Female and Male Adolescents' Subjective Orientations in Mathematics and Their Influence on Postsecondary Majors

Lara Perez-Felkner, NORC at the University of Chicago

Sarah-Kathryn McDonald, NORC at the University of Chicago

Barbara Schneider, Michigan State University

Erin Grogan, Michigan State University

Suggested Citation:

Perez-Felkner, L., McDonald, S., Schneider, B., and Grogan, E. "Female and Male Adolescents' Subjective Orientations in Mathematics and Their Influence on Postsecondary Majors." Conditional accept pending minor revisions (submitted), *Developmental Psychology.*

* Please do not cite without written permission from the corresponding author: larap@uchicago.edu. This material is based upon work supported by the National Science Foundation under Grant No. 0815295. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Female and Male Adolescents' Subjective Orientations in Mathematics and Their Influence on Postsecondary Majors

Abstract

Although important strides towards gender parity have been made in several scientific fields, females remain underrepresented in the physical sciences, engineering, mathematics, and computer sciences (PEMC). This study examines the effects of adolescents' subjective orientations, course taking, and academic performance on the likelihood of majoring in PEMC in college. Results indicate that racial-ethnic and gender underrepresentation in STEM fields are interrelated and should be examined with attention to the intersecting factors influencing female and racial-ethnic minority adolescents' pathways towards careers in these fields. Among those who major in PEMC fields, females closely resemble males with respect to their subjective orientations. The effects of subjective orientations on females' chances of majoring in PEMC vary by their secondary school mathematics course completion levels. Females who take more mathematics courses are more likely to major in PEMC; however course taking alone does not attenuate gender disparities in declaring these majors. High mathematics ability (as measured by standardized test scores in 10th grade) appears to be positively associated with females' selection of social and behavioral and clinical and health science majors. This association is less robust (and slightly negative) for females in PEMC. While advanced course taking appears to assist females in selecting PEMC majors, females who enter these fields may not be as strong as those who select other, less male-dominated scientific fields.

Keywords: gender, postsecondary education, social psychology, career, mathematics

Female and Male Adolescents' Subjective Orientations in Mathematics and Their Influence on Postsecondary Majors

In the last fifty years, females have made substantial strides, educationally and professionally. In most industrialized nations, females have been outpacing males in educational attainment since the 1980s (Goldin, Katz, & Kuziemko, 2006; National Science Foundation, 2011; Vincent-Lancrin, 2008). By 2004, women earned 58 percent of all undergraduate degrees awarded in the U.S. (National Science Foundation, 2009) and comprised 55 percent of those enrolled in higher education in OECD (Organisation for Economic Cooperation and Development) countries. Boys no longer outperform girls in mathematics in U.S. elementary and secondary schools (Hyde, Lindberg, Linn, Ellis, & Williams, 2008), nor leave high school with more mathematics and science credits than girls (Shettle, et al., 2007). At the postsecondary level, there has been a notable increase in the proportion of women receiving undergraduate degrees in science, technology, engineering, and mathematics (STEM), however the actual numbers of females in these fields lag behind those of males (see Hill, Corbett, & St. Rose, 2010). With respect to careers, U.S. women now constitute the majority of those employed in the biological sciences (nearly 53 percent in 2008, U.S. Department of Labor, 2009).

Nevertheless, problems of underrepresentation remain, particularly in the physical science, engineering, mathematics, and computer science disciplines (hereafter, PEMC). At the postsecondary level, fewer females enter and complete degrees in physics and engineering than males (Burke, 2007; Committee on Maximizing the Potential of Women in Academic Science and Engineering (U.S.), 2007). In other fields, (e.g., mathematics), the number of females earning undergraduate degrees has stalled (Babco, 2006) or, as in the case of computer science, is "backsliding" (Busch-Vishniac & Jarosz, 2007). National Science Foundation data show that in PEMC fields, women constitute only 39 percent of those employed in mathematics, 35 percent in chemistry, 26 percent in computer and information sciences, 14 percent in physics/astronomy, and 12 percent in engineering. Examining underrepresentation in engineering more closely, females comprise 23 percent of those in chemical engineering and less than ten percent of those employed in electrical, aerospace, and mechanical engineering (National Science Foundation (NSF), 2009: Table H-5).

Considerable effort has been directed to identifying the reasons for these persistent gendered differences. Factors likely to influence students' matriculation to college and subsequent selections of a major field of study include: students' abilities (Hyde & Mertz, 2009); the effort they devote to homework and extracurricular activities (Hallinan, 2008; Peck, Roeser, Zarrett, & Eccles, 2008; Stearns & Glennie, 2010); and family characteristics (including family composition, parents' education, and family income (An, 2010). Also influential are both students' educational expectations and the expectations their parents have for them (Schoon & Parsons, 2002; Simon & Starks, 2002).

Other particularly valuable strands of work focus on: subjective factors that shape adolescents' interests in STEM majors and careers; and the factors shaping students' course taking in secondary school, and how these course selections are related to postsecondary matriculation and college majors. The intersection of these factors remains relatively unexplored. This study focuses on how adolescents' subjective orientations and course taking influence gendered differences in their pursuit of STEM careers two years after high school graduation.

Gendered Differences in Subjective Orientations to Mathematics

A substantial body of literature underscores the differences in females' and males' socializations towards mathematics (e.g., Eccles, 1994; Lips, 2004; Watt, 2006). Gendered differences in subjective orientations have been shown to emerge early. Studies have found that females receive by age five (Eccles & Hoffman, 1984; Huston, 1985) multiple messages from various sources regarding the "maleness" of science and mathematics pursuits (e.g., Farland-Smith, 2009; Hill, et al., 2010; Jacobs, Davis-Kean, Bleeker, Eccles, & Malanchuk, 2005). Such implicit and explicit messages, including those parents communicate to young girls regarding the belief that science is for boys, have been shown to have lasting effects (Jodl, Michael, Malanchuk, Eccles, & Sameroff, 2001). In the U.S., gender differences detected in eighth grade widened to the point that by the last year of secondary school, 12 percent fewer females than males agreed that they were "good" at science and mathematics (Bae, Choy, Geddes, Sable, & Snyder, 2000). These are troubling findings when considering the likely impacts on students' development of what Carlone (2004) describes as a "science identity" (i.e., the idea that one is a "science person" and can "do science").

Student engagement (and whether it differs by gender) has also been studied across disciplines and countries. While these investigations vary in their conceptualization and measurement of academic engagement (Libbey, 2004), the term generally refers to students' investments in their studies, as measured by their affective and cognitive orientations toward and behaviors in school (Connell, Spencer, & Aber, 1994; Fredricks, Blumenfeld, & Paris, 2004; Johnson, Crosnoe, & Elder, 2001). In particular, engagement has been conceptualized by Csikszentmihalyi (1990) as "flow", an intense focus strongly associated with enjoyment of the task at hand, such that one becomes totally absorbed in the task. Decades of research on the experience of flow have found that the state is most likely to occur during periods in which an individual's experience in highly challenging activities is balanced with mastery of specific skills (Hektner, Schmidt, & Csíkszentmihályi, 2007).

Central to students' perceptions of their perceived abilities are self-assessments of their capacities to understand and master difficult course material and skills. Studies of students' confidence in their mathematics abilities have found that adolescent females rate themselves lower than males, and that this comparatively lower self-confidence in mathematics is associated with lower rates of majoring and pursuit of careers in the sciences (Eccles, 1987; Ware & Lee, 1988). High school females' self-concepts appear to be particularly gendered and closely aligned with norms and values of their same-gender peers (Lee, 1998). Across numerous studies, these gender differences in confidence in one's mathematics ability emerge during middle school and increase over time (Pajares, 2005). When females in secondary school assess their mathematics and science ability more favorably, their chances of aspiring to and pursuing careers in these fields increases (Eccles (Parsons), et al., 1983; Hollinger, 1983).

Researchers have found that an open or closed mindset toward the ability to learn and achieve in mathematics, a traditionally challenging field, is indicative of future academic performance (Dweck, 2006). Females may be more likely to consider mathematics ability as an innate skill rather than a learned ability, suggesting that they may be less open to pursuing PEMC fields when they encounter challenges (Dweck, 2007). Paradoxically, high-ability females are particularly susceptible to turning away from mathematics when they encounter challenges in the curriculum. Experimental studies evaluating females' and males' mathematics performance after identical content was presented – in either a clear or confusing manner – found high-performing females were the most likely to experience "debilitation" (Licht & Dweck, 1984).

Gender differences in interest in mathematics and science, like subjective orientations more generally, emerge early and widen over time, leaving fewer females than males to perceive an intrinsic or utility value in these subjects in secondary school. The degree to which females value mathematics seems particularly constrained by contextual and cultural beliefs about the relationships among gender and abilities, competition, and career opportunities in certain fields, including physics and other “quantitative” sciences (Correll, 2004; Eccles (Parsons), et al., 1983; Ridgeway & Correll, 2004).

Research suggests subjective orientations (including students’ engagement in mathematics, perceived mathematics ability, beliefs that most people can learn to be to be good in it, valuing mathematics, and students’ likelihood of explaining their work in mathematics classes) can have potentially powerful effects on interest and persistence in STEM. Many of these orientations represent or are influenced by values adolescents acquire through their families and in other social contexts, including, within their schools and peer groups. How students feel about mathematics (and other) course material is not the sole determinant of the choices they make when it comes to pursuing educational and career options. Also important are the experiences they accumulate and skills they develop through exposure to particular course material – each of which may shape, be shaped by, and/or operate in concert with their subjective orientations to affect the transition from late adolescence to early adulthood.

Correlates and Impacts of Gendered Differences in Secondary School Course Taking

The extent to which mathematics course taking patterns are predictive of gendered disparities on the pathway to various STEM careers has in recent years been the subject of extensive examination (see e.g., Crosnoe, Riegle-Crumb, Field, Frank, & Muller, 2008; Riegle-Crumb & King, 2010). Considerable research now supports the role secondary school mathematics and science course taking plays in predicting future college attendance and completion (e.g., Adelman, 2006; Davenport, Davison, Kuang, Ding, Kim, & Kwak, 1998). Advanced course taking may affect the selectivity of postsecondary institutions students attend, especially for nonwhite students (Stearns, Potochnick, Moller, & Southworth, 2008). Math course sequences influence adolescents' social positions in their schools, such that they travel through high school with peers on a similarly rigorous academic track (Frank, et al., 2008). Decisions to persist in the most advanced math sequences are influenced by peer networks (Crosnoe, et al., 2008), in particular those of same-gender friends (Riegle-Crumb, Farkas, & Muller, 2006).

Less understood is how secondary school course taking may shape other factors (such as student background and subjective orientations) which may independently affect postsecondary enrollment and majors. Advanced course taking in mathematics and science varies considerably across individual high schools and among students with different background characteristics. Students from more affluent backgrounds are more likely to take more advanced courses than their lower-income peers, as are white and Asian students when compared to minority students (Dalton, Ingels, Downing, & Bozick, 2007; Riegle-Crumb, 2006). Low-income high schools, often attended by high percentages of minority students, are less likely to offer the opportunity to take advanced mathematics and science courses (Adelman, 2006), and have less access to resources for course advising to assist students in learning about STEM careers and postsecondary school choices.

In schools with a strong college-going culture, students, teachers, and families are aligned in orienting adolescents toward college. Teachers and counselors in such schools may, for example, actively disseminate information and resources to better prepare students for postsecondary education, potentially off-setting the disadvantages faced by less-resourced families (Schneider, 2007). Such an environment may go a long way towards fostering the subjective orientations predictive of continued interest, persistence, and ultimately success in specific STEM pursuits. An open question is whether the individual- and school-level factors that shape adolescents' interest in PEMC and other STEM programs of study in college drive – or may be altered by – their academic experiences. Particularly interesting is the possibility that students' subjective orientations influence the mathematics courses they complete in secondary school, potentially mitigating gendered differences over time.

The Present Study

Studies of gender disparities in STEM careers, *often not distinguishing among these fields*, have focused on differences in female and male orientations towards mathematics (e.g., Eccles, 1994; Lips, 2004; Watt, 2006) and mathematics course taking (Riegle-Crumb, et al., 2006). While these factors each have been found to differentially influence female and male persistence in STEM careers more generally, past research on gender disparities has tended not to investigate the potentially interacting effects they may have on PEMC majors. This study investigates this issue, focusing on the longer-term effects of secondary school students' attitudes and behaviors on PEMC persistence. Four specific hypotheses are explored: (1) selection of specific STEM sciences, social and behavioral sciences, humanities, and education postsecondary majors varies by gender; (2) subjective orientations toward academic subjects in high school are related to PEMC persistence in college; (3) subjective orientations shape females' persistence in PEMC to more closely resemble the factors that are associated with males' persistence in these majors; and (4) mathematics course taking in high school influences the effect of female gender on majoring in PEMC fields.

Method

Participants

This analysis employs data from the Educational Longitudinal Study of 2002 (ELS: 2002), the most recent U.S. nationally-representative study conducted by the National Center for Educational Statistics regarding a cohort of students that transitioned from high school to work or postsecondary education. The ELS: 2002 design includes 14,200 respondents from 750 schools who were tenth-graders in 2002, with follow-ups in 2004 and 2006 (Ingels, et al., 2007). In addition to data collected directly from the students, the dataset also includes information from their parents, teachers, and schools, as well as their high school transcripts.

Although the ELS: 2002 sample was designed to be nationally representative of tenth-grade U.S. students, the base year sample includes more females (7,300) than males (6,800) (Ingels, et al., 2007, p. 106). Investigating these gender differences and other missing data for this study, using imputation techniques, we found that the majority of missing cases were males who did not enroll in postsecondary institutions.[i] Further imputations confirmed that the sub-sample of those who declared a major (our primary focus of study) was not compromised by missing data (analyses available on request). This study reports on the females and males who declared majors by the second follow-up in 2006, resulting in an analytic sample of 2,989 students. Unlike other studies (e.g., Riegle-Crumb & King, 2010), this sample includes those females and males who enrolled in both two- and four-year institutions.

Measures

Dependent Measures. The two primary dependent measures are: (1) whether or not students enrolled in a postsecondary institution, and (2) choice of college major. Constructed from the ELS: 2002 Second Follow-up dataset, postsecondary status is distinguished by enrollment in a two- or four-year institution (0=*did not attend*, 1=*two year*, 2=*four year*). Postsecondary institutional selectivity rankings were based on NCES' Barrons' Admissions Competitiveness Index Data File for 2004 (Schmitt, 2009), modified from a seven-point to a three-point scale (1=*noncompetitive,* 2=*competitive*, 3=*more competitive*).

Postsecondary majors are self-reported and include: humanities; education; social and behavioral sciences; biological sciences; clinical and health sciences; physical sciences, engineering, mathematics, and computer sciences (PEMC); and other majors.

Independent predictors: Level I.

Student background characteristics. To control for individual and family characteristics measures include: race-ethnicity (*Asian, African American, Latino,* and *white*); foreign-born status (0=*native-born*, 1=*foreign-born*); family composition (0=*single, widowed, divorced*, 1=*married parents or in marriage-like relationships*); parent education (1=*less than high school*, 8=*PhD or other advanced degree*); family income (1=*none*, 13=*$200,000 or more*); student mathematics ability (standardized range: *-2.26* to *2.51*); and parents' expectations for their children's future educational attainment, from the parent survey (1=*less than high school*, 7=*doctorate*).

Subjective orientations. Adolescents were asked a series of items tapping the extent to which they agree (1=*strongly disagree*, 4=*strongly agree*) with statements regarding their: mathematics engagement – becoming totally absorbed in math and studying even if the material is difficult; perceived mathematics ability – the ability to understand a difficult math class and master math skills; mathematics mindset – belief that most people can learn to be good in math; mathematics participation – explaining one's work in math classes; and valuing mathematics – belief that math is important.

Student academic experiences. Adolescents were asked to report the number of hours per week they spend on extracurricular activities (0=*none*, 5=*20 or more*) and mathematics homework (0=*none*, 7=*16 or more*). Course taking was based on NCES' constructed sequences for mathematics (1=*no course in the subject*, 8=*calculus*) and science (1=*no course in the subject*, 7=*chemistry II, physics II, or advanced biology*). Students' academic grade point averages (0=*0.0-0.5*, 8=*4.0 or higher*) come from the transcript file.

Independent Predictors: Level II.

High school characteristics. With respect to high school student characteristics we include the proportion of the student population that is non-white (*0-100%*). Additionally included are measures that have been shown to be associated with college enrollment: the proportion of students taking Advanced Placement and/or International Baccalaureate courses (0=*none*, 10=*45 percent or higher*), and the proportion of 2003 graduates enrolling in a 4-year college or university (0=*none*, 6=*75-100%*). These two measures were combined to represent a high school's college-going culture; items were combined into quartiles based on these distributions (1=*low college-going culture*, 4=*high college-going culture*).

Analysis Plan

We begin by comparing the distribution of males and females who declared a postsecondary education major to those who either did not declare a major or did not enroll in postsecondary institutions. Suspecting differences in prior subjective orientations by college major we conducted a correlational analysis to examine these relationships. Given the effects of secondary school contexts on adolescents' preparedness for and interests in various scientific fields, we estimated two Hierarchical Linear Models to examine the effects of subjective orientations and course taking on college majors two years after high school graduation, and if they varied by gender. Our general HLM model assumes that students are nested in schools and estimates the effects of the predictors on the dependent variable, college major. Individual-level characteristics are entered as predictors at level 1 and high school-level characteristics are entered at level 2. The general equation for both models is:

Level-1 (student-level):
Likelihood of specific college major (2006) = $\beta_0 + \beta_1$ *Student background characteristics* $_{ij} + \beta_2$ *Subjective orientation* $_{ij} + \beta_3$ *Student academic experiences in high school* $_{ij} + \beta_4\ q_{ij}$

Level-2 (school-level):
$\beta_{1\ ij} = \gamma_{(0\text{ - fixed})} + \gamma_1$ *High School Characteristics* $_{ij} + \gamma_2\ s_{ij}$
$\beta_{2\ ij} = \gamma_{(0\text{ - fixed})} + \gamma_1$ *High School Characteristics* $_{ij} + \gamma_2\ s_{ij}$
$\beta_{3\ ij} = \gamma_{(0\text{ - fixed})} + \gamma_1$ *High School Characteristics* $_{ij} + \gamma_2\ s_{ij}$

These HLMs include several interaction terms between gender and key predictor variables to determine how these factors in combination specifically affect females' choices of a PEMC major. Odds ratio comparisons demonstrate the degree to which these predictors affect the likelihood of declaring PEMC majors two years after high school, for adolescents, taking gender into account.

Results

Comparing Gender Differences in Secondary School

Descriptive analyses presented in Table 1 examine the matriculation patterns of females and males after high school graduation, distinguishing among those who: (1) declared college majors; (2) enrolled in postsecondary institutions but did not declare majors; and (3) did not enroll in postsecondary institutions. We focus here, and in the remainder of our analyses, on those who declared college majors two years after secondary school.

[INSERT TABLE 1]

Males constitute a smaller proportion of those who declared a college major. Males who declared majors tend to be from slightly more advantaged backgrounds; on average, their families are more likely to have higher incomes, and their parents are more likely to have completed higher levels of education and be married. Males also score higher on their 10th grade mathematics ability test than females, although their college educational expectations are lower than females'. With respect to student academic experiences in high school, females who declare a college major exceed males on some measures of secondary school effort and performance. Their grade point averages are significantly higher and they spend marginally more time (16 minutes each week) on mathematics homework. However according to their high school transcripts, females complete slightly fewer advanced math and science courses than males.

Turning to students' subjective orientations; in the 10th grade, males' perceived mathematics ability, on average, was higher than females' and they were more likely to agree with the statement that mathematics is "important." Males also reported higher levels of being absorbed in mathematics and the belief that most people can learn to be good in math. With respect to postsecondary experience, when asked two years after high school if their secondary school math experiences prepared them for postsecondary education, males are more likely to agree than females.

Comparing Gender Differences in College Majors

Two years after graduating from high school, female and male postsecondary majors vary considerably (see Table 2). As others have found, gender differences are greatest in the clinical and health sciences, with 15% more females than males majoring in these fields; more females (7.8%) than males major in education.

[INSERT TABLE 2]

The next largest difference is seen in the PEMC majors, with 11% more males than females majoring in engineering. Two other PEMC differences are less pronounced; 5.4% more males major in computer sciences, 0.8% more in mathematics. Combining the totals across PEMC disciplines, nearly a quarter (23%) of males, but only 5.3% of females are majoring in the physical sciences, engineering, mathematics, or computer sciences.

Relations between Subjective Orientations and Choice of College Majors

Secondary school students' subjective orientations towards mathematics are significantly related to PEMC persistence in college (see Table 3). With the exception of students' likelihood to keep studying difficult material, the overall trend of Table 3 shows that connections among subjective orientations and PEMC are the strongest, with increasingly less robust associations moving to the negative across majors. The highest correlations are found between PEMC majors and students' perceived mathematics ability (r=0.214), valuing mathematics (r=0.183), and the extent to which students were totally absorbed in mathematics (r=0.113). All three of these subjective orientations in mathematics are also positively associated with selecting a biological science major, although less robust than found with PEMC majors (r=0.106, r=0.071, and r=0.076 respectively).

[INSERT TABLE 3]

Believing that most people can learn to be good in math is positively and significantly related with being in a PEMC major (r=0.086); correlations with the other specific fields of study are insignificant with the exception of "other" majors, which is negatively significant. Also interesting is the connection between the extent to which adolescents report they would keep studying difficult mathematics material and their postsecondary majors. This item is positively correlated with biological sciences (r=0.106), PEMC (r=0.081), and social and behavioral sciences (r=0.052). However it is negatively and insignificantly related to education, clinical and health sciences, and humanities.

Explaining Gendered Differences in Predicting Selection of Specific Majors

Recall that Table 1 reported mean differences in the subjective and academic experiences of female and male adolescents who declared majors, who attended postsecondary school but did not declare majors, and who did not attend postsecondary school. Given gender differences in selection of PEMC and other science majors (reported in Table 2) and the associations between subjective orientations toward mathematics and entry into these majors (reported in Table 3), the question arises: how do subjective orientations influence these gender differences in selection of college majors? Two-level HLM multivariate logistic regression models were estimated to predict selection of specific science majors: (a) PEMC; (b) biological sciences; (c) social and behavioral sciences; and (d) clinical and health sciences, as compared to all other majors. For each outcome, these models assess the influence of individual-level and school-level factors on major choice, taking into account the influence of the other predictor variables.

Table 4 reports the likelihood of majoring in PEMC, biological, social and behavioral, and clinical and health science fields, using odds ratios. The unstandardized slope coefficients are reported in Appendix Table A2. While the magnitude and direction of the main effects and interactions are shown in each of these tables, the odds ratios reported in Table 4 can be used to interpret the direct effects of gender on college major and the moderating effects of subjective orientations and student characteristics on these differences.

[INSERT TABLE 4]

Odds ratios serve as a measure of effect size; an odds ratio relates the odds of an outcome occurring for members of one group to the odds of an outcome occurring for members of the reference category.[ii] Recall that Table 2 indicates 23.0% of those males declaring a postsecondary major two years after graduating from high school chose to major in PEMC. Thus the odds that a male will declare a PEMC major are .299 (calculated as the proportion of those who do, here 29.9%, divided by the proportion of those who do not, here 70.1%). Table 4 indicates the main effect for female gender is such that the odds a female will declare a PEMC major are .014 times the odds for males (here, .299); thus the odds a female will declare a PEMC major (.014 *.299) are .004. Using these odds to calculate the proportion of females who would declare a PEMC major, (calculated as the odds/[1+odds], i.e., 0.004/1.004) our model suggests .4% of females would declare a PEMC major two years after high school. The fact that this fitted outcome differs from the raw proportion reported in Table 2 (5.3%) suggests that an even more complex model – perhaps including additional interactions among the variables – would be worth exploring.

Gendered differences in selecting PEMC majors. With respect to student background characteristics, there are three particularly salient differences: gender, race-ethnicity, and ability. Looking first at the slope for the main effect for being female in Table 4, the odds ratio of .014 (with a slope of -4.28 as shown in Table A2) means that – accounting for the other variables in the model –females have a .01% likelihood of majoring in PEMC, while males have a .4% chance of majoring in PEMC. Second, race-ethnicity influences the likelihood of majoring in PEMC. These effects are distinct for each subgroup. Remembering that the reference group is white, African American adolescents have higher odds of majoring in PEMC fields than white adolescents (Odds ratio=3.23); Latino adolescents on the other hand have lower odds of majoring in PEMC than white adolescents (OR=.76). Turning to the interaction terms for female gender and race-ethnicity, these effects are shown to be specific to males.[iii] With respect to the third salient background predictor, the 10th grade mathematics ability test score has a positive main effect on majoring in PEMC (OR=1.36). Turning to the interaction between gender and mathematics ability (female*10th grade math ability test), the odds ratio suggests that the slightly effect of 10th grade math ability on gender differences in selecting a PEMC major as opposed to other majors is not practically significant. We return to the interaction of ability and gender in students' selection of other scientific majors below.

Adolescents' subjective orientations toward mathematics are found to influence the likelihood of majoring in PEMC. Adolescents' chances of majoring in PEMC are positively influenced by their self-reported perceptions of mathematics ability, valuing math, and their belief that math ability can be learned (mindset). Adolescents' self-reported engagement has varying effects on majoring in PEMC. Perhaps surprisingly, persistence in (domain-general) difficult material has a negative effect, while becoming absorbed in mathematics specifically has a slightly positive effect. The interaction results testing the potentially moderating effects of subjective orientations on gender differences in selecting PEMC majors suggest that, while females are statistically different from males with respect to these orientations, the practical differences (in comparison to the main effect for female gender) are small. Those females who major in PEMC seem to resemble males on their subjective orientations toward mathematics.

Accounting for the other predictor variables in the model, each additional mathematics course completed increases adolescents' odds of declaring PEMC majors (OR=1.11). This main effect also has a small but important moderating effect on the main effect of gender (interaction: .024; main effect: .014).

School effects. These analyses were conducted as multilevel models to account for the clustering of responses by school. The results indicate that, within this focused study of differences among those who declare majors, school effects are relatively weak predictors of determining the majors adolescents select in college. Here, the intraclass correlations refer to the degree to which adolescents who attended the same high school resemble one another. The intraclass correlations are significant in two of the four models. Students in schools with stronger college-going cultures and with higher concentrations of minority students have higher odds of pursuing social and behavioral sciences majors. Those in schools with higher college-going cultures have lower odds of pursuing clinical and health science majors, however.

Gendered patterns across disciplines. This pattern of small moderating effects observed for PEMC major selection does not hold for the other three categories of majors examined here: biological, social and behavioral, and clinical and health sciences. Recall that we reported the national figures for females and males' entry to specific scientific fields in Table 2. Examining the main effects for gender, we see large gender differences in selecting clinical and health sciences majors and more modest differences in selecting other scientific majors. Females have a 70.7% chance of majoring in clinical and health fields, after controlling for the predictors in our model, while males have a 25.4% chance. Meanwhile, females have a 20.4% chance of majoring in biological sciences, while males have a 16.9% chance. Similarly, females have an 18.9% chance of majoring in social and behavioral sciences, while males have a 14.5% chance.

Race-ethnicity. Racial-ethnic characteristics directly influence choice of major in all three categories and – in most cases – moderate the influence of gender as well. However the direction and magnitude of these effects varies across models. As in PEMC, being African American has a positive main effect on the chances of majoring in biological sciences (OR=1.45) and social and behavioral sciences (OR=1.37), although it has a negative effect on clinical and health science majors (OR=.79). Being Latino has a negative effect on clinical and health science majors (OR=.41), as it does in PEMC majors, but has a positive effect on biological science majors (OR=1.53) and social and behavioral sciences majors (OR=1.35). Being Asian positively predicts majoring in clinical and health science fields (OR=2.54), but negatively predicts majoring in biological (OR=.70) and social and behavioral sciences fields (OR=.86).

The magnitude and direction of the moderating effects of race-ethnicity on gendered differences in choice of major are distinctive. In the biological sciences model, the main effect for female gender is positive. Asian females have higher odds of majoring in biology, and Latina females have lower odds. In the social and behavioral sciences, Latina and Asian females each have higher odds of majoring in these fields than white females. Finally, the odds of majoring in clinical and health sciences are almost double for Latina females as compared to white females (interaction: 13.67; main effect: 7.10), but are smaller for Asian females (interaction: 2.94).

Observed vs. perceived ability. Two of the most powerful predictors of majoring in PEMC fields in comparison to other fields are observed mathematics ability (as measured by 10th grade ability test scores) and perceived mathematics ability. Mathematics ability test scores are the strongest direct predictor of majoring in the social and behavioral sciences (OR=1.51) and positively moderate females' likelihood of selecting a major in this category (i.e., interaction: 1.44; main effect: 1.38). Observed mathematics ability has a direct negative effect on majoring in clinical and health science fields (OR=.59). However, when we focus specifically on adolescent females, we see that test scores positively moderate females' likelihood of majoring in the clinical and health sciences (interaction: 8.68; main effect: 7.10). In contrast, observed mathematics ability has a negative moderating effect on females' entry into biological science fields (interaction: = 1.57; main effect: 2.08). Meanwhile, *perceived* mathematics ability has a negative moderating effect on females' selection of clinical and health science majors (interaction: = 6.05; main effect: 7.10) and social and behavioral science majors (interaction:

1.18; main effect: 1.38), but a positive association with biological science majors (interaction: 2.29; main effect: 2.08).

Engagement. Both of the math engagement measures moderate the effect of female gender on declaring non-PEMC majors. Increased persistent study of difficult material positively influences females' odds of selecting biological science majors and social and behavioral science majors, but decreases their chances of clinical and health science majors. Becoming totally absorbed in math positively influences females' odds of majoring in biological sciences and social and behavioral sciences, but again decreases their odds of selecting majors in clinical and health sciences.

Course taking. As in PEMC, mathematics course taking moderates gendered differences in selection of scientific fields two years after high school. However, while course taking interacts with gender to increase the likelihood of a PEMC major, it has the opposite effect for non-PEMC science majors. Examining adolescents' paths from secondary to postsecondary education, mathematics course taking decreases females' odds of declaring biological science majors, clinical and health science majors, and social and behavioral science majors.

Subjective Orientations for Adolescents Completing Moderate or Advanced Math Courses

Table 5 reports on analyses examining distinctions in the effects of subjective orientations on PEMC for those who completed either moderate or advanced levels of mathematics course sequences in secondary school, based on high school transcript data from the ELS study. Moderate course taking is defined as having completed some college preparatory track courses in mathematics; specifically, algebra 1, geometry, algebra II, trigonometry, and/or statistics. Advanced course taking is defined as having completed precalculus or calculus.

[INSERT TABLE 5]

Turning first to the main effect of gender, these results show that females who completed higher course taking sequences have higher odds of majoring in PEMC fields. Among those who completed moderate levels of mathematics in secondary school, females have a .2% chance of majoring in PEMC fields, compared to males who have a 2.6% chance. Among those who completed precalculus and/or calculus in secondary school, females' chances of majoring in PEMC were notably higher; they have a 16.0% chance of selecting a PEMC major while males have a 19.3% chance of selecting a PEMC major. While course taking increases females' chances of going into PEMC fields in postsecondary school, advanced course taking does not close the gap between females and males.

Subjective orientations do moderate gendered differences in majoring in PEMC fields however, and both the magnitude and direction vary by course taking level. Moderation is assessed by comparing the odds ratio for gender interactions with that of the main effect for female gender. Participating in mathematics classes is a positive moderator for females in both levels of course taking, however its influence is more pronounced for advanced (interaction: .96; main effect: .80) than for moderate (interaction: .11; main effect: .09). Among those who completed higher levels of math, however, there is a negative moderating relationship between perceived math ability and female gender (interaction: .66). A similar pattern is found with respect to mathematics mindset such that, accounting for the other predictors in the model, females who completed advanced courses and believe that mathematics is an ability that can be learned perhaps surprisingly have lower odds of majoring in PEMC than females would, irrespective of their mindset (interaction: .40; main effect: .80).

Engagement in mathematics as assessed by persistent study and absorption is a positive moderator of gender differences in the advanced course taking model (interactions: .87 and .88, respectively), indicating that females who complete these courses have higher odds of majoring in PEMC than do females who are not as interested or engaged in mathematics. Absorption in mathematics is a negative moderator of gender differences in the moderate course taking group however (interaction: .04). In the moderate course taking model, valuing math also negatively moderates gender differences (interaction: .06), indicating that females who are interested and engaged in mathematics, but do not complete advanced course sequences, have lower odds of selecting PEMC majors than do females who are less interested and engaged in mathematics.

Discussion

Using a nationally representative longitudinal dataset, our analyses focus on the underrepresentation of women at the postsecondary level in the subject areas of physical sciences, engineering, mathematics, and computer science (PEMC). These analyses specifically examine the effects of subjective orientations toward of mathematics and course taking during secondary school. Consistent with other research, we find that females are reaching parity in the biological sciences, and eclipsing males in the social and behavioral and clinical and health sciences at the postsecondary level. Males continue to strikingly outnumber females in engineering, mathematics, and computer science. The small gender differences in the physical sciences are not statistically significant.

Several subjective orientations are associated with pursuing PEMC fields and influence gendered differences in selection of scientific majors. When subjective orientations are considered in conjunction with course taking behaviors in secondary school, the results for PEMC identify several distinct gender differences. These findings suggest several different hypotheses as to why women are less likely to pursue careers in these fields (Hill, et al., 2010).

PEMC and other scientific fields. Students' perceptions of their abilities, their interests, and their engagement in specific subjects are likely to affect performance and future goals (Eccles, 2005; Eccles, Vida, & Barber, 2004). Building on existing concepts, we examined the effects of a series of measures of subjective orientation towards mathematics, across fields. We find that these subjective orientations are most closely associated with declaring PEMC majors. Adolescents in PEMC majors were more likely to perceive themselves as having mathematics ability, and coupled with that, were more likely to believe that mathematics is important. Even though PEMC majors as a whole have positive perceptions of their mathematics ability, females with the highest tenth grade mathematics ability scores appear to choose social and behavioral and clinical and health science majors two years after high school, over PEMC and biological fields. Overall, these results suggest that females who pursue PEMC majors in college are not the females who were the highest performers in high school.

Gender, subjective orientations, and courses. We then turned to examine females in PEMC more closely to gain a clearer understanding of how their secondary school experiences have shaped these differences among orientations and performance. One of the key predictors of college major has been advanced course taking in mathematics and other academic subjects (e.g., Crisp, Nora, & Taggart, 2009; Riegle-Crumb & King, 2010). The gender disparity in PEMC is strongest among those adolescents who do not complete the most advanced courses in the mathematics secondary school sequence. It may be that females in PEMC had high interest and engagement in mathematics in tenth grade, and this may have motivated them to persist in taking more advanced courses even though they received lower test scores than males. We have some evidence to suggest that mathematics course taking may be a driver for sustaining females' positive subjective orientations towards mathematics, even when their performance is lower than males.

The results comparing the moderating effects of orientations on gender differences for females who completed either advanced or moderate levels of secondary school mathematics show positive associations between the likelihood of majoring in PEMC, and interest and engagement in mathematics for the high course taking females – which would be expected. The lower course taking females who went on to major in PEMC were less interested and engaged in mathematics in 10^{th} grade. Females who major in PEMC after completing moderate levels of course taking in secondary school have higher perceptions of their abilities and a more open mindset than those who do not, but females who completed advanced mathematics courses have lower perceptions of their abilities and a more closed mindset than those who choose other majors.

It may be that females' confidence in their ability to succeed is eroded in advanced mathematics and science classrooms. This could also affect their grades. At the same time, for those females who major in PEMC, their engagement in mathematics and valuing of mathematics closely resembles that of males. Females who major in PEMC may find mathematics no more challenging than do their male classmates, but their performance may be affected by stereotype threats pertaining to the idea that females are less likely to succeed in mathematics.

Altogether, our results suggest that increasing females' mathematics course completion is important in addressing gender disparities in PEMC careers. However our results suggest that course taking alone is insufficient. While the females who select PEMC majors are those who complete the most advanced courses, the females with the highest mathematics ability early in high school go on to pursue those other scientific fields in which females have either gained parity or are eclipsing males (biological sciences, social and behavioral sciences, and clinical and health sciences). PEMC majors attract those females who are most prepared, but not those who are most able.

Limitations and Future Directions

It is important to underscore that we are examining secondary school experiences and that it is possible females' mathematics ability scores (measured here in the tenth grade) improved by the time they graduated from secondary school. It is also possible that females' performance in PEMC more generally becomes stronger in college, something we are unable to assess as the next wave of data are not yet available. However there is other evidence that suggests that females continue to leave PEMC fields at greater rates than males. One concern is that additional attention may need to be placed on helping females who show strong interest in mathematics and other PEMC fields in high school achieve more scholastically. Clearly, there are some experiences occurring in secondary school classrooms that are affecting females' performance, even when their value structures are similar to those of males.

We cannot determine in this study whether females who major in PEMC are underachieving. It may be that PEMC fields attract women confident in their abilities, irrespective of their skills. Given that females who major in PEMC look more like males, we suspect socialization factors may be affecting their performance. It may be the case, as studied by others (e.g., Eccles, Vida, & Barber, 2004), that other fields are much more attractive to females with higher ability scores in mathematics. PEMC careers are often perceived as solitary, dominated by males, with few female role models and perhaps few perceived opportunities to achieve success. Further, it may be that other fields are perceived as more amenable to balancing careers and families. At present, it seems some progress has been made in interesting females in PEMC courses and potentially careers. To continue on this positive trajectory, it may be necessary to look more closely at what happens inside these postsecondary school classrooms, and why females' performance in these areas is still lagging behind that of males.

References

Adelman, C. (2006). *The toolbox revisited: Paths to degree completion from high school through college*. Washington, D.C.: US Department of Education. Retrieved from http://www2.ed.gov/rschstat/research/pubs/toolboxrevisit/toolbox.pdf.

An, B. P. (2010). The relations between race, family characteristics, and where students apply to college. *Social Science Research, 39*(2), 310-323. doi: 10.1016/j.ssresearch.2009.08.003

Babco, E. (2006). *Four decades of STEM degrees, 1966–2004: "The devil is in the details" (STEM workforce data project: Report no. 6)*. Washington, DC: Commission on Professionals in Science and Technology. Retrieved from http://www.cpst.org/STEM/STEM6_Report.pdf.

Bae, Y., Choy, S., Geddes, C., Sable, J., & Snyder, T. (2000). *Trends in educational equity of girls & women*. Washington, DC: National Center for Education Statistics. Retrieved from http://nces.ed.gov/pubs2000/2000030.pdf.

Burke, R. J. (2007). Women and minorities in STEM: A primer. In R. J. Burke & M. C. Mattis (Eds.), *Women and minorities in science, technology, engineering and mathematics: Upping the numbers* (Vol. 1, pp. 3-27). Northampton, MA: Edward Elgar Publishing.

Busch-Vishniac, I. J., & Jarosz, J. P. (2007). Achieving greater diversity through curricular change. In R. J. Burke & M. C. Mattis (Eds.), *Women and minorities in science, technology, engineering and mathematics: Upping the numbers* (Vol. 1, pp. 245-275). Northampton, MA: Edward Elgar Publishing.

Carlone, H. B. (2004). The cultural production of science in reform-based physics: Girls' access, participation, and resistance. *Journal of Research in Science Teaching, 41*(4), 392-414. doi: 10.1002/tea.20006

Committee on Maximizing the Potential of Women in Academic Science and Engineering (U.S.). (2007). *Beyond bias and barriers: Fulfilling the potential of women in academic science and engineering*. Washington, D.C.: National Academies Press.

Connell, J. P., Spencer, M. B., & Aber, J. L. (1994). Educational risk and resilience in African-American youth: Context, self, action, and outcomes in school. *Child Development, 65*(2), 493-506. doi: 10.1111/j.1467-8624.1994.tb00765.x

Correll, S. J. (2004). Constraints into preferences: Gender, status, and emerging career aspirations. *American Sociological Review, 69*(1), 93-113. doi: 10.1177/000312240406900106

Crosnoe, R., Riegle-Crumb, C., Field, S., Frank, K. A., & Muller, C. (2008). Peer group contexts of girls' and boys' academic experiences. *Child Development, 79*(1), 139-155. doi: 10.1111/j.1467-8624.2007.01116.x

Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience: Steps toward enhancing the quality of life*. New York: Harper & Row.

Dalton, B., Ingels, S. J., Downing, J., & Bozick, R. (2007). *Advanced mathematics and science coursetaking in the spring high school senior classes of 1982, 1992, and 2004 (NCES 2007-312)*. Washington, DC: National Center for Educational Statistics, Institute of Education Sciences, US Department of Education. Retrieved from http://nces.ed.gov/pubs2007/2007312.pdf.

Davenport, E. C., Davison, M. L., Kuang, H., Ding, S., Kim, S.-K., & Kwak, N. (1998). High school mathematics course-taking by gender and ethnicity. *American Educational Research Journal, 35*(3), 497-514. doi: 10.3102/00028312035003497

Dweck, C. (2006). *Mindset: The new psychology of success*. New York: Random House.

Dweck, C. (2007). Is math a gift? Beliefs that put females at risk. In S. C. Ceci & W. M. Williams (Eds.), *Why aren't more women in science? Top researchers debate the evidence* (pp. 47-55). Washington, D.C.: American Psychological Association.

Eccles (Parsons), J. S., Adler, T., Futterman, R., Goff, S., Kaczala, C., Meece, J., & Midgley, C. (1983). Expectancies, values, and academic behaviors. In J. T. Spence (Ed.), *Perspective on achievement and achievement motivation* (pp. 75-146). San Francisco: W.H. Freeman.

Eccles, J. S. (1987). Gender roles and women's achievement-related decisions. *Psychology of Women Quarterly, 11*(2), 135-172. doi: 10.1111/j.1471-6402.1987.tb00781.x

Eccles, J. S. (1994). Understanding women's educational and occupational choices: Applying the Eccles et al. Model of achievement-related choices. *Psychology of Women Quarterly, 18*(4), 585-609. doi: 10.1111/j.1471-6402.1994.tb01049.x

Eccles, J. S., & Hoffman, L. (1984). Sex roles, socialization, and occupational behavior. In H. W. Stevenson & A. E. Siegel (Eds.), *Child development research and social policy: Volume 1* (pp. 367). Chicago: University of Chicago Press.

Eccles, J. S., Vida, M. N., & Barber, B. (2004). The relation of early adolescents' college plans and both academic ability and task-value beliefs to subsequent college enrollment. *The Journal of Early Adolescence, 24*(1), 63-77. doi: 10.1177/0272431603260919

Farland-Smith, D. (2009). Exploring middle school girls' science identities: Examining attitudes and perceptions of scientists when working "side-by-side" with scientists. *School Science and Mathematics, 109*(7), 415-427. doi: 10.1111/j.1949-8594.2009.tb17872.x

Frank, K. A., Muller, C., Schiller, K. S., Riegle-Crumb, C., Mueller, A. S., Crosnoe, R., & Pearson, J. (2008). The social dynamics of mathematics coursetaking in high school. *The American Journal of Sociology, 113*(6), 1645-1696. doi: 10.1086/587153

Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: Potential of the concept, state of the evidence. *Review of Educational Research, 74*(1), 59-109. doi: 10.3102/00346543074001059

Goldin, C., Katz, L. F., & Kuziemko, I. (2006). The homecoming of American college women: The reversal of the college gender gap. *Journal of Economic Perspectives, 20*(4), 133-156. doi: doi: 10.1257/jep.20.4.133

Hallinan, M. T. (2008). Teacher influences on students' attachment to school. *Sociology of Education, 81*, 271-283. doi: 10.1177/003804070808100303

Hektner, J. M., Schmidt, J. A., & Csíkszentmihályi, M. (2007). *Experience sampling method: Measuring the quality of everyday life*: Sage Publications.

Hill, C., Corbett, C., & St. Rose, A. (2010). *Why so few? Women in science, technology, engineering, and mathematics*. Washington DC: American Association of University Women. Retrieved from http://eric.ed.gov/PDFS/ED509653.pdf.

Hollinger, C. L. (1983). Self-perception and the career aspirations of mathematically talented female adolescents. *Journal of Vocational Behavior, 22*(1), 49-62. doi: 10.1016/0001-8791(83)90005-2

Huston, A. C. (1985). The development of sex typing: Themes from recent research. *Developmental Review, 5*(1), 1-17. doi: 10.1016/0273-2297(85)90028-0

Hyde, J. S., Lindberg, S. M., Linn, M. C., Ellis, A. B., & Williams, C. C. (2008). Gender similarities characterize math performance. *Science, 321*(5888), 494-495. doi: 10.1126/science.1160364

Hyde, J. S., & Mertz, J. E. (2009). Gender, culture, and mathematics performance. *Proceedings of the National Academy of Sciences, 106*(22), 8801-8807. doi: 10.1073/pnas.0901265106

Ingels, S. J., Pratt, D. J., Wilson, D., Burns, L. J., Currivan, D., Rogers, J. E., & Hubbard-Bednasz, S. (2007). *Educational longitudinal study of 2002 (ELS: 2002): Base-year to second follow-up data file documentation (NCES 2008-347)*. Washington, DC: National Center for Education Statistics. Retrieved from http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2008347.

Jacobs, J. E., Davis-Kean, P., Bleeker, M. M., Eccles, J. S., & Malanchuk, O. (2005). "I can, but i don't want to": The impact of parents, interests, and activities on gender differences in math. In A. M. Gallagher & J. C. Kaufman (Eds.), *Gender differences in mathematics: An integrative psychological approach* (pp. 246–263). New York: Cambridge University Press.

Jodl, K. M., Michael, A., Malanchuk, O., Eccles, J. S., & Sameroff, A. (2001). Parents' roles in shaping early adolescents' occupational aspirations. *Child Development, 72*(4), 1247-1265. doi: 10.1111/1467-8624.00345

Johnson, M. K., Crosnoe, R., & Elder, G. H. (2001). Students' attachment and academic engagement: The role of race and ethnicity. *Sociology of Education, 74*(4), 318-340. doi: 10.2307/2673138

Lee, J. D. (1998). Which kids can "become" scientists? Effects of gender, self-concepts, and perceptions of scientists. *Social Psychology Quarterly, 61*(3), 199-219. doi: 10.2307/2787108

Libbey, H. P. (2004). Measuring student relationships to school: Attachment, bonding, connectedness, and engagement. *Journal of School Health, 74*(7), 274-283. doi: 10.1111/j.1746-1561.2004.tb08284.x

Licht, B. G., & Dweck, C. S. (1984). Determinants of academic achievement: The interaction of children's achievement orientations with skill area. *Developmental Psychology, 20*(4), 628-636. doi: 10.1037/0012-1649.20.4.628

Lips, H. (2004). The gender gap in possible selves: Divergence of academic self-views among high school and university students. *Sex Roles, 50*(5), 357-371. doi: 10.1023/B:SERS.0000018891.88889.c9

National Science Foundation. (2011). *Women, minorities, and persons with disabilities in science and engineering: 2011*. Arlington, VA: http://www.nsf.gov/statistics/wmpd/.

National Science Foundation (NSF). (2009). *Women, minorities, and persons with disabilities in science and engineering: 2009 (NSF 09-305)*. Arlington, VA: National Science Foundation.

Pajares, F. (2005). Gender differences in mathematics self-efficacy beliefs. In A. M. Gallagher & J. C. Kaufman (Eds.), *Gender differences in mathematics: An integrative psychological approach* (pp. 294-315). New York: Cambridge University Press.

Peck, S. C., Roeser, R. W., Zarrett, N., & Eccles, J. S. (2008). Exploring the roles of extracurricular activity quantity and quality in the educational resilience of vulnerable adolescents: Variable- and pattern-centered approaches. *Journal of Social Issues, 64*(1), 135-156. doi: 10.1111/j.1540-4560.2008.00552.x

Ridgeway, C. L., & Correll, S. J. (2004). Unpacking the gender system: A theoretical perspective on gender beliefs and social relations. *Gender Society, 18*(4), 510-531. doi: 10.1177/0891243204265269

Riegle-Crumb, C. (2006). The path through math: Course sequences and academic performance at the intersection of race-ethnicity and gender. *American Journal of Education, 113*(1), 101-122. doi: 10.1086/506495

Riegle-Crumb, C., Farkas, G., & Muller, C. (2006). The role of gender and friendship in advanced course taking. *Sociology of Education, 79*(3), 206-228. doi: 10.1177/003804070607900302

Riegle-Crumb, C., & King, B. (2010). Questioning a white male advantage in STEM. *Educational Researcher, 39*(9), 656-664. doi: 10.3102/0013189x10391657

Schmitt, C. A. (2009). NCES-Barron's admissions competitiveness index data files: 1972, 1982, 1992, 2004, 2008, from http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2010331

Schneider, B. L. (2007). *Forming a college going culture in U.S. Public high schools*. Bill and Melinda Gates Foundation, Seattle, WA.

Schoon, I., & Parsons, S. (2002). Teenage aspirations for future careers and occupational outcomes. *Journal of Vocational Behavior, 60*(2), 262-288. doi: 10.1006/jvbe.2001.1867

Shettle, C., Rhep, S., Mordica, J., Perkins, R., Nord, C., Teodorovic, J., . . . Brown, J. (2007). *The nation's Report card: America's high school graduates – results from the 2005 NAEP high school transcript study*. Washington, D.C.: U.S. Department of Education, National Center for Education Statistics, . Retrieved from http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2007467.

Simon, C., & Starks, B. (2002). Racial differences in the effects of significant others on students' educational expectations. *Sociology of Education, 75*(4), 306-327. doi: 10.2307/3090281

Stearns, E., & Glennie, E. J. (2010). Opportunities to participate: Extracurricular activities' distribution across and academic correlates in high schools. *Social Science Research, 39*(2), 296-309. doi: DOI: 10.1016/j.ssresearch.2009.08.001

Stearns, E., Potochnick, S., Moller, S., & Southworth, S. (2008). High school course-taking and post-secondary institutional selectivity. *Research in Higher Education, 51*(4), 366-395. doi: 10.1007/s11162-009-9161-8

U.S. Department of Labor, Bureau of Labor Statistics. (2009). *Women in the labor force: A databook (Report 1018)*. Washington, D.C.

Vincent-Lancrin, S. (2008). The reversal of gender inequalities in higher education: An on-going trend. *Higher education to 2030* (Vol. 1: Demography, pp. 265-298). Paris: OECD Publishing.

Ware, N. C., & Lee, V. E. (1988). Sex differences in choice of college science majors. *American Educational Research Journal, 25*(4), 593-614. doi: 10.3102/00028312025004593

Watt, H. M. G. (2006). The role of motivation in gendered educational and occupational trajectories related to maths. *Educational Research and Evaluation, 12*(4), 305-322. doi: 10.1080/13803610600765562

Footnotes

[i] This comparison table is available from the authors by request. We report on the construction of our measures in the Appendix in Table A1.

[ii] Positive values for odds ratios range from 1 to infinity, while the set of possible negative values ranges from 0 to 1.

[iii] The moderation suggested by the interaction terms can be examined in detail with Table A2, which shows the slopes for the main effects of each predictor as well as the slopes for the interaction terms. Statistical significance for the interaction terms is assessed using a post-hoc test to evaluate the difference between the interaction and the main effect.

Table 1

Sample Characteristics, by Gender

	Postsecondary major declared		Enrolled in postsecondary but no major declared		Not enrolled in a postsecondary institution	
	Females	Males	Females	Males	Females	Males
	N= 1751	N= 1238	N= 441	N= 408	N= 396	N= 497
	$\bar{X}$ (SD)	$\bar{X}$ (SD)	$\bar{X}$ (SD)	$\bar{X}$ (SD)	$\bar{X}$ (SD)	$\bar{X}$ (SD)
Student background characteristics						
Race and ethnicity						
White	0.764	0.779	0.719	0.728	0.664	0.637
	(0.425)	(0.415)	(0.450)	(0.446)	(0.473)	(0.481)
Asian American	0.041	0.063 *	0.073	0.061	0.027	0.022
	(0.200)	(0.242)	(0.261)	(0.240)	(0.163)	(0.147)
African American	0.096	0.072 *	0.071	0.082	0.091	0.113
	(0.295)	(0.258)	(0.257)	(0.274)	(0.288)	(0.317)
Latino	0.096	0.086	0.131	0.119	0.207	0.211
	(0.294)	(0.280)	(0.337)	(0.324)	(0.405)	(0.409)
Foreign-born	0.060	0.057	0.058	0.068	0.079	0.036 **
	(0.237)	(0.233)	(0.234)	(0.252)	(0.270)	(0.188)
Family composition	0.831	0.860 *	0.799	0.829	0.717	0.726
	(0.374)	(0.347)	(0.401)	(0.377)	(0.451)	(0.446)
Parents' education	4.316	4.536 **	4.214	4.454	2.706	2.957 *
	(1.775)	(1.767)	(1.901)	(1.831)	(1.397)	(1.474)
Family income	9.695	10.130 ***	9.669	9.909	8.210	8.356
	(2.102)	(1.828)	(2.206)	(2.080)	(2.356)	(2.255)
10th grade math ability test score	0.400	0.674 ***	0.325	0.534 **	-0.553	-0.312 ***
	(0.864)	(0.876)	(0.912)	(0.908)	(0.841)	(0.937)
College educational expectations	5.822	5.557 ***	5.667	5.477 *	4.490	4.090 ***
	(0.965)	(1.053)	(1.116)	(1.161)	(1.667)	(1.536)
Parent expectations	5.725	5.672	5.746	5.641	4.822	4.783
	(0.979)	(1.000)	(1.013)	(0.979)	(1.468)	(1.445)
Subjective orientations, 10th						
Math engagement						
Keeps studying even if difficult	2.897	2.936	2.720	2.751	2.427	2.415
	(0.845)	(0.837)	(0.842)	(0.893)	(0.878)	(0.845)
Becomes totally absorbed in math	2.474	2.615 ***	2.436	2.547 *	2.420	2.470

	(0.757)	(0.802)		(0.775)	(0.796)		(0.891)	(0.789)	
Valuing math	2.458	2.652	***	2.440	2.634	**	2.268	2.433	**
	(0.862)	(0.888)		(0.790)	(0.889)		(0.896)	(0.862)	
Perceived math ability	2.613	2.901	***	2.506	2.796	***	2.264	2.469	**
	(0.875)	(0.846)		(0.886)	(0.886)		(0.863)	(0.850)	
Math mindset	2.881	3.016	***	2.851	2.972	**	2.937	3.037	*
	(0.635)	(0.658)		(0.661)	(0.687)		(0.708)	(0.642)	
Math participation	2.554	2.525		2.411	2.315		2.413	2.370	
	(1.372)	(1.411)		(1.404)	(1.310)		(1.485)	(1.441)	
Student academic experiences in high school, 9th-12th									
Hours spent per week on extracurricular activities (10th)	2.691	2.776		2.551	2.489		1.827	1.973	
	(1.206)	(1.287)		(1.215)	(1.284)		(1.040)	(1.224)	
Hours spent per week on math homework (10th)	3.521	3.255	***	3.502	3.304		3.024	2.731	
	(1.978)	(2.044)		(2.196)	(2.041)		(2.342)	(2.169)	
Math sequence completion (9th-12th)	6.233	6.408	**	5.964	6.119		4.413	4.347	
	(1.318)	(1.386)		(1.377)	(1.371)		(1.276)	(1.378)	
Science sequence completion (9th-12th)	5.524	5.629	*	5.442	5.538		4.269	4.230	
	(1.110)	(1.106)		(1.129)	(1.200)		(1.250)	(1.270)	
Grade Point Average (GPA) (9th-12th)	6.007	5.659	***	5.781	5.134	***	3.901	3.459	***
	(1.393)	(1.497)		(1.398)	(1.660)		(1.597)	(1.439)	
High School Characteristics									
% Minority	26.869	26.137		29.374	28.784		31.091	32.482	
	(26.721)	(25.452)		(27.499)	(26.058)		(29.667)	(29.326)	
College-going culture	2.724	2.797	*	2.570	2.736	*	2.218	2.111	
	(0.979)	(0.927)		(0.983)	(0.936)		(0.958)	(0.886)	
Postsecondary experience									
College selectivity rank	2.309	2.364		2.491	2.449		N/A	N/A	
	(0.687)	(0.688)		(0.616)	(0.663)				
2-year college or university	0.216	0.214		0.373	0.378		N/A	N/A	
	(0.412)	(0.410)		(0.484)	(0.485)				
4-year college or university	0.778	0.783		0.613	0.605		N/A	N/A	
	(0.416)	(0.412)		(0.488)	(0.489)				
Perceives that high school math prepared for postsecondary	2.361	2.458	***	2.286	2.344		N/A	N/A	
	(0.651)	(0.594)		(0.647)	(0.643)				
Perceives that high school science prepared for postsecondary	2.243	2.241		2.078	2.207	**	N/A	N/A	
	(0.684)	(0.660)		(0.683)	(0.657)				

Source. U.S. Department of Education, National Center for Education Statistics. Educational Longitudinal Study of 2002 (ELS: 2002). We report only on cases with non-missing data on the analytic variables modeled in Tables 4 and 5.

Note. Data are weighted to population means. Significant differences between female and male means were calculated using the Bonferroni method to evaluate differences between equal and unequal sample sizes, lowering the chances of incorrectly rejecting the null hypothesis. * $p<0.05$, ** $p<0.01$, *** $p<0.001$.

Table 2

Differences in Postsecondary Major, by Gender

Majors	Females N= 1751 Percent	Males N= 1238 Percent	
Humanities	10.9%	11.3%	
Education	12.7%	4.9%	***
Social and behavioral sciences (including psychology and economics)	13.1%	10.9%	
Clinical and health sciences (e.g. nurse assisting, occupational therapy, dentistry)	19.7%	4.6%	***
Biological sciences	7.1%	5.6%	
Physical sciences (chemistry, physics, or related sciences)	1.8%	2.2%	
Engineering	1.8%	12.9%	***
Mathematics (including statistics)	0.7%	1.5%	*
Computer sciences	1.0%	6.4%	***
Other sciences (agricultural, architectural, and technology)	1.9%	3.0%	*
Other majors	29.3%	36.7%	***
Total	100.0%	100.0%	

Source. U.S. Department of Education, National Center for Education Statistics. Educational Longitudinal Study of 2002 (ELS: 2002).

Note. Data are weighted to population means. Significant differences between female and male means were calculated using the Bonferroni method. *p<0.05, ** p<0.01, *** p<0.001.

Table 3

Bivariate Correlations between Subjective Orientations and Postsecondary Majors Two Years After High School Graduation

Subjective orientation variables	Physical Sciences, Engineering, Mathematics, or Computer Science (PEMC) Majors	Biological Sciences Majors	Clinical & Health Sciences Majors	Social & Behavioral Sciences Majors	Education Majors	Humanities Majors	Other Majors
Math engagement							
Keeps studying if difficult	0.081 ***	0.106 ***	-0.021	0.052 **	-0.033	-0.020	-0.096 ***
Becomes totally absorbed in math	0.113 ***	0.076 ***	-0.015	-0.051 **	-0.028	-0.086 ***	-0.004
Valuing math	0.183 ***	0.071 ***	-0.018	-0.041 *	-0.039 *	-0.088 ***	-0.045 *
Perceived math ability	0.214 ***	0.106 ***	-0.070 ***	0.038 *	-0.036	-0.065 ***	-0.117 ***
Math mindset	0.086 ***	-0.002	0.030	-0.019	-0.012	-0.023	-0.058 **
Math participation	0.007	-0.013	-0.038 *	0.033	0.026	-0.004	0.015

Source. U.S. Department of Education, National Center for Education Statistics. Educational Longitudinal Study of 2002 (ELS: 2002).

Note. Data are weighted to population means, using the second follow up base year panel weight. Unweighted analyses yielded similar results. * $p<0.05$, ** $p<0.01$, *** $p<0.001$.

Table 4

Gendered Differences in the Likelihood of Declaring Specific Science Majors vs. Other Majors

	PEMC Majors		Biological Sciences Majors		Social and Behavioral Sciences Majors		Clinical and Health Sciences Majors	
	OR	SE	OR	SE	OR	SE	OR	SE
Student background characteristics								
Main effect for female gender	0.014 ***	0.000	2.079 ***	0.049	1.383 ***	0.019	7.102 ***	0.114
Race-ethnicity (reference: white)								
Asian	0.956 ***	0.003	0.699 ***	0.004	0.863 ***	0.004	2.540 ***	0.013
African American	3.228 ***	0.014	1.445 ***	0.012	1.372 ***	0.008	0.793 ***	0.006
Latino	0.764 ***	0.004	1.534 ***	0.011	1.354 ***	0.007	0.405 ***	0.003
10th grade math ability test score	1.356 ***	0.002	1.031 ***	0.004	1.505 ***	0.004	0.594 ***	0.002
Subjective orientations, 10th								
Math engagement								
Keeps studying even if difficult	0.852 ***	0.001	0.751 ***	0.002	1.005 *	0.002	1.048 ***	0.003
Becomes totally absorbed in math	1.096 ***	0.002	0.946 ***	0.003	0.737 ***	0.001	1.242 ***	0.003
Valuing math	1.445 ***	0.002	1.016 ***	0.003	0.780 ***	0.001	0.751 ***	0.002
Perceived math ability	1.536 ***	0.003	1.071 ***	0.003	1.026 ***	0.002	1.087 ***	0.003
Mathematics mindset	1.151 ***	0.002	1.042 ***	0.003	1.146 ***	0.003	0.940 ***	0.003
Math participation	0.971 ***	0.001	0.973 ***	0.001	1.044 ***	0.001	0.965 ***	0.001
Student academic experiences in high school, 9th-12th								
Math sequence completion (9-12th)	1.110 ***	0.001	1.607 ***	0.004	1.017 ***	0.002	0.944 ***	0.002
High school characteristics								
% Minority	1.001 ***	0.000	0.999 ***	0.000	1.006 ***	0.000	1.001 ***	0.000
College-going culture	0.943 ***	0.001	0.989 ***	0.001	1.061 ***	0.001	0.916 ***	0.001
Interactions between gender and student characteristics								
Race-ethnicity								
Female * Asian	0.012 ***	0.000	8.519 ***	0.213	1.582 ***	0.024	2.942 ***	0.051
Female * African American	0.011 ***	0.000	2.053	0.052	1.228 ***	0.019	7.180	0.134
Female * Latino	0.023 ***	0.000	0.748 ***	0.019	2.229 ***	0.034	13.672 ***	0.253
Female * 10th grade math ability test	0.010 ***	0.000	1.571 ***	0.040	1.436 ***	0.021	8.676 ***	0.152
Female * Math sequence completion (9-12th)	0.024 ***	0.000	1.567 ***	0.034	1.179 ***	0.015	6.241 ***	0.093
Interactions between gender and subjective orientations, 10th								
Female * Math engagement								
Female * Keeps studying even if difficult	0.015 ***	0.000	3.583 ***	0.084	1.942 ***	0.026	6.325 ***	0.101
Female * Becomes totally absorbed in math	0.011 ***	0.000	2.720 ***	0.064	1.725 ***	0.023	5.190 ***	0.081
Female * Valuing math	0.014 ***	0.000	1.974 ***	0.048	1.495 ***	0.021	11.426 ***	0.188
Female * Perceived math ability	0.013 ***	0.000	2.287 ***	0.055	1.182 ***	0.017	6.045 ***	0.099
Female * Mathematics mindset	0.011 ***	0.000	1.626 ***	0.037	1.184 ***	0.015	9.413 ***	0.139
Female * Math participation	0.017 ***	0.000	1.939 ***	0.046	1.361 ***	0.019	6.645 ***	0.106

Hierarchical Linear Model statistics								
Level 1 variance component	0.003	0.000	0.003	0.001	0.274	0.003	0.574	0.002
Level 2 variance component	-11.526	0.314	-11.44	0.504	-2.588	0.020	-1.111	0.006
Intraclass correlation	0.000	0.000	0.000	0.000	0.022 ***	0.000	0.091 ***	0.000
Log likelihood	-1489037 ***		-2846506 ***		-4798950 ***		-4992703 ***	
N observations	2963		2963		2963		2963	
N clusters	575		575		575		575	

Source. U.S. Department of Education, National Center for Education Statistics. Educational Longitudinal Study of 2002 (ELS: 2002).

Note. Data are weighted to population means. Odds ratios represent the change in the odds of the outcome occurring for every one-unit increase in the predictor variable, relative to 1. Odds ratios for the interaction terms were calculated by adding the coefficients of the main effect and the interaction and exponentiating this sum. Statistical significance for the interaction terms is assessed using a post-hoc test to evaluate the difference between the main effect for female gender and the interaction. These models include the following predictors, not shown for space constraints: family composition, family income, college educational expectations, parent expectations, hours spent per week on math, and weekly extracurricular hours. Full tables available upon request from the authors. Unstandardized coefficients and their standard errors are reported in Table A2.

Table 5

Gendered Differences in Likelihood of Declaring PEMC Majors, By Highest Mathematics Course Completed

	Algebra I, Geometry, Algebra II, Trigonometry, or Statistics			Precalculus or Calculus		
	OR		SE	OR		SE
Student background characteristics						
Main effect for female gender	0.090	***	0.002	0.798	***	0.014
Race-ethnicity (reference: white)						
Asian	0.254	***	0.002	1.274	***	0.005
African American	5.660	***	0.037	1.885	***	0.013
Latino	1.371	***	0.010	0.567	***	0.003
Foreign-born	2.668	***	0.017	0.827	***	0.003
Family composition	0.876	***	0.004	0.824	***	0.003
Parental education	0.811	***	0.001	1.030	***	0.001
Family income	1.153	***	0.001	1.027	***	0.001
10th grade math ability test score	1.673	***	0.005	1.197	***	0.003
College educational expectations	0.927	***	0.002	0.785	***	0.001
Parent expectations	0.925	***	0.002	1.001		0.001
Subjective orientations, 10th						
Math engagement						
Keeps studying even if difficult	0.861	***	0.002	0.769	***	0.002
Becomes totally absorbed in mathematics	0.971	***	0.003	1.166	***	0.002
Valuing math	1.364	***	0.004	1.639	***	0.003
Perceived math ability	1.487	***	0.004	1.698	***	0.004
Math mindset	0.970	***	0.003	1.254	***	0.003
Math participation	1.095	***	0.002	0.923	***	0.001
Student academic experiences in high school, 9th-12th						
Weekly extracurricular hours (10th)	0.736	***	0.001	0.842	***	0.001
Hours spent per week on math homework (10th)	1.087	***	0.001	0.934	***	0.001
Grade Point Average (GPA) (9-12th)	1.123	***	0.002	1.277	***	0.002
High school characteristics						
% Minority	1.000	**	0.000	1.002	***	0.000
College-going culture	0.961	***	0.002	0.963	***	0.001
Interactions between gender and student characteristics						
Race-ethnicity						
Asian females (female * Asian)	0.229	***	0.007	0.669	***	0.012
African American females (female * African American)	0.076	***	0.002	0.674	***	0.013
Latina females (female * Latino)	0.127	***	0.003	1.440	***	0.028
Female * 10th grade math ability test score	0.087	***	0.002	0.793		0.013
Interactions between gender and subjective orientations, 10th						
Female * Math engagement						
Female * Keeps studying even if difficult	0.123	***	0.003	0.868	***	0.014
Female * Becomes totally absorbed in math	0.044	***	0.001	0.883	***	0.014
Female * Valuing math	0.059	***	0.001	0.923	***	0.016
Female * Perceived math ability	0.099	***	0.002	0.664	***	0.011
Female * Mathematics mindset	0.147	***	0.003	0.400	***	0.006
Female * Math participation	0.107	***	0.002	0.961	***	0.016

Hierarchical Linear Model statistics				
Level 1 variance component	0.003	0.001	0.002	0.000
Level 2 variance component	-11.571	0.896	-12.274	0.450
Intraclass correlation	0.000	0.000	0.000	0.000
Log likelihood	-1390907 ***		-2669837 ***	
N observations	1381		1550	
N clusters	485		484	

Source. U.S. Department of Education, National Center for Education Statistics. Educational Longitudinal Study of 2002 (ELS: 2002).

Note. Data are weighted to population means. Odds ratios represent the change in the odds of the outcome occurring for every one-unit increase in the predictor variable, relative to 1.

Appendix Table A1

Characteristics of the Analytic Sample: Descriptions, Weighted Means, and Standard Deviations

	Definition and range	Weighted Means	SD
Student background characteristics			
Female (reference = male)	Dummy variable = 1 if female	0.60	0.49
Race-ethnicity			
White	Dummy variable = 1 if white	0.77	0.42
Asian	Dummy variable = 1 if Asian/ Asian American	0.05	0.22
African American	Dummy variable = 1 if black/ African American	0.09	0.28
Latino	Dummy variable = 1 if Hispanic / Latino	0.09	0.29
Foreign-born	Dummy variable = 1 if foreign-born	0.06	0.24
Family composition (1 = marriage-like relationships)	Dummy variable = 1 for married or marriage-like relationships and 0 for all other nonmissing categories	0.84	0.36
Parents' education	Unstandardized range 1-8; 8 = both parents (or one parent if only one was reported) completed PhD, MD, other advanced degree	4.40	1.77
Family income	Unstandardized scale representing 2001 income from all sources ranging 1-13; 13 = $200,001 or more	9.87	2.01
10th grade math ability test score	NCES instrument, standardized range; -2.26 to 2.51	0.51	0.88
College educational expectations	Educational expectations in the 10th grade are coded 1 (less than high school diploma) to 7 (doctorate).	5.71	1.01
Parent expectations (10th)	Parent expectations were obtained from the 10th grade parent survey and are coded 1 (less than high school diploma) to 7 (doctorate)	5.70	0.99
Subjective orientations			
Math engagement			
Keeps studying if material is difficult	Unstandardized scale range 1-4; 4 = strongly agree	2.91	0.84
Becomes totally absorbed in math	Unstandardized scale range 1-4; 4 = strongly agree	2.53	0.78
Valuing math (math is important)	Unstandardized scale range 1-4; 4 = strongly agree	2.53	0.88
Perceived math ability (mean of "can understand a difficult math class" and "can master math skills")	Unstandardized scale range 1-4; 4 = strongly agree	2.73	0.88
Math mindset (believe that most people can learn to be good in math)	Unstandardized scale range 1-4; 4 = strongly agree	2.94	0.65
Math participation (how often explains work to math class orally)	Unstandardized scale range 1-4; 4 = strongly agree	2.54	1.39

Student academic experiences in high school, 9th-12th			
Weekly extracurricular hours (10th)	Unstandardized scale range 1-5; 5 = 20 or more	2.72	1.24
Weekly math homework hours (10th)	Unstandardized scale range 0-7; 7 = 16 or more hours	3.41	2.01
Math pipeline completion (9th-12th)	Unstandardized scale range 1-8; ranging from 1 (no course in the subject) to 8 (most advanced courses)	6.30	1.35
Science pipeline completion (9th-12th)	Unstandardized scale range 1-7; ranging from 1 (no course in the subject) to 7 (most advanced courses)	5.57	1.11
Grade Point Average (GPA) for all academic courses (9th-12th)	GPA is coded 0 (0.00 to 0.50) to 8 (More than 4.00), includes only academic courses, honors weighted	5.86	1.45
High School Characteristics			
% Minority	Percent minority refers to the percent of nonwhite students. This variable was obtained from the 10th grade school administrator surveys.	26.59	26.27
College-going culture	Unstandardized range 1-4 based on variables below; 4 = high college-going culture	2.76	0.96
% of student body taking AP/IB courses	Percentage taking advanced courses was generated from the 12th grade administrator file, recoded by the authors from 0 (0%) to 10 (45% or higher).	3.34	2.39
% enroll in 4-year college or university	Percentage enrolled corresponds to administrator-reported proportions of high school graduates' postsecondary enrollments, coded by NCES from 1 (0%) to 6 (75-100%).	4.67	1.06
Postsecondary experience			
2-year or less than 2- year college or university	Dummy variable = 1 if highest level of education attempted is was at a 2-year institution	0.21	0.41
4-year college or university	Dummy variable = 1 if highest level of education attempted is was at a 4-year institution	0.78	0.41
Institutional selectivity rank	Unstandardized range, modified from Barrons' selectivity index 1-3; 3 = very, highly, and most competitive	2.33	0.69
Perceives that high school math prepared for postsecondary	Unstandardized range 1-3; 3 = a great deal	2.40	0.63
Perceives that high school science prepared for postsecondary	Unstandardized range 1-3; 3 = a great deal	2.24	0.67

Source. U.S. Department of Education, National Center for Education Statistics. Educational Longitudinal Study of 2002 (ELS: 2002).

Table A2

Gender Differences in Likelihood of Declaring Specific Science Majors Versus Other Majors, Two Years After High School Graduation

	PEMC Majors			Biological Sciences Majors			Social and Behavioral Sciences Majors			Clinical and Health Sciences Majors		
	b		SE	*b*		SE	*b*		SE	*b*		SE
Student background characteristics												
Main effect for female gender	-4.281	***	0.019	0.732	***	0.024	0.324	***	0.014	1.960	***	0.016
Race-ethnicity (reference: white)												
Asian	-0.045	***	0.003	-0.358	***	0.006	-0.147	***	0.004	0.932	***	0.005
African American	1.172	***	0.004	0.368	***	0.009	0.316	***	0.006	-0.232	***	0.008
Latino	-0.269	***	0.005	0.428	***	0.007	0.303	***	0.005	-0.904	***	0.009
Foreign-born (reference: native-born)	0.102	***	0.003	0.351	***	0.004	-0.095	***	0.003	-0.146	***	0.003
Family composition	-0.248	***	0.003	-0.366	***	0.003	0.139	***	0.003	0.421	***	0.003
Parental education	-0.048	***	0.001	0.011	***	0.001	0.041	***	0.001	-0.138	***	0.001
Family income	0.068	***	0.001	-0.012	***	0.001	0.016	***	0.001	-0.029	***	0.000
10th grade math ability test score	0.304	***	0.002	0.031	***	0.003	0.409	***	0.002	-0.520	***	0.003
College educational expectations	-0.230	***	0.001	0.394	***	0.002	0.240	***	0.001	0.185	***	0.001
Parent expectations	-0.014	***	0.001	0.389	***	0.002	-0.002		0.001	-0.029	***	0.001
Subjective orientations, 10th												
Math engagement												
Keeps studying even if difficult	-0.160	***	0.002	-0.286	***	0.003	0.005	*	0.002	0.047	***	0.003
Becomes totally absorbed in math	0.092	***	0.002	-0.056	***	0.003	-0.305	***	0.002	0.217	***	0.003
Valuing math	0.368	***	0.002	0.016	***	0.003	-0.248	***	0.002	-0.287	***	0.003
Perceived math ability	0.429	***	0.002	0.068	***	0.003	0.026	***	0.002	0.083	***	0.003
Mathematics mindset	0.141	***	0.002	0.041	***	0.003	0.136	***	0.002	-0.062	***	0.003
Math participation	-0.030	***	0.001	-0.027	***	0.001	0.043	***	0.001	-0.036	***	0.001
Student academic experiences in high school, 9th-12th												
Weekly extracurricular hours (10th)	-0.212	***	0.001	0.048	***	0.001	0.027	***	0.001	-0.038	***	0.001
Hours spent per week on math homework (10th)	-0.012	***	0.000	0.050	***	0.001	-0.001		0.000	-0.009	***	0.000
Math sequence completion (9-12th)	0.104	***	0.001	0.475	***	0.003	0.017	***	0.001	-0.057	***	0.002
Science sequence completion (9-12th)	0.200	***	0.001	0.326	***	0.001	0.060	***	0.001	0.032	***	0.001
Grade Point Average (GPA) (9-12th)	0.103	***	0.001	0.081	***	0.001	0.057	***	0.001	-0.014	***	0.001
High school characteristics												

% Minority	0.001	***	0.000	-0.001	***	0.000	0.006	***	0.000	0.001	***	0.000
College-going culture	-0.059	***	0.001	-0.011	***	0.001	0.059	***	0.001	-0.088	***	0.001
Interactions between gender and student characteristics												
Race-ethnicity												
Asian females (female * Asian)	-0.134	***	0.006	1.410	***	0.01	0.135	***	0.005	-0.881	***	0.006
African American females (female * African American)	-0.260	***	0.007	-0.013		0.010	-0.119	***	0.007	0.011		0.009
Latina females (female * Latino)	0.503	***	0.007	-1.023	***	0.009	0.477	***	0.006	0.655	***	0.009
Female * 10th grade math ability test score	-0.279	***	0.003	-0.280	***	0.004	0.037	***	0.003	0.200	***	0.003
Female * Math sequence completion	0.532	***	0.002	-0.282	***	0.003	-0.160	***	0.002	-0.129	***	0.002
Interactions between gender and subjective orientations												
Female * Math engagement												
Female * Keeps studying even if difficult	0.068	***	0.003	0.544	***	0.003	0.340	***	0.003	-0.116	***	0.003
Female * Becomes totally absorbed in math	-0.200	***	0.003	0.269	***	0.003	0.221	***	0.003	-0.314	***	0.003
Female * Valuing math	0.019	***	0.003	-0.052	***	0.003	0.078	***	0.002	0.476	***	0.003
Female * Perceived math ability	-0.063	***	0.003	0.095	***	0.004	-0.157	***	0.003	-0.161	***	0.003
Female * Mathematics mindset	-0.268	***	0.003	-0.246	***	0.004	-0.155	***	0.003	0.282	***	0.004
Female * Math participation	0.199	***	0.001	-0.069	***	0.002	-0.016	***	0.001	-0.067	***	0.002
Constant	-4.553	***	0.011	-12.543	***	0.023	-4.746	***	0.013	-2.539	***	0.016
Hierarchical Linear Model statistics												
Level 1 variance component	0.003		0.000	0.003		0.001	0.274		0.003	0.574		0.002
Level 2 variance component	-11.526		0.314	-11.438		0.504	-2.588		0.020	-1.111		0.006
Intraclass correlation	0.000		0.000	0.000		0.000	0.022	***	0.000	0.091	***	0.000
Log likelihood	-4165700	***		-2846506	***		-4798950	***		-4992703	***	
N observations	2963			2963			2963			2963		
N clusters	575			575			575			575		

Source. U.S. Department of Education, National Center for Education Statistics. Educational Longitudinal Study of 2002 (ELS: 2002).

Note. Data are weighted to population means. Unstandardized beta coefficients and standard errors are reported.