favoring math stereotypes, math motivational beliefs, and math GPA that varied by race/ethnicity and grade level (Table 2). In 11th grade, Asian (d = 0.49) and White boys (d = 0.38) reported stronger in-group-favoring math stereotypes than Asian and White girls, whereas no gender differences were observed in 9th grade. In contrast, Black (d = 0.25) and Latine girls (d = 0.21) reported stronger in-group-favoring stereotypes than Black and Latine boys in 9th grade, with no gender differences in 11th grade. Latine boys (d = 0.22 in 9th grade; d = 0.24 in 11th grade) and White boys (d = 0.22 in 11th grade) reported higher math expectancies than Latine and White girls, and Asian boys showed consistently higher math expectancies in 9th and 11th grade (ds = 0.22, 0.21) and higher math identity in 11th grade (d = 0.20) than Asian girls. However, no gender differences in math expectancies or identity were observed among Black adolescents. Across all racial/ethnic groups, girls reported higher math GPAs than boys (ds = 0.20–0.34).

We next present the path coefficients of the hypothesized model as shown in Figure 1. As described earlier, we tested four separate multi-group models with gender as the grouping variable to examine the relations among the focal indicators (i.e., a separate model was tested for each of the four racial/ethnic groups). Coefficients across the four separate models are compiled in Figure 1 and Table 3. The statistical significance of each path is noted with asterisks. In addition to noting the statistical significance of each path, we also tested if each path shown in Figure 1 varied across girls and boys in each racial/ethnic group with the chi-square different test. Because the statistical significance of path is a separate issue from if there are gender differences in the path (e.g., a path could be different across boys and girls but not statistically significant for either), we marked path coefficients that significantly differed across gender with superscript a in Figure 1 and Table 3. The path coefficients for the covariates are shown in Table S5 and the indirect effects are reported in Table 4.

RQ1. Reciprocal Associations Between In-Group-Favoring Math Stereotypes and Perceived Math Teacher Support From 9th Through 11th Grade

The left side of Figure 1 shows the associations between adolescents' in-group-favoring math stereotypes and perceived math teacher support from 9th to 11th grade. First, we start by describing the relative stability in each of these constructs between 9th and 11th grade. In-group–favoring math stereotypes consistently demonstrated moderate stability across all gender and racial/ethnic groups (β = 0.20–0.26, SE =0.02-0.07, p < .001-.01). Similarly, perceived teacher support showed moderate stability across most groups (β = 0.10–0.35, SE = 0.02-0.09, p < .001–.01), except among Asian boys who had non-significant coefficients. Only one gender difference was found in the eight paths that tested relative stability of these two constructs. Specifically, perceived teacher support demonstrated significant relative stability from 9th to 11th grade for Asian girls (β = 0.35, SE = 0.09, p < .001) but not for Asian boys (β = 0.04, SE = 0.07, p = .613). In sum, these two constructs demonstrated moderate stability from 9th to 11th grade across most groups with a gender difference in one of the eight paths tested.

Next, we summarize the findings on the reciprocal relations between adolescents' in-group-favoring math stereotypes and their perceptions of math teacher support. Significant positive reciprocal relations were found for Asian and White girls (see Table 3), but were largely non-significant for all other groups. In-group-favoring math stereotypes in 9th grade predicted greater perceived math teacher support in 11th grade for Asian (β = 0.21, SE = 0.06, p < .01) and White girls (β = 0.05, SE = 0.02, p < .05); also, perceived math teacher support in 9th grade predicted stronger in-group-favoring math stereotypes in 11th grade for Asian girls (β = 0.17, SE = 0.07, p < .05), White girls (β = 0.07, SE = 0.02, p < .001), and White boys (β = 0.06, SE = 0.02, p < .001). In each of these cases, having a more positive view of one's own gender's math abilities predicted an increase in perceptions of math teacher instructional support over time. Moreover, higher perceptions of math teacher support were also associated with a longitudinal increase in the belief that members of one's gender have greater math ability than those of the opposite gender.

RQ2. Associations of In-Group-Favoring Math Stereotypes and Perceived Math Teacher Support in 11th Grade with Math Outcomes in 11th and 12th Grade

The right side of Figure 1 shows the associations between (a) adolescents' in-group-favoring math stereotypes and perceived math teacher support in 11th grade, (b) their math expectancies and identity in 11th grade, and (c) their math GPA in high school. The associations between adolescents' in-group-favoring math stereotypes and their math motivational beliefs in 11th grade were consistently positive for boys as expected, though the associations were positive but less consistent for girls. Among boys across all racial/ethnic groups, in-group-favoring math stereotypes in 11th grade were positively associated with math expectancies (β = 0.10–0.13, *SE* = 0.02-0.05, p < .001–.05) and math identity (β = 0.14–0.20, *SE* = 0.01-0.09, p < .001–.05) in 11th grade. A slightly different pattern emerged for girls; female-favoring math stereotypes were positively related to math expectancies among Asian girls (β = 0.12, *SE* = 0.04, p < .01), Black girls (β = 0.08, *SE* = 0.03, p < .05), and White girls (β = 0.09, *SE* = 0.01, p < .001) and to math identity only among Black girls (β = 0.15, *SE* = 0.03, p < .001) and White girls (β = 0.14, *SE* = 0.01, p < .001). These associations were not significant for Latine girls (math expectancies: β = -0.03, *SE* = 0.05, p = .556; math identity: β = 0.04, *SE* = 0.04, p = .246). Of the eight paths tested, gender differences were observed in one association with math expectancies and two with math identity among non-White groups; in these cases, path coefficients were significant for boys but not for girls. Specifically, the association between in-group-favoring math stereotypes and math expectancies was stronger for Latine boys (β = 0.11, *SE* = 0.05, $p < .05$) than for Latine girls (β = −0.03, *SE* = 0.05, $p = .566$). The associations with math identity were also stronger for Asian boys (β = 0.20, *SE* =0.09, $p < .05$) than for Asian girls (β = 0.01, *SE* = 0.07, $p = .878$), and for Latine boys (β = 0.14, *SE* = 0.03, $p < .001$) than for Latine girls (β = 0.04, *SE* = 0.04, $p = .246$). In sum, adolescents' in-group-favoring math stereotypes were positively associated with their concurrent math expectancies and identity for Asian, Black, Latine, and White boys as well as for Black and White girls. However, these relations were less consistent for Asian girls and not significant at all for Latine girls.

Next, we describe the associations between adolescents' perceived math teacher support and their math motivational beliefs in 11th grade. In all cases except one, adolescents' perceptions of teacher support were positively associated with their math expectancies (β = 0.44–0.53, *SE* = 0.02-0.05, $p < .001$) and identity (β = 0.24–0.40, *SE* = 0.02-0.07, $p < .001$). The one exception was that perceived teacher support was not related to Asian boys' concurrent math identity (β = 0.12, *SE* = 0.09, $p = .144$). This association was significant and stronger for Asian girls (β = 0.30, *SE* = 0.07, $p < .001$), indicating a gender difference. Another gender difference was found in the association between perceived teacher support and math expectancies; although the association was significant for White girls and boys, it was stronger for White girls (β = 0.50, *SE* = 0.02, $p < .001$) than for White boys (β = 0.44, *SE* = 0.02, $p < .001$). In sum, adolescents' perceived teacher support in 11th grade was consistently associated with their concurrent math expectancies and identity, with gender differences in two of the eight paths tested.

Lastly, we describe the associations between adolescents' math motivational beliefs in 11th grade and their high school cumulative math GPAs in 12th grade. Math expectancies were positively related to math GPA for most groups (β = 0.11–0.22, *SE* = 0.02-0.05, $p < .001$). The exception was that this association was not significant for either Asian boys (β = 0.13, *SE* = 0.08, p = .097) and girls (β = 0.14, *SE* = 0.08, p = .092). It was also not significant for Latine girls (β = 0.03, *SE* = 0.06, p = .571), but was significant and stronger for Latine boys (β = 0.18, *SE* = 0.04, p < .001), indicating a gender difference. In contrast, math identity was consistently related to math GPA (β = 0.15–0.24, *SE* = 0.02-0.08, p < .001-.05), with one exception; the association was not significant for Black boys (β = 0.02, *SE* = 0.07, p = .772). This pattern indicated a gender difference, as the same association was significant and stronger for Black girls (β = 0.23, *SE* = 0.05, p < .001). In sum, math motivational beliefs in 11th grade were positively and consistently related to math GPA among Black girls, Latine boys, and White boys and girls, but less consistently among Asian boys and girls, Black boys, and Latine girls, with gender differences observed in two of the eight paths tested.

Though adolescents' in-group-favoring math stereotypes and perceived teacher support in 11th grade were not directly associated with their high school cumulative math GPA (see Table 3), there were some significant indirect effects through adolescents' math motivational beliefs (see Table 4). The findings suggest that all indirect effects from in-group-favoring math stereotypes in 11th grade were associated with their math GPA through their math expectancies and identity among White boys and White girls (β = 0.01–0.04, *SE* = 0.00-0.01, p < .001-.01). These indirect paths from adolescents' in-group-favoring stereotypes were not statistically significant for any other group. The second set of indirect paths were adolescents' perceived teacher support to their math motivational beliefs to their math GPA. These indirect effects were statistically significant for Black, Latine, and White adolescents (β = 0.04–0.11, *SE* = 0.01-0.03, p < .001-.05) except two cases. Specifically, the indirect effect through math expectancies was not significant for Latine girls and the indirect effect through math identity was not significant for Black boys. Thus, the indirect effects of adolescents' in-group-favoring math stereotypes and perceived teacher support on their math GPA were more consistent for White adolescents compared to other groups and for adolescents' perceptions of teacher support compared to their in-group-favoring math stereotypes.

Discussion

Using nationally representative data from the High School Longitudinal Study of 2009 (HSLS:09), this study examined (a) reciprocal developmental relations between adolescents' in-group-favoring math stereotypes and perceived math teacher support; (b) their associations with math motivational outcomes, including math expectancies, math identity, and math grade point average (GPA); and (c) gender differences in these associations within each of four largest racial/ethnic groups in the United States (Asian, Black, Latine, and White).

Our key findings are summarized in Table 5. First, we found developmentally divergent patterns of in-group-favoring math stereotypes and math motivational beliefs. Black and Latine girls exhibited stronger in-group-favoring stereotypes than boys in early adolescence, whereas Asian and White boys showed stronger stereotypes than girls in late adolescence. In 11th grade, boys were higher in math expectancies than girls across all other racial and ethnic groups except Black adolescents showing no gender differences. Math identity favored Asian boys over Asian girls in 11th grade, with no gender differences across all other racial/ethnic groups. Math GPAs were significantly higher for girls than boys across all racial/ethnic groups. Second, we found a reinforcing feedback loop between female-favoring math stereotypes and perceived math teacher support among Asian and White girls from early to late adolescence, but not among other gender by race/ethnicity groups. The motivational benefits of in-group-favoring math stereotypes emerged among boys across all racial/ethnic groups and Black and White girls. whereas the motivational benefits of perceived math teacher support were consistent across most social groups (except Asian boys' math identity) in our study.

Consistent with social status theory, our findings suggest that in-group-favoring math stereotypes do not develop and benefit adolescents equally; rather, social positions that privilege certain gender (e.g., boys) and racial/ethnic groups (e.g., Asian and White girls) may facilitate these processes in the United States math context. At the same time, mixed findings among some non-White groups (e.g., gender differences in the motivational benefits of stereotype lift among Latine adolescents, but not among Black adolescents) suggest that gender norms may vary significantly across racial/ethnic groups. Overall, such interplay between gender-related beliefs, attitudes, and ideas across racial/ethnic groups reinforces the importance of an intersectional approach to better capture complex motivational processes in real-world contexts. We discuss the implications of our findings in detail below.

Reciprocity between In-Group-Favoring Math Stereotypes and Perceived Math Teacher Support

We found positive reciprocal relations between female-favoring math stereotypes and perceived math teacher support from 9th to 11th grade among Asian and White girls. Consistent with developmental intergroup theory (DIT; Bigler & Liben, 2006), Asian and White girls perceived instructional support in ways that reinforces their female-favoring math stereotypes. It should be noted that our data do not allow us to disentangle whether math teachers actually provided more instructional support to Asian and White girls (e.g., due to potential racial biases; Copur-Gencturk et al., 2020) or whether they perceived greater support despite comparable levels of actual support. Nonetheless, these findings highlight the importance of Asian and White girls' *perceptions* of math teacher support, which may not always reflect teachers' objective actions but rather are reorganized by individuals' cognitive frameworks. As noted by situated expectancy-value theory (SEVT; Eccles & Wigfield, 2020) and self-fulfilling prophecy perspectives (Madon et al., 2018), we also provide evidence that Asian and White girls perceive math teachers' instructional support in stereotype-consistent ways or are especially attuned to such positive competence cues from math teachers when they hold female-favoring math stereotypes.

These findings suggest that racial/ethnic backgrounds also play a role in the developmental processes of in-group-favoring math stereotypes. Asian and White adolescents are often academically advantaged due to model minority stereotypes (e.g., beliefs that Asians are naturally good at math; McGee et al., 2017) and pro-White academic expectations and practices (Tenenbaum & Ruck, 2007). Despite gender-based disadvantages, these racial advantages may better position Asian and White girls to support female-favoring math beliefs in response to general instructional support as well as to interpret this instructional support in self-fulfilling ways. Furthermore, the pronounced associations among Asian girls may reflect their collectivistic backgrounds (Kitayama et al., 2004); thus, they may be especially sensitive to competence cues from teachers, as authority figures, in the development of female-favoring math beliefs. Taken together, the salience of reciprocity only among Asian and White girls reinforces prior conclusions that gender, racial, and ethnic identities interact to influence how gendered stereotypes develop in the social world (Eccles & Wigfield, 2020; Master et al., 2025b).

Conversely, the fact that male-favoring math stereotypes did not predict perceived teacher support among Asian and White boys indicate that these boys may not necessarily rely on such beliefs to interpret math teacher support in male-favoring ways, as their social status in math is already well established (Johnson et al., 2012; Josephs et al., 2003; Lazarides & Watt, 2015).

Still, perceived teacher support predicted White boys' male-favoring math stereotypes, which reinforces the notion of DIT that racial and gender advantages may enable certain groups to leverage even positive competence cues toward the entire class to develop their beliefs about their own group's math competence. This may also help explain why in-group-favoring math stereotypes were significantly stronger among White boys than among White girls in late adolescence. Yet, the absence of this association among Asian boys suggests that other sources of social information (e.g., parental expectations) or objective indicators of math performance may be more salient for this group in developing male-favoring math beliefs (Riegle-Crumb & Peng, 2021).

Among Black and Latine boys and girls, in-group-favoring math stereotypes were not significantly related to perceived math teacher support. Our findings suggest that cumulative racial barriers (e.g., racial bias and unfair practices; Copur-Gencturk et al., 2020) may constrain Black and Latine adolescents' ability to infer in-group-favoring math beliefs from instructional support directed toward the entire class and to perceive such support in self-fulfilling ways, consistent with prior findings that female-favoring math stereotypes may not protect Black and Latine girls from social threats (Huguet & Régner, 2009; Riegle-Crumb & Peng, 2021). At the same time, such racial/ethnic barriers may also contribute to greater variances in these reciprocal associations, making them more difficult to detect in our study. Relatedly, these non-significant associations may also partly explain why these girls' initially higher levels of in-group-favoring math stereotypes became comparable to boys' levels by 11th grade in these racial groups. Future research is thus warranted to examine the mechanisms and socio-contextual factors that thwart or facilitate the development of in-group-favoring math stereotypes among Black and Latine adolescents.

Taken together, our findings provide empirical evidence for an interplay between individual agency and social influences underlying the development of in-group-favoring math stereotypes. Particularly, our findings suggest that such stereotypes may develop even through instructional support toward the entire class rather than toward specific groups. However, these developmental patterns were significant only among Asian and White girls, suggesting that racial advantages may position only certain subgroups to develop in-group-favoring math beliefs in response to such classroom-level support within the math context.

Motivational Consequences of In-Group-Favoring Math Stereotypes and Perceived Math Teacher Support

We found that stereotype lift benefits were evident for boys across all racial/ethnic groups, but only for White and Black girls, which is consistent with prior studies documenting stronger stereotype lift benefits for boys than for girls (Evans et al., 2011; Steffens & Jelenec, 2011). Stereotype lift theory posits that academic benefits of in-group-favoring stereotypes emerge when individuals can make favorable comparisons with marginalized out-groups (Walton & Cohen, 2003; Wang et al., 2022). In light of this, boys with male-favoring math stereotypes may be better able to engage in downward comparisons with girls and thus experience increases in their math expectancies and math identity, as their male-favoring beliefs are supported within broader male-superiority STEM narratives.

Interestingly, we found mixed patterns among girls. Notably, Black girls were the only non-White female group to show evidence of motivational benefits associated with female-favoring math stereotypes. Gender-egalitarian norms of ability within Black communities—as reflected in no gender differences in both math expectancies and math identity in our data—are a well-documented source of Black girls' academic resilience (Hsieh et al., 2021; McKellar et al., 2024). Such norms may also help Black girls engage in self-enhancement processes through female-favoring math stereotypes, contributing to increases in both math expectancies and math identity. We also found that White girls with female-favoring math stereotypes showed increases in both motivational beliefs, which may reflect structural racial advantages that enable them to have motivational benefits from female-favoring math stereotypes.

However, the lack of these associations among Latine girls, but not among Black girls, clearly illustrates how gender norms within different racial communities shape unique motivational processes among girls of color with a similar social position in math. We speculate that Latine girls may be less able to engage in downward social comparisons with their male counterparts in reality even when endorsing female-favoring math stereotypes, because of traditional gender-role norms (e.g., women as caregivers and men as providers) and male dominance (Else-Quest et al., 2010) within Latine communities. Similarly, although Asian girls occupy relatively advantaged racial positions in the math contexts similar to White girls, they showed significant associations only with math expectancies, but not math identity. It may be that racial advantages associated with Asian adolescents' academic competence facilitate stereotype lift benefits for competence-related beliefs among Asian girls. However, traditional gender-role norms that persist within some Asian communities may nevertheless constrain them from identifying with math.

It is encouraging that perceived teacher support emerged as a strong predictor of increases in math motivational beliefs for both boys and girls across most racial/ethnic groups, except for Asian boys' math identity. Our findings reinforce the importance of perceived math teacher support for boys and girls in Latine and Black groups because such support may help compensate for structural barriers such as discrimination and limited learning opportunities

(Copur-Gencturk et al., 2020; Rosenbloom & Way, 2004). Regarding the exceptional pattern observed among Asian boys, cultural emphases on academic excellence (Yamamoto & Holloway, 2010) and model minority stereotypes (McGee et al., 2017) may foster a performance-based math identity (e.g., "I am a math person only if I succeed"). As a result, Asian boys may be less likely to rely on teacher support to shape their math identities (McGee et al., 2017; Shih, 2019). This interpretation is further supported by evidence that math identity among Asian boys was substantially accounted for by prior math achievement in our data (Table S5).

With respect to math GPA, in-group-favoring math stereotypes predicted achievement only indirectly through motivational beliefs among White adolescents. Consistent with Plante et al. (2013), our findings suggest that stereotype lift benefits for achievement may emerge primarily through the motivational internalization of stereotypes, with White adolescents appearing consistently racially advantaged in our data. Moreover, indirect pathways linking perceived math teacher support to math GPA among some Black and Latine adolescents further reinforce the importance of teacher support for these groups' math success (Else-Quest et al., 2013; Lee-Poon et al., 2024). Although these mediational pathways were absent among Asian adolescents, we speculate that this may be due to their consistently high math achievement, limiting the explanatory role of motivational beliefs.

Theoretical and Practical Implications

First, we uniquely integrate developmental intergroup theory (Bigler & Liben, 2006) and situated expectancy–value theory (Eccles & Wigfield, 2020) to advance our understanding of how individuals and social information interact in the development of in-group-favoring math stereotypes over time. We found that Asian and White girls with female-favoring math stereotypes were more likely to perceive math teacher support favorably, which was subsequently incorporated into their female-favoring math stereotypes, whereas Black and Latine girls did not. This pattern suggests that racial disadvantages may constrain the development of this reinforcing feedback loop among Black and Latine girls, which may help explain the developmental shift away from female-favoring math beliefs in these groups by late adolescence.

Second, we extend the literature by demonstrating gendered benefits of stereotype lift, suggesting that broader societal narratives of male superiority may shape who is most likely to benefit from in-group-favoring math stereotypes. As described by Steele's (1997) concept of "threat in the air," the more pronounced motivational benefits of in-group-favoring stereotypes for boys than girls in math expectancies and math identity (e.g., significantly positive associations for boys across all racial groups, but only within specific subgroups for girls) indicate that pervasive societal messages can create psychological barriers that prevent some girls (e.g., Asian and Latine girls) from fully internalizing or leveraging female-favoring beliefs. Yet, stereotype lift benefits for Black girls' both math expectancies identity imply that gender-related values, norms, and practices operate across multiple contextual layers (e.g., from one's racial community to broader society), such that the influence of gender norms at one layer (e.g., the racial community) may buffer those at another (e.g., broader society). Considering these dynamics would allow for a more nuanced understanding of how gender-related stereotypes are uniquely experienced and yield benefits or threats across multiple social groups.

Third and relatedly, we reinforce the importance of a race-reimaged approach to motivational processes (DeCuir-Gunby & Schutz, 2014) by showing that some traditionally assumed motivational pathways do not hold consistently across non-White groups (e.g., Asian boys and Black girls). These racially/ethnically patterned gender differences highlight unique socio-contextual influences, (dis)advantages, and experiences that adolescents from different racial/ethnic backgrounds face in the development of motivational beliefs, underscoring the importance of considering race to move beyond dominant narratives and better capture motivation in the real world.

Our findings provide several practical implications. Despite female-favoring math stereotypes in 9th grade among Black and Latine girls, the limited correlates of these stereotypes within these groups call for societal and institutional efforts, rather than simply changing individual beliefs and attitudes, to help maximize the development of positive gender beliefs and math motivational benefits among these girls. In response to race/ethnicity-based obstacles, we encourage math teachers to adopt culturally responsive practices that affirm Black and Latine girls' racial identities and lived experiences, thereby making their instructional support more meaningful and personally relevant (Kolovou, 2023). To foster girls' female-favoring math beliefs, exposing them to gender counter-stereotypical role models—such as women in STEM leadership roles who demonstrate collaborative work styles (Olsson & Martiny, 2018) or those who share similar demographic backgrounds or psychological experiences (e.g., female scientists who have overcome challenges; Lee et al., 2023)—can be a promising strategy. Furthermore, recognizing and valuing the time and effort that Black and Latine girls dedicate to learning math (Lee et al., 2021; Lee et al., 2025) may help counter dominant narratives about girls' abilities in STEM.

Limitations and Recommendations for Future Research

Despite the valuable contributions of the current study, several limitations should be acknowledged, which can inform directions for future research. First, although we believe the present study contributes to the literature on gender stereotypes about math abilities by examining in-group-favoring math stereotypes, it should be noted that female-favoring math stereotypes were assessed by reverse coding a single item that captures gender stereotypes about math. The scale used in this study was intended to assess math stereotypes favoring one gender over another (e.g., "Males are much better at math than females"), rather than general gender-based math stereotypes (e.g., "Males are good at math"). Thus, our use of reverse coding was appropriate for examining the specific gender-favoring patterns. However, prior research suggests that the way gender stereotypes are measured can influence the variation in responses (Master et al., 2025b). Therefore, future research should extend the current study's findings using alternative measures specifically designed to assess in-group-favoring gender stereotypes about math.

Second, the generalizability of the current study's findings is limited to high school students within the context of math. Given that developmental trends of gender stereotypes about math (Miller et al., 2024; Passolunghi et al., 2014; Starr et al., 2023), the associations among the study variables may differ across developmental stages. Furthermore, given that the prevalence and content of gender-based stereotypes vary across specific STEM fields—for instance, traditional gender stereotypes are more salient in areas such as engineering and computer science—we expect that the patterns of associations may also differ across STEM domains. Therefore, we encourage future research to extend this work to different age groups and other STEM fields to gain a more nuanced understanding of how these developmental processes vary across STEM disciplines with differing levels of gender-role norms (Master et al., 2025a).

Third, it is important to note that our study examined gender differences in the associations within each racial/ethnic group. Given the in-group-favoring patterns of gender stereotypes addressed in this study, we aimed to understand how such beliefs operate differently by gender. To do so, we isolated the effects of gender independent of race/ethnicity by running the models separately for each racial/ethnic group. However, caution is warranted in interpreting these findings, as this approach does not allow for direct comparisons across racial/ethnic groups within the same gender (e.g., Black girls vs. White girls). Future research should build on these findings by further exploring intersectionality—examining racial/ethnic differences within each gender or among subgroups defined by the intersection of race/ethnicity and gender.

Finally, the current findings—specific to certain subgroups of adolescents (e.g., boys, Asian and White girls)—underscore the need for future research to examine additional aspects of math teacher influences (e.g., equity-oriented teaching practices; Sparks & Pole, 2019) that may be more directly relevant for shaping in-group-favoring math beliefs among minoritized adolescents, thereby complementing the findings of the present study. Relatedly, examining both within-person dynamics (moment-to-moment changes) and stable between-person differences (developmental changes) in in-group-favoring math stereotypes and their associations with teacher influences would provide a more nuanced understanding of in-group-favoring math stereotype development within math learning environments.

Conclusion

The current study highlights gender differences in adolescents' in-group-favoring math stereotypes and their correlates within each of four largest racial/ethnic groups in the United States. Overall, we found positive reciprocal developmental relations between female-favoring math stereotypes and perceived teacher support among Asian and White girls, as well as motivational benefits of in-group-favoring math stereotypes for boys across all racial/ethnic groups and for Black and White girls. These findings suggest that gender- and racial/ethnic-based norms, disadvantages, and privileges may shape how in-group-favoring math stereotypes develop and inform math motivational beliefs and achievement over time, underscoring the need for institutional and societal efforts to counter male-superiority STEM narratives and to support girls and racially minoritized adolescents in leveraging in-group-favoring math stereotypes in math-intensive pathways.

References

Bigler, R. S., & Liben, L. S. (2006). A developmental intergroup theory of social stereotypes and prejudice. *Advances in Child Development and Behavior*, *34*, 39-89. https://doi.org/10.1016/S0065-2407(06)80004-2

Calabrese Barton, A., Kang, H., Tan, E., O'Neill, T. B., BautistaGuerra, J., & Brecklin, C. (2013). Crafting a future in science: tracing middle school girls' identity work over time and space. *American Educational Research Journal, 50*(1), 37–75. https://doi.org/10.3102/0002831212458142

Castro, A. R., & Collins, C. S. (2021). Asian American women in STEM in the lab with "White Men Named John". *Science Education*, *105*(1), 33-61. https://doi.org/10.1002/sce.21598

Chatard, A., Guimond, S., & Selimbegovic, L. (2007). "How good are you in math?" The effect of gender stereotypes on students' recollection of their school marks. *Journal of Experimental Social Psychology*, *43*(6), 1017-1024. https://doi.org/10.1016/j.jesp.2006.10.024

Cheung, G. W., & Rensvold, R. B. (2002). Evaluating goodness-of-fit indexes for testing measurement invariance. *Structural Equation Modeling, 9*(2), 233–255. https://doi.org/10.1207/S15328007SEM0902_5

Cole, E. R. (2009). Intersectionality and research in psychology. *American Psychologist, 64*(3), 170–180. https://doi.org/10.1037/a0014564

Copur-Gencturk, Y., Cimpian, J. R., Lubienski, S. T., & Thacker, I. (2020). Teachers' bias against the mathematical ability of female, Black, and Hispanic students. *Educational Researcher*, *49*(1), 30-43. https://doi.org/10.3102/0013189X19890577

Czopp, A. M., Kay, A. C., & Cheryan, S. (2015). Positive stereotypes are pervasive and powerful. *Perspectives on Psychological Science*, *10*(4), 451-463. https://doi.org/10.1177/174569161558809

DeCuir-Gunby, J. T., & Schutz, P. A. (2014). Researching race within educational psychology contexts. *Educational Psychologist*, *49*(4), 244-260. https://doi.org/10.1080/00461520.2014.957828

Dicke, A. L., Rubach, C., Safavian, N., Karabenick, S. A., & Eccles, J. S. (2021). Less direct than you thought: Do teachers transmit math value to students through their cognitive support for understanding?. *Learning and Instruction*, *76*, 101521. https://doi.org/10.1016/j.learninstruc.2021.101521

Diemer, M. A., Marchand, A. D., McKellar, S. E., & Malanchuk, O. (2016). Promotive and corrosive factors in African American students' math beliefs and achievement. *Journal of Youth and Adolescence*, *45*, 1208-1225. https://doi.org/10.1007/s10964-016-0439-9

Eccles, J. (2009). Who am I and what am I going to do with my life? Personal and collective identities as motivators of action. *Educational Psychologist*, *44*(2), 78-89. https://doi.org/10.1080/00461520902832368

Eccles, J. S., & Wigfield, A. (2020). From expectancy-value theory to situated expectancy-value theory: A developmental, social cognitive, and sociocultural perspective on motivation. *Contemporary Educational Psychology*, *61*, 101859. https://doi.org/10.1016/j.cedpsych.2020.101859

Else-Quest, N. M., & Hyde, J. S. (2016). Intersectionality in quantitative psychological research: II. Methods and techniques. *Psychology of Women Quarterly*, *40*(3), 319-336. https://doi.org/10.1177/0361684316647953

Else-Quest, N. M., Hyde, J. S., & Linn, M. C. (2010). Cross-national patterns of gender differences in mathematics: A meta-analysis. *Psychological Bulletin, 136*(1), 103–127. https://doi.org/10.1037/a0018053

Else-Quest, N. M., Mineo, C. C., & Higgins, A. (2013). Math and science attitudes and achievement at the intersection of gender and ethnicity. *Psychology of Women Quarterly*, *37*(3), 293-309. https://doi.org/10.1177/0361684313480694

Enders, C. K. (2022). *Applied missing data analysis* (2nd ed.). The Guilford Press.

Evans, A. B., Copping, K. E., Rowley, S. J., & Kurtz-Costes, B. (2011). Academic self-concept in Black adolescents: Do race and gender stereotypes matter?. *Self and Identity*, *10*(2), 263-277. https://doi.org/10.1080/15298868.2010.485358

Frenzel, A. C., Goetz, T., Pekrun, R., & Watt, H. M. (2010). Development of mathematics interest in adolescence: Influences of gender, family, and school context. *Journal of Research on Adolescence*, *20*(2), 507-537. https://doi.org/10.1111/j.1532-7795.2010.00645.x

Gaspard, H., Dicke, A. L., Flunger, B., Brisson, B. M., Häfner, I., Nagengast, B., & Trautwein, U. (2015). Fostering adolescents' value beliefs for mathematics with a relevance intervention in the classroom. *Developmental Psychology*, *51*(9), 1226. http://dx.doi.org/10.1037/dev0000028

Graham, S., & Taylor, A. Z. (2016). Attribution theory and motivation in school. In K. R. Wentzel & D. B. Miele (Eds.), *Handbook of motivation at school* (pp. 11–33). Routledge.

Hsieh, T. Y., Simpkins, S. D., & Eccles, J. S. (2021). Gender by racial/ethnic intersectionality in the patterns of adolescents' math motivation and their math achievement and engagement. *Contemporary Educational Psychology*, *66*, 101974. https://doi.org/10.1016/j.cedpsych.2021.101974

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, *6*(1), 1-55. https://doi.org/10.1080/10705519909540118

Huguet, P., & Régner, I. (2009). Counter-stereotypic beliefs in math do not protect school girls from stereotype threat. *Journal of Experimental Social Psychology*, *45*(4), 1024-1027. https://doi.org/10.1016/j.jesp.2009.04.029

Ingels, S. J., Pratt, D. J., Herget, D. R., Burns, L. J., Dever, J. A., Ottem, R., Rogers, J. E., Jin, Y., & Leinwand, S. (2011). *High school longitudinal study of 2009 (HSLS:09), Base-year data file documentation* (NCES 2011-328). Department of Education. National Center for Education Statistics. http://nces.ed.gov/surveys/hsls09/hsls09_data.asp

Johnson, H. J., Barnard-Brak, L., Saxon, T. F., & Johnson, M. K. (2012). An experimental study of the effects of stereotype threat and stereotype lift on men and women's performance in mathematics. *The Journal of Experimental Education*, *80*(2), 137-149. https://doi.org/10.1080/00220973.2011.567312

Josephs, R. A., Newman, M. L., Brown, R. P., & Beer, J. M. (2003). Status, testosterone, and human intellectual performance: Stereotype threat as status concern. *Psychological Science*, *14*(2), 158-163. https://doi.org/10.1111/1467-9280.t01-1-0143

Kelly, S., & Zhang, Y. (2016). Teacher support and engagement in math and science: Evidence from the high school longitudinal study. *The High School Journal 99*(2), 141-165. https://dx.doi.org/10.1353/hsj.2016.0005.

Kitayama, S., Snibbe, A. C., Markus, H. R., & Suzuki, T. (2004). Is there any “free” choice? Self and dissonance in two cultures. *Psychological Science*, *15*(8), 527-533. https://doi.org/10.1111/j.0956-7976.2004.0071

Kolovou, M. (2023). Embracing culturally relevant education in mathematics and science: A literature review. *The Urban Review*, *55*(1), 133-172. https://doi.org/10.1007/s11256-022-00643-4

Kurtz-Costes, B., Copping, K. E., Rowley, S. J., & Kinlaw, C. R. (2014). Gender and age differences in awareness and endorsement of gender stereotypes about academic abilities. *European Journal of Psychology of Education*, *29*(4), 603-618. https://doi.org/10.1007/s10212-014-0216-7

Lazarides, R., & Watt, H. M. (2015). Girls' and boys' perceived mathematics teacher beliefs, classroom learning environments and mathematical career intentions. *Contemporary Educational Psychology*, *41*, 51-61. https://doi.org/10.1016/j.cedpsych.2014.11.005

Lazarides, R., Schiepe-Tiska, A., Heine, J. H., & Buchholz, J. (2022). Expectancy-value profiles in math: How are student-perceived teaching behaviors related to motivational transitions?. *Learning and Individual Differences*, *98*, 102198. https://doi.org/10.1016/j.lindif.2022.102198

Lee, G., & Simpkins, S. D. (2021). Ability self-concepts and parental support may protect adolescents when they experience low support from their math teachers. *Journal of Adolescence*, *88*, 48-57. https://doi.org/10.1016/j.adolescence.2021.01.008

Lee, H., Du, W., Pedersen, R. M., Estrada, M., Adams, A. S., Barnes, R. T., ... & Hernandez, P. R. (2024). To stay, switch, or leave: A four-year longitudinal study of the situated and stable social influences on women's STEM major choices. *Contemporary Educational Psychology*, *79*, 102324. https://doi.org/10.1016/j.cedpsych.2024.102324

Lee, H., Hernandez, P. R., Tise, J. C., & Du, W. (2023). How role models can diversify college students in STEM: A social-cognitive perspective. *Theory Into Practice*, *62*(3), 232-244. https://doi.org/10.1080/00405841.2023.2226554

Lee, H., Tulagan, N. B., Lee-Poon, G., Starr, C. R., Rubach, C., Safavian, N., Goldstein, M. G., Eccles, J. S., & Simpkins, S. D. (2026a). Adolescents of color have greater mathematics values than White adolescents across gender: Replication evidence across high school and datasets in the U.S. *ZDM–Mathematics Education*. 1-18. https://doi.org/10.1007/s11858-025-01761-5

Lee, H., Lee-Poon, G., Eccles, J. S., & Simpkins, S. D. (2026b, May 29). The development of in-group-favoring math stereotypes: Teacher influence and motivational consequences. https://doi.org/10.17605/OSF.IO/W98UE

Lee, H., Yu, S. L., Kim, M., & Koenka, A. C. (2021). Concern or comfort with social comparisons matter in undergraduate physics courses: Joint consideration of situated expectancy-value theory, mindsets, and gender. *Contemporary Educational Psychology*, *67*, 102023. https://doi.org/10.1016/j.cedpsych.2021.102023

Lee, H., Yu, S. L., Lin, T.-J., & Kim, M. (2025). "Am I trying hard or harder than others?": Gender differences in reciprocal relations between perceived effort, science self-concept, and achievement in chemistry. *Contemporary Educational Psychology*, *80*, 102349. https://doi.org/10.1016/j.cedpsych.2025.102349

Lee-Poon, G., Eccles, J. S., & Simpkins, S. D. (2024). Math motivational belief development during high school by race/ethnicity: Teachers and parents as predictors of changes. *Developmental Psychology, 60*(12), 2367-2384. https://doi.org/10.1037/dev0001823

London, J. S., Lee, W. C., & Hawkins Ash, C. D. (2021). Potential engineers: A systematic literature review exploring Black children's access to and experiences with STEM. *Journal of Engineering Education*, *110*(4), 1003-1026. https://doi.org/10.1002/jee.20426

Madon, S., Jussim, L., Guyll, M., Nofziger, H., Salib, E. R., Willard, J., & Scherr, K. C. (2018). The accumulation of stereotype-based self-fulfilling prophecies. *Journal of Personality and Social Psychology, 115*(5), 825–844. https://doi.org/10.1037/pspi0000142

Markus, H., & Nurius, P. (1986). Possible selves. *American Psychologist, 41*(9), 954–969. https://doi.org/10.1037/0003-066X.41.9.954

Master, A., Meltzoff, A. N., Tang, D., & Cheryan, S. (2025a). Divergence in children's gender stereotypes and motivation across STEM fields. *Proceedings of the National Academy of Sciences*, *122*(18), e2408657122. https://doi.org/10.1073/pnas.2408657122

Master, A., Baker, S., Patel, K. S., Roy, P., & Butler, L. P. (2025b). The role of stereotypes in gender development and disparities. *Annual Review of Developmental Psychology*, *7*. https://doi.org/10.1146/annurev-devpsych-111323-115554

McGee, E. O., Thakore, B. K., & LaBlance, S. S. (2017). The burden of being "model": Racialized experiences of Asian STEM college students. *Journal of Diversity in Higher Education*, *10*(3), 253. https://doi.org/10.1037/ dhe0000022

McGuire, L., Mulvey, K. L., Goff, E., Irvin, M. J., Winterbottom, M., Fields, G. E., ... & Rutland, A. (2020). STEM gender stereotypes from early childhood through adolescence at informal science centers. *Journal of Applied Developmental Psychology*, *67*, 101109. https://doi.org/10.1016/j.appdev.2020.101109

McKellar, S. E., Marchand, A. D., Diemer, M. A., Malanchuk, O., & Eccles, J. S. (2019). Threats and supports to female students' math beliefs and achievement. *Journal of Research on Adolescence*, *29*(2), 449-465. https://doi.org/10.1111/jora.12384

McKown, C., Gregory, A., & Weinstein, R. S. (2010). *Expectations, stereotypes, and self-fulfilling prophecies in classroom and school life*. In J. Meece & J. Eccles (Eds.), Handbook of research on schools, schooling, and human development. New York: Routledge

Miller, D. I., Lauer, J. E., Tanenbaum, C., & Burr, L. (2024). The development of children's gender stereotypes about STEM and verbal abilities: A preregistered meta-analytic review of 98 studies. *Psychological Bulletin, 150*(12), 1363–1396. https://doi.org/10.1037/bul0000456

Muthén, L. K. & Muthén, B. O. (1998-2017). *Mplus user's guide* (8th ed.) Los Angeles, CA: Muthén & Muthén.

O'Brien, L. T., Blodorn, A., Adams, G., Garcia, D. M., & Hammer, E. (2015). Ethnic variation in gender-STEM stereotypes and STEM participation: An intersectional approach. *Cultural Diversity & Ethnic Minority Psychology, 21*(2), 169–180. https://doi.org/10.1037/a0037944

Ober, T. M., Coggins, M. R., Rebouças-Ju, D., Suzuki, H., & Cheng, Y. (2021). Effect of teacher support on students' math attitudes: Measurement invariance and moderation of students' background characteristics. *Contemporary Educational Psychology*, *66*, 101988. https://doi.org/10.1016/j.cedpsych.2021.101988

Olsson, M., & Martiny, S. E. (2018). Does exposure to counterstereotypical role models influence girls' and women's gender stereotypes and career choices? A review of social psychological research. *Frontiers in Psychology*, *9*, 2264. https://doi.org/10.3389/fpsyg.2018.02264

Ong, M., Wright, C., Espinosa, L., & Orfield, G. (2011). Inside the double bind: A synthesis of empirical research on undergraduate and graduate women of color in science, technology, engineering, and mathematics. *Harvard Educational Review*, *81*(2), 172-209. https://doi.org/10.17763/haer.81.2.t022245n7x4752v2

Oyserman, D. (2015). Identity-based motivation. *Emerging Trends in the Social and Behavioral Sciences*, *38*, 1-11. https://doi.org/10.1002/9781118900772.etrds0171

Passolunghi, M. C., Ferreira, T. I. R., & Tomasetto, C. (2014). Math–gender stereotypes and math-related beliefs in childhood and early adolescence. *Learning and Individual Differences*, *34*, 70-76. https://doi.org/10.1016/j.lindif.2014.05.005

Plante, I., de la Sablonniere, R., Aronson, J. M., & Theoret, M. (2013). Gender stereotype endorsement and achievement-related outcomes: The role of competence beliefs and task values. *Contemporary Educational Psychology, 38*(3), 225–235. https://doi.org/10.1016/j.cedps ych.2013.03.004.

Raabe, T., & Beelmann, A. (2011). Development of ethnic, racial, and national prejudice in childhood and adolescence: A multinational meta-analysis of age differences. *Child development*, *82*(6), 1715-1737. https://doi.org/10.1111/j.1467-8624.2011.01668.x

Riegle-Crumb, C., & Peng, M. (2021). Examining high school students' gendered beliefs about math: Predictors and implications for choice of STEM college majors. *Sociology of Education*, *94*(3), 227-248. https://doi.org/10.1177/00380407211014777

Robinson, K. A., & Lee, S. Y. (2025). Same classroom, different affordances? Demographic differences in perceptions of motivational climate in five STEM courses. *The Journal of Experimental Education*, *93*(1), 110-135. https://doi.org/10.1080/00220973.2023.2267006

Rodriguez, S. L., & Blaney, J. M. (2021). "We're the unicorns in STEM": Understanding how academic and social experiences influence sense of belonging for Latina undergraduate students. *Journal of Diversity in Higher Education*, *14*(3), 441. http://dx.doi.org/10.1037/dhe0000176

Rosenbloom, S. R., & Way, N. (2004). Experiences of discrimination among African American, Asian American, and Latino adolescents in an urban high school. *Youth & Society*, *35*(4), 420-451. https://doi.org/10.1177/0044118X03261479

Rowley, S. J., Kurtz-Costes, B., Mistry, R., & Feagans, L. (2007). Social status as a predictor of race and gender stereotypes in late childhood and early adolescence. *Social Development*, *16*(1), 150-168. https://doi.org/10.1111/j.1467

Satorra, A., & Bentler, P. M. (2010). Ensuring positiveness of the scaled difference chi-square test statistic. *Psychometrika*, *75*(2), 243-248. doi:10.1007/s11336-009-9135-y

Selig, J. P., & Little, T. D. (2012). Autoregressive and cross-lagged panel analysis for longitudinal data. In B. Laursen, T. D. Little, & N. A. Card (Eds.), *Handbook of developmental research methods* (pp. 265–278). The Guilford Press.

Seo, E., Shen, Y., & Alfaro, E. C. (2019). Adolescents' beliefs about math ability and their relations to STEM career attainment: Joint consideration of race/ethnicity and gender. *Journal of Youth and Adolescence*, *48*(2), 306-325. https://doi.org/10.1007/s10964-018-0911-9

Shih, K. Y., Chang, T. F., & Chen, S. Y. (2019). Impacts of the model minority myth on Asian American individuals and families: Social justice and critical race feminist perspectives. *Journal of Family Theory & Review, 11*(3), 412-428. https://doi.org/10.1111/jftr.12342

Shih, M., Ambady, N., Richeson, J. A., Fujita, K., & Gray, H. M. (2002). Stereotype performance boosts: The impact of self-relevance and the manner of stereotype activation. *Journal of Personality and Social Psychology, 83*(3), 638–647. https://doi.org/10.1037/0022-3514.83.3.638

Skinner, O. D., Kurtz-Costes, B., Vuletich, H., Copping, K., & Rowley, S. J. (2021). Race differences in Black and white adolescents' academic gender stereotypes across middle and late adolescence. *Cultural Diversity & Ethnic Minority Psychology, 27*(3), 537–545. https://doi.org/10.1037/cdp0000384

Sparks, D. M., & Pole, K. (2019). "Do we teach subjects or students?" Analyzing science and mathematics teacher conversations about issues of equity in the classroom. *School Science and Mathematics*, *119*(7), 405-416. https://doi.org/10.1111/ssm.12361

Starr, C. R., & Simpkins, S. D. (2021). High school students' math and science gender stereotypes: Relations with their STEM outcomes and socializers' stereotypes. *Social Psychology of Education*, *24*(1), 273-298. https://doi.org/10.1007/s11218-021-09611-4

Starr, C. R., Gao, Y., Rubach, C., Lee, G., Safavian, N., Dicke, A. L., ... & Simpkins, S. D. (2023). "Who's better at math, boys or girls?": Changes in adolescents' math gender stereotypes and their motivational beliefs from early to late adolescence. *Education Sciences*, *13*(9), 866. https://doi.org/10.3390/educsci13090866

Steele, C. M. (1997). A threat in the air: How stereotypes shape intellectual identity and performance. *American Psychologist, 52*(6), 613–629. https://doi.org/10.1037/0003-066X.52.6.613

Steffens, M. C., & Jelenec, P. (2011). Separating implicit gender stereotypes regarding math and language: Implicit ability stereotypes are self-serving for boys and men, but not for girls and women. *Sex Roles*, *64*(5), 324-335. https://doi.org/10.1007/s11199-010-9924-x

Tang, D., Meltzoff, A. N., Cheryan, S., Fan, W., & Master, A. (2024). Longitudinal stability and change across a year in children's gender stereotypes about four different STEM fields. *Developmental Psychology*, *60*(6), 1109–1130. https://doi.org/10.1037/dev0001733

Tenenbaum, H. R., & Ruck, M. D. (2007). Are teachers' expectations different for racial minority than for European American students? A meta-analysis. *Journal of Educational Psychology, 99*(2), 253–273. https://doi.org/10.1037/0022-0663.99.2.253

Valdes, O. M., Denner, J., Dickson, D. J., & Laursen, B. (2021). Teacher expectations and perceived teacher involvement anticipate changes in Latino/a middle school students' expectations of math success. *Educational Psychology*, *41*(6), 786-805. https://doi.org/10.1080/01443410.2020.1837345

Walton, G. M., & Cohen, G. L. (2003). Stereotype lift. *Journal of Experimental Social Psychology*, *39*(5), 456-467. https://doi.org/10.1016/S0022-1031(03)00019-2

Wang, M. T. (2012). Educational and career interests in math: A longitudinal examination of the links between classroom environment, motivational beliefs, and interests. *Developmental Psychology*, *48*(6), 1643. DOI: 10.1037/a0027247

Wang, M. T., Henry, D. A., Wu, W., Toro, J. D., & Huguley, J. P. (2022). Racial stereotype endorsement, academic engagement, mindset, and performance among Black and White

American adolescents. *Journal of Youth and Adolescence*, *51*(5), 984-1001. https://doi.org/10.1007/s10964-022-01587-4

Wang, M. T., Hofkens, T., & Ye, F. (2020). Classroom quality and adolescent student engagement and performance in mathematics: A multi-method and multi-informant approach. *Journal of Youth and Adolescence*, *49*, 1987-2002. https://doi.org/10.1007/s10964-020-01195-0

Wentzel, K. R. (1997). Student motivation in middle school: The role of perceived pedagogical caring. *Journal of Educational Psychology, 89,* 411– 419. http://dx.doi.org/10.1037/0022-0663.89.3.411

Wheeler, S. C., & Petty, R. E. (2001). The effects of stereotype activation on behavior: A review of possible mechanisms. *Psychological Bulletin, 127*(6), 797–826. https://doi.org/10.1037/0033-2909.127.6.797

Wille, E., Gaspard, H., Trautwein, U., Oschatz, K., Scheiter, K., & Nagengast, B. (2018). Gender stereotypes in a children's television program: Effects on girls' and boys' stereotype endorsement, math performance, motivational dispositions, and attitudes. *Frontiers in Psychology*, *9*, 2435. https://doi.org/10.3389/fpsyg.2018.02435

Yamamoto, Y., & Holloway, S. D. (2010). Parental expectations and children's academic performance in sociocultural context. *Educational Psychology Review*, *22*, 189-214. https://doi.org/10.1007/s10648-010-9121-z

Yu, R., & Singh, K. (2018). Teacher support, instructional practices, student motivation, and mathematics achievement in high school. *The Journal of Educational Research*, *111*(1), 81-94. https://doi.org/10.1080/00220671.2016.1204260

Table 1
Bivariate correlations and descriptive statistics among study variables

	1	2	3	4	5	6	7	8	9	10	11	12
1. In-group math ST 9th	-											
2. In-group math ST 11th	0.26**	-										
3. Teacher support 9th	0.07**	0.07**	-									
4. Teacher support 11th	0.04**	0.08**	0.15**	-								
5. Math expectancies 9th	0.17**	0.16**	0.39**	0.14**	-							
6. Math expectancies 11th	0.10**	0.19**	0.16**	0.48**	0.37**	-						
7. Math identity 9th	0.20**	0.19**	0.27**	0.15**	0.58**	0.35**	-					
8. Math identity 11th	0.16**	0.25**	0.16**	0.32**	0.40**	0.59**	0.57**	-				
9. Math achievement 9th	0.09**	0.10**	0.07**	0.07**	0.31**	0.25**	0.39**	0.38**	-			
10. Math GPA	0.11**	0.10**	0.11**	0.16**	0.33**	0.32**	0.36**	0.40**	0.55**	-		
11. Girls	0.04**	-0.14**	-0.04**	-0.03**	-0.10**	-0.11**	-0.05**	-0.09**	0.00	0.15**	-	
12. Socioeconomic status	0.03**	0.03**	0.01	0.03**	0.15**	0.12**	0.14**	0.13**	0.44**	0.37**	0.00	-
n	17,810	16,026	16,973	14,277	17,004	16,075	18,241	16,089	18,282	17,151	18,419	18,419
Min.	1	1	1	1	1	1	1	1	15.85	0	1	-1.92
Max.	5	5	4	4	4	4	4	4	69.93	4	2	2.98
M	3.09	3.04	2.83	2.73	2.94	2.78	2.53	2.43	40.66	2.39	1.50	0.07
SD.	0.91	0.92	0.84	0.86	0.66	0.70	0.86	0.91	11.91	0.96	0.50	0.79
Skewness	0.08	0.12	-0.45	-0.36	-0.35	-0.30	-0.16	-0.01	-0.04	-0.27	0.02	0.34
Kurtosis	0.66	0.45	-0.40	-0.60	0.29	-0.05	-0.72	-0.86	-0.62	-0.63	-2.00	-0.10
α	-	-	0.82	0.84	0.90	0.89	0.85	0.88	-	-	-	-

Note. Math stereotypes were assessed using one item. In-group math ST=In-group-favoring gender stereotypes about math abilities; Teacher support=Perceived instructional support from math teachers; Math GPA=The grade point average of all math courses taken during high school.

*p <.05. ** p <.01. *** p <.001.

Table 2

Descriptive statistics of key variables across gender by race/ethnicity

	Asian				Black			
	Boys (*n* = 829)		Girls (*n* = 817)		Boys (*n* = 1,057)		Girls (*n* = 1,020)	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
In-group math ST 9^{th}	3.19	0.87	3.11	0.78	**3.05** [a]	**1.07**	**3.32** [a]	**1.01**
In-group math ST 11^{th}	**3.31** [a]	**0.86**	**2.90** [a]	**0.81**	3.07	1.03	3.08	1.02
Teacher support 9^{th}	2.93	0.77	2.90	0.76	2.92	0.84	2.89	0.87
Teacher support 11^{th}	2.91	0.80	2.81	0.81	2.80	0.85	2.79	0.85
Math expectancies 9^{th}	**3.20** [a]	**0.58**	**3.07** [a]	**0.59**	3.08	0.59	2.96	0.64
Math expectancies 11^{th}	**3.03** [a]	**0.63**	**2.89** [a]	**0.67**	2.93	0.66	2.80	0.67
Math identity 9^{th}	2.96	0.72	2.82	0.76	2.54	0.85	2.52	0.86
Math identity 11^{th}	**2.89** [a]	**0.79**	**2.72** [a]	**0.87**	2.48	0.88	2.33	0.92
Math achievement 9^{th}	49.00	12.09	48.52	11.91	34.70	10.98	35.20	10.89
Math GPA	**2.81** [a]	**0.90**	**2.98** [a]	**0.81**	**1.82** [a]	**0.87**	**2.12** [a]	**0.91**
Socioeconomic status	0.33	0.86	0.39	0.92	-0.15	0.72	-0.16	0.74
	Latine				White			
	Boys (*n* = 1,652)		Girls (*n* = 1,652)		Boys (*n* = 5,750)		Girls (*n* = 5,642)	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
In-group math ST 9^{th}	**2.99** [a]	**1.01**	**3.19** [a]	**0.85**	3.06	0.96	3.08	0.79
In-group math ST 11^{th}	3.06	0.92	2.98	0.87	**3.20** [a]	**0.97**	**2.86** [a]	**0.82**
Teacher support 9^{th}	2.91	0.81	2.80	0.84	2.83	0.84	2.76	0.84
Teacher support 11^{th}	2.82	0.83	2.71	0.88	2.72	0.85	2.66	0.88
Math expectancies 9^{th}	**2.96** [a]	**0.64**	**2.82** [a]	**0.64**	2.98	0.67	2.85	0.66
Math expectancies 11^{th}	**2.85** [a]	**0.67**	**2.69** [a]	**0.68**	**2.83** [a]	**0.70**	**2.67** [a]	**0.72**
Math identity 9^{th}	2.48	0.86	2.40	0.83	2.55	0.87	2.46	0.86
Math identity 11^{th}	2.45	0.88	2.29	0.89	2.49	0.91	2.32	0.92
Math achievement 9^{th}	36.90	11.46	37.44	10.76	41.63	11.84	41.48	11.08
Math GPA	**1.93** [a]	**0.92**	**2.23** [a]	**0.91**	**2.33** [a]	**0.94**	**2.64** [a]	0.92
Socioeconomic status	-0.41	0.73	-0.36	0.73	0.20	0.75	0.19	0.74

Note. Means in bold indicate meaningful gender differences within each race/ethnicity. In-group math ST=In-group-favoring gender stereotypes about math abilities; Teacher support=Perceived instructional support from math teachers; Math GPA=The grade point average of all math courses taken during high school.

[a]Statistically significant effect size concerning the difference between boys and girls within each racial/ethnic group, with Cohen's *d* ranging from 0.20 to 0.49.

$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Table 3

Summary of direct path coefficients across gender within each racial/ethnic group

	Asian				Black			
	Boys		Girls		Boys		Girls	
	β	*SE*	*β*	*SE*	*β*	*SE*	*β*	*SE*
Stability Paths								
In-group math ST 9th → 11th	**0.26*****	**0.07**	**0.24*****	**0.07**	**0.26*****	**0.02**	**0.24*****	**0.02**
Support 9th → 11th	0.04^{a}	0.07	**0.35**^{***a}	**0.09**	**0.11*****	**0.02**	**0.10*****	**0.02**
Reciprocity Paths								
In-group math ST 9th → support 11th	0.06^{a}	0.11	**0.21**^{**a}	**0.06**	0.04	0.05	0.03	0.04
Support 9th → In-group math ST 11th	0.10^{a}	0.09	**0.17**^{*a}	**0.07**	0.04	0.04	0.05	0.05
Paths to Motivational Outcomes								
In-group math ST 11th → Expect 11th	**0.13****	**0.04**	**0.12****	**0.04**	**0.10***	**0.04**	**0.08***	**0.03**
In-group math ST 11th → Identity 11th	**0.20**^{*a}	**0.09**	0.01^{a}	0.07	**0.17*****	**0.04**	**0.15*****	**0.03**
Support 11th → Expectancy 11th	**0.50*****	**0.05**	**0.46*****	**0.04**	**0.49*****	**0.05**	**0.50*****	**0.05**
Support 11th → Identity 11th	0.12^{a}	0.09	**0.30**^{***a}	**0.07**	**0.37*****	**0.05**	**0.40*****	**0.05**
In-group math ST 11th → Math GPA	0.01	0.05	0.01	0.04	0.07	0.05	0.06	0.04
Support 11th → Math GPA	0.02	0.08	0.02	0.07	0.03	0.05	0.03	0.05
Expectancies 11th → Math GPA	0.13	0.08	0.14	0.08	**0.20*****	**0.04**	**0.22*****	**0.05**
Identity 11th → Math GPA	**0.15***	**0.07**	**0.16***	**0.08**	0.02^{a}	0.07	**0.23**^{***a}	**0.05**
	Latine				White			
	Boys		Girls		Boys		Girls	
	β	*SE*	*β*	*SE*	*β*	*SE*	*β*	*SE*
Stability Paths								
In-group math ST 9th → 11th	**0.24*****	**0.04**	**0.22*****	**0.03**	**0.26*****	**0.02**	**0.24*****	**0.02**
Support 9th → 11th	**0.17*****	**0.04**	**0.16*****	**0.05**	**0.11*****	**0.02**	**0.10*****	**0.02**
Reciprocity Paths								
In-group math ST 9th → Support 11th	0.02	0.06	0.02	0.05	0.01^{a}	0.02	**0.05**^{*a}	**0.02**
Support 9th → In-group math ST 11th	0.03	0.03	0.03	0.04	**0.06*****	**0.02**	**0.07*****	**0.02**
Paths to Motivational Outcomes								
In-group math ST 11th → Expect 11th	**0.11**^{*a}	**0.05**	-0.03^{a}	0.05	**0.11*****	**0.02**	**0.09*****	**0.01**

In-group math ST 11th → Identity 11th	**0.14*** a**	**0.03**	0.04 a	0.04	**0.16*** **	**0.01**	**0.14*** **	**0.01**
Support 11th → Expectancy 11th	**0.49*** **	**0.04**	**0.53*** **	**0.04**	**0.44*** a**	**0.02**	**0.50*** a**	**0.02**
Support 11th → Identity 11th	**0.25*** **	**0.04**	**0.28*** **	**0.04**	**0.24*** **	**0.02**	**0.25*** **	**0.02**
In-group Math ST 11th → Math GPA	0.00	0.03	0.00	0.03	0.01	0.01	-0.01	0.01
Support 11th → Math GPA	-0.04	0.04	-0.04	0.04	-0.01	0.02	-0.01	0.02
Expectancy 11th → Math GPA	**0.18* a**	**0.04**	0.03 a	0.06	**0.11*** **	**0.02**	**0.12*** **	**0.02**
Identity 11th → Math GPA	**0.23*** **	**0.04**	**0.24*** **	**0.04**	**0.22*** **	**0.02**	**0.23*** **	**0.02**

Note. Significant path coefficients are in bold. Gender differences in all path coefficients were tested using chi-square difference tests. In-group math ST=In-group-favoring gender stereotypes about math abilities; Support=Perceived instructional support from math teachers; Expectancy=math expectancies; Identity=math identity; Math GPA= the grade point average of all math courses taken during high school.

[a]Path coefficient that differed significantly by gender at $p < .05$.

*p <.05. ** p <.01. *** p <.001.

Table 4

Summary of indirect path coefficients across gender by race/ethnicity

	Asian				Black			
	Boys		Girls		Boys		Girls	
	β	*SE*	*β*	*SE*	*β*	*SE*	*β*	*SE*
In-group math ST 11th → Expectancy 11th → Math GPA	0.02	0.02	0.02	0.01	0.02	0.01	0.02	0.01
In-group math ST 11th → Identity 11th → Math GPA	0.03	0.03	0.00	0.01	0.01	0.01	0.04	0.02
Support 11th → Expectancy 11th → Math GPA	0.02	0.07	0.03	0.04	**0.09***	**0.04**	**0.11*****	**0.03**
Support 11th → Identity 11th → Math GPA	0.05	0.02	0.06	0.03	0.03	0.03	**0.09*****	**0.03**
	Latine				**White**			
	Boys		Girls		Boys		Girls	
	β	*SE*	*β*	*SE*	*β*	*SE*	*β*	*SE*
In-group math ST 11th → Expectancy 11th → Math GPA	0.02	0.01	-0.01	0.00	**0.01****	**0.00**	**0.01*****	**0.00**
In-group math ST 11th → Identity 11th → Math GPA	0.03	0.01	0.01	0.01	**0.04*****	**0.01**	**0.03*****	**0.01**
Support 11th → Expectancy 11th → Math GPA	**0.07***	**0.03**	0.04	0.03	**0.04*****	**0.01**	**0.08*****	**0.01**
Support 11th → Identity 11th → Math GPA	**0.05***	**0.02**	**0.05***	**0.02**	**0.05*****	**0.01**	**0.06*****	**0.01**

Note. Significant path coefficients are in bold. In-group math ST=In-group-favoring gender stereotypes about math abilities; Support=Perceived support from math teachers; Expectancy=math expectancies; Identity=math identity; Math GPA= the grade point average of all math courses taken during high school.

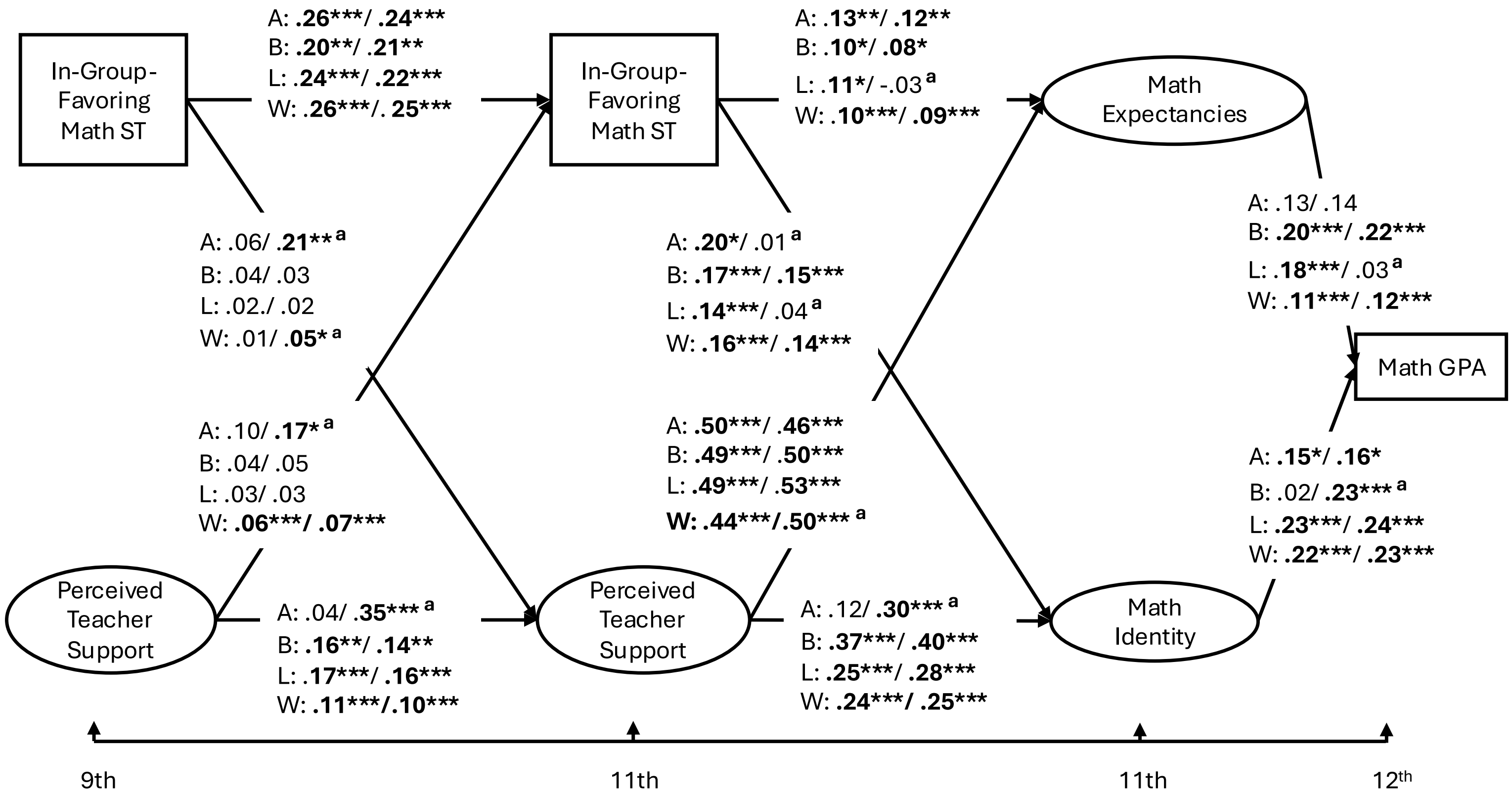
*p <.05. ** p <.01. *** p <.001.

Table 5.
Summary of key findings and supporting evidence in the current study

Key Findings	Evidence
Mean-level Trends of In-Group-Favoring Math Stereotypes	
(1) Adolescents' in-group-favoring stereotypes in 9th grade were significantly higher for Black and Latine girls than boys with no gender differences among Asian and White adolescents.	Table 2
(2) In contrast, adolescents' in-group-favoring stereotypes in 11th grade were significantly higher for Asian and White boys than girls with no gender differences among Black and Latine adolescents.	
Mean-level Trends of Math Motivational Beliefs and Math achievement	
(3) Math expectancies in 11th grade were significantly higher for Asian, Latine, and White boys than girls with no gender differences among Black adolescents.	Table 2
(4) Math identity in 11th grade was significantly higher for Asian boys than girls with no gender differences among other racial/ethnic groups.	
(5) Math GPAs were significantly higher for girls than boys across all racial/ethnic groups.	
RQ1. Developmental Processes of In-group-Favoring Math stereotypes	
(6) Asian and White girls' in-group-favoring math stereotypes and perceived math teacher support reinforced one another across 9th and 11th grades though these relations did not emerge among other groups.	Table 3; Figure 1
RQ2. Motivational Benefits of In-group-Favoring Math Stereotypes and Perceived Math Teacher Support	
(7) In-group-favoring math stereotypes positively predicted math motivational beliefs for boys across all racial/ethnic groups and for Black and White girls.	Table 3; Figure 1
(8) Perceived math teacher support positively predicted math motivational beliefs for most gender and racial/ethnic groups.	
(9) In-group-favoring math stereotypes indirectly predicted math GPA via motivational beliefs for White boys and girls; perceived math teacher support indirectly predicted math GPA for Black, Latine, and White adolescents.	Table 4

Figure 1

Standardized path coefficients for boys/girls of the four racial/ethnic groups: (A)sian, (B)lack, (L)atine, and (W)hite.



Note. Path coefficients are presented in order of boys/girls. A=Asian, B=Black, L=Latine, W=White. Significant path coefficients are in bold. Correlated errors among study variables and covariates (i.e., 9th math achievement, 9th math expectancies and math identity, and socioeconomic status) are not shown in the figure for graphical simplicity. See Figure S1 for the baseline model.

[a]Path coefficient that differed significantly by gender at $p < .05$.

*p <.05. ** p <.01. *** p <.001.