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Female and Male Adolescents' Subjective Orientations to Mathematics and The Influence of Those Orientations on Postsecondary Majors

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Although important strides toward gender parity have been made in several scientific fields, women remain underrepresented in the physical sciences, engineering, mathematics, and computer sciences (PEMCs). 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 science, technology, engineering, and mathematics (STEM) fields are interrelated and should be examined with attention to the intersecting factors influencing female and racial–ethnic minority adolescents' pathways toward careers in these fields. Among those who major in PEMC fields, women closely resemble men with respect to their subjective orientations. The effects of subjective orientations on women's chances of majoring in PEMC vary by their secondary school mathematics course completion levels. Women 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 the 10th grade) appears to be positively associated with women's selection of social, behavioral, clinical, and health science majors. This association is less robust (and slightly negative) for women in PEMC. While advanced course taking appears to assist women in selecting PEMC majors, women 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

In the last 50 years, women have made substantial strides, educationally and professionally. In most industrialized nations, women have been outpacing men in educational attainment since the 1980s (Goldin, Katz, & Kuziemko, 2006; National Science Foundation, 2011; Vincent-Lancrin, 2008). By 2004, women earned 58% of all undergraduate degrees awarded in the United States (National Science Foundation, 2009) and comprised 55% of those enrolled in higher education in Organisation for Economic Cooperation and Development (OECD) countries. Boys no longer outperform girls in mathematics in U.S. elementary and secondary schools (Hyde, Lindberg, Linn, Ellis, & Williams, 2008), nor do boys leave high school with more mathematics and science credits than do 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 women in these fields lag behind those of men (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% in 2008, U.S. Department of Labor, Bureau of Labor Statistics, 2009).

Nevertheless, problems of underrepresentation remain, particularly in the physical science, engineering, mathematics, and computer science disciplines (PEMC). At the postsecondary level, fewer women enter and complete degrees in physics and engineering than men (Burke, 2007; Committee on Maximizing the Potential of Women in Academic Science and Engineering, 2007). In other fields (e.g., mathematics), the number of women 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% of those employed in mathematics, 35% in chemistry, 26% in computer and information sciences, 14% in physics/astronomy, and 12% in engineering. Examining underrepresentation in engineering more closely, women comprise 23% of those in chemical engineering and less than 10% of those employed in electrical, aerospace, and mechanical engineering (National Science Foundation, 2009: Table H5).

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Considerable effort has been directed at 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 the students' educational expectations and the expectations their parents have for them (Cheng & Starks, 2002; Schoon & Parsons, 2002).

Other particularly valuable strands of work focus on the subjective factors that shape adolescents' interests in STEM majors and careers, 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 2 years after high school graduation.

Gendered Differences in Subjective Orientations to Mathematics

A substantial body of literature underscores the differences in women's and men's socializations toward mathematics (e.g., Eccles, 1994; Lips, 2004; Watt, 2006). Gendered differences in subjective orientations have been shown to emerge early. Studies have found that girls receive by age 5 years (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 United States, gender differences detected in the eighth grade widened to the point that by the last year of secondary school, 12% fewer girls than boys 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) described 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 shown 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 girls rate themselves lower than boys and that this comparatively lower self-confidence in mathematics is associated with lower rates of majoring in and pursuing careers in the sciences (Eccles, 1987; Ware & Lee, 1988). High school girl's 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 girls in secondary school assess their mathematics and science ability more favorably, their chances of aspiring to and pursuing careers in these fields increase (Eccles 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). Girls 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 girls are particularly susceptible to turning away from mathematics when they encounter challenges in the curriculum. Experimental studies evaluating girls' and boys' mathematics performance after identical content was presented—in either a clear or confusing manner—found high-performing girls 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 girls than boys to perceive an intrinsic or utility value in these subjects in secondary school. The degree to which women 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, 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 et al., 1998). Advanced course taking may affect the selectivity of the postsecondary institutions that students attend, especially for non-White students (Stearns, Potochnick, Moller, & Southworth, 2010). 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) that 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 are their lower income peers, as are White and Asian students, when compared with 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 offsetting the disadvantages faced by less-resourced families (Schneider, 2007). Such an environment may go a long way toward 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 toward 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 researchers on gender disparities have tended not to investigate the potentially interacting effects these factors might 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: (a) Selection of specific STEM sciences, social and behavioral sciences, humanities, and education postsecondary majors varies by gender; (b) subjective orientations toward academic subjects in high school are related to PEMC persistence in college; (c) subjective orientations shape women's persistence in PEMC to more closely resemble the factors that are associated with men's persistence in these majors; and (d) 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 who transitioned from high school to work or postsecondary education. The ELS: 2002 design includes 14,200 respondents from 750 schools who were 10th graders in 2002, with follow-ups in 2004 and 2006 (Ingels et al., 2007). In addition to data collected directly from the students, the data set 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 10th grade U.S. students, the base year sample includes more women (7,300) than men (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 men who did not enroll in postsecondary institutions.[1] Further imputations confirmed that the subsample 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 women and men who declared majors by the second follow-up in 2006, resulting in an analytic sample of 2,990 students. Unlike other studies (e.g., Riegle-Crumb & King, 2010), this sample includes those women and men who enrolled in both 2- and 4-year institutions.

Measures

Dependent measures. The two primary dependent measures are (a) whether students enrolled in a postsecondary institution and (b) what their choices of college majors were. Constructed from the ELS: 2002 second follow-up data set, postsecondary status is distinguished by enrollment in a 2- or 4-year institution (0 = *did not attend*, 1 = *2 year*, 2 = *4 year*). Postsecondary institutional selectivity rankings were based on the National Center for Educational Statistics' Barron's Admissions Competitiveness Index Data

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

File for 2004 (Schmitt, 2009), modified from a 7-point scale to a 3-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, 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, their perceived mathematics ability—the ability to understand a difficult math class and master math skills, their mathematics mindset—belief that most people can learn to be good in math, their mathematics participation—explaining one's work in math classes, and their valuing of 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 the National Center for Educational Statistics' 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% 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 men and women who declared a postsecondary education major with 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 hierarchical linear models (HLMs) to examine the effects of subjective orientations and course taking on college majors 2 years after high school graduation and examine whether they varied by gender. Our HLM models assume that students are nested in schools and estimate 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. In the notation below, b_0 refers to the intercept and $b_{1\,\ldots\,\infty}$ refers to the coefficient of particular independent variables. Additionally, i refers to individuals, j refers to schools, and q refers to Level-1 control variables. The general equation for both models is

Level 1 (student-level):

Likelihood of specific college major (2006)

$$= \beta_0 + \beta_1 \text{ student background characteristics}_{ij}$$

$$+ \beta_2 \text{ subjective orientation}_{ij}$$

$$+ \beta_3 \text{ student academic experiences in high school}_{ij} + \beta_4\, q_{ij};$$

Level-2 (school-level):

$$\beta_{0j} = \gamma_{00} + \gamma_{01} \text{ high school characteristics}_j$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11} \text{ high school characteristics}_j$$

$$\beta_{2j} = \gamma_{20} + \gamma_{21} \text{ high school characteristics}_j$$

$$\beta_{3j} = \gamma_{30} + \gamma_{31} \text{ high school characteristics}_j$$

$$\beta_{4j} = \gamma_{40} + \gamma_{41} \text{ high school characteristics}_j$$

These HLMs include several interaction terms between gender and key predictor variables to determine how these factors in combination specifically affect women's choices of a PEMC major. Odds ratio comparisons demonstrate the degree to which these predictors affect the likelihood of declaring PEMC majors 2 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 women and men after high school graduation, distinguishing among those who (a) declared college majors, (b) enrolled in postsecondary institutions but did not declare majors, and (d) did not enroll in postsecondary institutions. We focus here, and in the remainder of our analyses, on those who declared college majors 2 years after secondary school.

Men constitute a smaller proportion of those who declared a college major. Men 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. Men also scored higher on their 10th grade mathematics ability test than women did, although their college educational expectations were lower than women's were. With respect to student academic experiences in high school, women who declare a college major

Table 1
Sample Characteristics, by Gender

Variable	Postsecondary major declared		Enrolled in postsecondary but no major declared		Not enrolled in a postsecondary institution	
	Women	Men	Women	Men	Women	Men
N	1,751	1,238	441	408	396	497
Student background characteristics						
Race and ethnicity						
White $\bar{X}$	0.764	0.779	0.719	0.728	0.664	0.637
White *SD*	0.425	0.415	0.450	0.446	0.473	0.481
Asian American $\bar{X}$	0.041	0.063*	0.073	0.061	0.027	0.022
Asian American *SD*	0.200	0.242	0.261	0.240	0.163	0.147
African American $\bar{X}$	0.096	0.072	0.071	0.082	0.091	0.113
African American *SD*	0.295	0.258	0.257	0.274	0.288	0.317
Latino $\bar{X}$	0.096	0.086	0.131	0.119	0.207	0.211
Latino *SD*	0.294	0.280	0.337	0.324	0.405	0.409
Foreign born $\bar{X}$	0.060	0.057	0.058	0.068	0.079	0.036**
Foreign born *SD*	0.237	0.233	0.234	0.252	0.270	0.188
Family composition $\bar{X}$	0.831	0.860*	0.799	0.829	0.717	0.726
Family composition *SD*	0.374	0.347	0.401	0.377	0.451	0.446
Parents' education $\bar{X}$	4.316	4.536**	4.214	4.454	2.706	2.957*
Parents' education *SD*	1.775	1.767	1.901	1.831	1.397	1.474
Family income $\bar{X}$	9.695	10.130***	9.669	9.909	8.210	8.356
Family income *SD*	2.102	1.828	2.206	2.080	2.356	2.255
10th grade math ability test score $\bar{X}$	0.400	0.674***	0.325	0.534**	−0.553	−0.312***
10th grade math ability test score *SD*	0.864	0.876	0.912	0.908	0.841	0.937
College educational expectations $\bar{X}$	5.822	5.557***	5.667	5.477*	4.490	4.090***
College educational expectations *SD*	0.965	1.053	1.116	1.161	1.667	1.536
Parent expectations $\bar{X}$	5.725	5.672	5.746	5.641	4.822	4.783
Parent expectations *SD*	0.979	1.000	1.013	0.979	1.468	1.445
Subjective orientations, 10th						
Math engagement						
Keeps studying even if difficult $\bar{X}$	2.897	2.936	2.720	2.751	2.427	2.415
Keeps studying even if difficult *SD*	0.845	0.837	0.842	0.893	0.878	0.845
Becomes totally absorbed in math $\bar{X}$	2.474	2.615***	2.436	2.547*	2.420	2.470
Becomes totally absorbed in math *SD*	0.757	0.802	0.775	0.796	0.891	0.789
Valuing math $\bar{X}$	2.458	2.652***	2.440	2.634**	2.268	2.433**
Valuing math *SD*	0.862	0.888	0.790	0.889	0.896	0.862
Perceived math ability $\bar{X}$	2.613	2.901***	2.506	2.796***	2.264	2.469**
Perceived math ability *SD*	0.875	0.846	0.886	0.886	0.863	0.850
Math mindset $\bar{X}$	2.881	3.016***	2.851	2.972**	2.937	3.037*
Math mindset *SD*	0.635	0.658	0.661	0.687	0.708	0.642
Math participation $\bar{X}$	2.554	2.525	2.411	2.315	2.413	2.370
Math participation *SD*	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) $\bar{X}$	2.691	2.776	2.551	2.489	1.827	1.973
Hours spent per week on extracurricular activities (10th) *SD*	1.206	1.287	1.215	1.284	1.040	1.224
Hours spent per week on math homework (10th) $\bar{X}$	3.521	3.255***	3.502	3.304	3.024	2.731
Hours spent per week on math homework (10th) *SD*	1.978	2.044	2.196	2.041	2.342	2.169
Math sequence completion (9th–12th) $\bar{X}$	6.233	6.408**	5.964	6.119	4.413	4.347
Math sequence completion (9th–12th) *SD*	1.318	1.386	1.377	1.371	1.276	1.378
Science sequence completion (9th–12th) $\bar{X}$	5.524	5.629*	5.442	5.538	4.269	4.230
Science sequence completion (9th–12th) *SD*	1.110	1.106	1.129	1.200	1.250	1.270
Grade point average (9th–12th) $\bar{X}$	6.007	5.659***	5.781	5.134***	3.901	3.459***
Grade point average (9th–12th) *SD*	1.393	1.497	1.398	1.660	1.597	1.439
High school characteristics						
% Minority $\bar{X}$	26.869	26.137	29.374	28.784	31.091	32.482
% Minority *SD*	26.721	25.452	27.499	26.058	29.667	29.326
College-going culture $\bar{X}$	2.724	2.797*	2.570	2.736*	2.218	2.111
College-going culture *SD*	0.979	0.927	0.983	0.936	0.958	0.886
Postsecondary experience						
College selectivity rank $\bar{X}$	2.309	2.364	2.491	2.449	n/a	n/a
College selectivity rank *SD*	0.687	0.688	0.616	0.663		
2-year college or university $\bar{X}$	0.216	0.214	0.373	0.378	n/a	n/a
2-year college or university *SD*	0.412	0.410	0.484	0.485		

Table 1 (*continued*)

Variable	Postsecondary major declared		Enrolled in postsecondary but no major declared		Not enrolled in a postsecondary institution	
	Women	Men	Women	Men	Women	Men
4-year college or university $\bar{X}$	0.778	0.783	0.613	0.605	n/a	n/a
4-year college or university *SD*	0.416	0.412	0.488	0.489		
Perceives that high school math prepared for postsecondary $\bar{X}$	2.361	2.458***	2.286	2.344	n/a	n/a
Perceives that high school math prepared for postsecondary *SD*	0.651	0.594	0.647	0.643		
Perceives that high school science prepared for postsecondary $\bar{X}$	2.243	2.241	2.078	2.207**	n/a	n/a
Perceives that high school science prepared for postsecondary *SD*	0.684	0.660	0.683	0.657		

Note. From our analyses of the Educational Longitudinal Study of 2002 (ELS: 2002; U.S. Department of Education, National Center for Education Statistics, 2006) restricted-use data file. We report only on cases with nonmissing data on the analytic variables modeled in Tables 4 and 5. 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.
* $p < .05$. ** $p < .01$. *** $p < .001$.

exceed men on some measures of secondary school effort and performance. Their grade point averages are significantly higher, and they spend marginally more time (16 min each week) on mathematics homework. However according to their high school transcripts, women complete slightly fewer advanced math and science courses than men.

Turning to students' subjective orientations, in the 10th grade, men's perceived mathematics ability, on average, was higher than women's, and they were more likely to agree with the statement that mathematics is important. Men 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 2 years after high school if their secondary school math experiences prepared them for postsecondary education, men are more likely to agree than are women.

Comparing Gender Differences in College Majors

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

The next largest difference is seen in the PEMC majors, with 11% more men than women majoring in engineering. Two other PEMC differences are less pronounced; 5.4% more men major in computer sciences, 0.8% more men major in mathematics. Combining the totals across PEMC disciplines, nearly a quarter (23%) of men, but only 5.3% of women 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 toward 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 = .214), their valuing mathematics (r = .183), and the extent to which students were totally absorbed in mathematics (r = .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 = .106, r = .071, and r = .076, respectively).

Believing that most people can learn to be good in math is positively and significantly related with being in a PEMC major (r = .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 that they would keep studying difficult mathematics material and their postsecondary majors.

Table 2
Differences in Postsecondary Major, by Gender

Majors	Women	Men
N	1,750	1,240
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

Note. From our analyses of the Educational Longitudinal Study of 2002 (ELS: 2002; U.S. Department of Education, National Center for Education Statistics, 2006) restricted-use data file. Data are weighted to population means. Significant differences between female and male means were calculated using the Bonferroni method.
* $p < .05$. *** $p < 0.001$.

Table 3
Bivariate Correlations Between Subjective Orientations and Postsecondary Majors 2 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

Note. From our analysis of the Educational Longitudinal Study of 2002 (ELS: 2002; U.S. Department of Education, National Center for Education Statistics, 2006) restricted-use data file. Data are weighted to population means, using the second follow-up base year panel weight. Unweighted analyses yielded similar results.
* $p < .05$. ** $p < .01$. *** $p < .001$.

This item is positively correlated with biological sciences (r = .106), PEMC (r = .081), and social and behavioral sciences (r = .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 the selection of college majors? Two-level HLM multivariate logistic regression models were estimated to predict the selection of specific science majors: (a) PEMC, (b) biological sciences, (c) social and behavioral sciences, and (d) clinical and health sciences, as compared with 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.

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.[2] Recall that Table 2 indicates 23.0% of those men declaring a postsecondary major 2 years after graduating from high school chose to major in PEMC. Thus the odds that a man 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 woman will declare a PEMC major are .014 times the odds for men (here, .299); thus, the odds a woman will declare a PEMC major (.014 * .299) are .004. Using these odds to calculate the proportion of women who would declare a PEMC major (calculated as the odds/[1 + odds], i.e., 0.004/1.004), our model suggests 0.4% of women would declare a PEMC major 2 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 0.014 (with a slope of −4.28 as shown in Table A2) means that—accounting for the other variables in the model—women have a .01% likelihood of majoring in PEMC, while men 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 [OR] = 3.23); Latino adolescents, on the other hand, have lower odds of majoring in PEMC than do White adolescents (OR = 0.76). Turning to the interaction terms for female gender and race-ethnicity, these effects are shown to be specific to men.[3] With respect to the third salient background predictor, the 10th

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

[3] 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 4
Gendered Differences in the Likelihood of Declaring Specific Science Majors Versus Other Majors

	PEMC majors		Biological sciences majors		Social and behavioral sciences majors		Clinical and health sciences majors	
Predictor variable	*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 (9th–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 score	0.010***	0.000	1.571***	0.040	1.436***	0.021	8.676***	0.152
Female * Math sequence completion (9th–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	−1,489,037***		−2,846,506***		−4,798,950***		−4,992,703***	
N observations	2,990		2,990		2,990		2,990	
N clusters	575		575		575		575	

Note. From our analyses of the Educational Longitudinal Study of 2002 (ELS: 2002; U.S. Department of Education, National Center for Education Statistics, 2006) restricted-use data file. 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 are available upon request from the authors. Unstandardized coefficients and their standard errors are reported in Table A2. PEMC = physical sciences, engineering, mathematics, or computer science.
** $p < .01$. *** $p < .001$.

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 slight 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, their 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 women are statistically different from men with respect to these orientations, the practical differences (in comparison to the main effect for female gender) are small. Those women who major in PEMC seem to resemble men 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 women's and men's 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. Women have a 70.7% chance of majoring in clinical and health fields, after controlling for the predictors in our model, while men have a 25.4% chance. Meanwhile, women have a 20.4% chance of majoring in biological sciences, while men have a 16.9% chance. Similarly, women have an 18.9% chance of majoring in social and behavioral sciences, while men 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* = 0.79). Being Latino has a negative effect on clinical and health science majors (*OR* = 0.41), 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* = 0.70) and social and behavioral sciences fields (*OR* = 0.86).

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 women have higher odds of majoring in biology, and Latina women have lower odds. In the social and behavioral sciences, Latina and Asian women each have higher odds of majoring in these fields than do White women. Finally, the odds of majoring in clinical and health sciences are almost double for Latina women, compared with White women (interaction: 13.67; main effect: 7.10), but are smaller for Asian women (interaction: 2.94).

Observed versus perceived ability. Two of the most powerful predictors of majoring in PEMC fields in comparison with 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 those scores positively moderate women's 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* = 0.59). However, when we focus specifically on adolescent women, we see that test scores positively moderate women's 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 women's entry into biological science fields (interaction: = 1.57; main effect: 2.08). Meanwhile, perceived mathematics ability has a negative moderating effect on women's 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 women's 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 women's 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 the selection of scientific fields 2 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 women's 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: 2002 study. Moderate course taking is defined as having completed some college preparatory track courses in mathematics, specifically, Algebra I, geometry, Algebra II, trigonometry, and/or statistics. Advanced course taking is defined as having completed precalculus or calculus.

Turning first to the main effect of gender, these results show that women 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, women have a 0.2% chance of majoring in PEMC fields, compared with men, who have a 2.6% chance. Among those who completed precalculus and/or calculus in secondary school, women's chances of majoring in PEMC were notably higher; they have a 16.0% chance of selecting a PEMC major while men have a 19.3% chance of selecting a PEMC major. While course taking increases women's chances of going into PEMC fields in postsecondary school, advanced course taking does not close the gap between women and men.

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 women 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, women 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 women 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 women who complete these courses have higher odds of majoring in PEMC than do women 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 women who are interested and engaged in mathematics but do not complete advanced course sequences have lower odds of selecting PEMC majors than do women who are less interested and engaged in mathematics.

Discussion

Using a nationally representative longitudinal data set, 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 women are reaching parity in the biological sciences and eclipsing men in the social and behavioral and clinical and health sciences at the postsecondary level. Men continue to strikingly outnumber women 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 toward 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, women with the highest tenth grade mathematics ability scores appear to choose social and behavioral and clinical and health science majors 2 years after high school, over PEMC and biological fields. Overall, these results suggest that women who pursue PEMC majors in college are not the women who were the highest performers in high school.

Gender, Subjective Orientations, and Courses

We then turned to examine women 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 women in PEMC had high interest and engagement in mathematics in 10th

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	
Predictor variable	*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 (9th–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 women (female * Asian)	0.229***	0.007	0.669***	0.012
African American women (female * African American)	0.076***	0.002	0.674***	0.013
Latina women (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	−1,390,907***		−2,669,837***	
N observations	1,380		1,550	
N clusters	485		484	

Note. From our analyses of the Educational Longitudinal Study of 2002 (ELS: 2002; U.S. Department of Education, National Center for Education Statistics, 2006) restricted-use data file. 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. PEMC = physical sciences, engineering, mathematics, or computer science.
** $p < .01$. *** $p < .001$.

grade, and this may have motivated them to persist in taking more advanced courses, even though they received lower test scores than men. We have some evidence to suggest that mathematics course taking may be a driver for sustaining women's positive subjective orientations toward mathematics, even when their performance is lower than that of men.

The results comparing the moderating effects of orientations on gender differences for women 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 women—which would be expected. The lower course taking women who went on to major in PEMC were less interested and engaged in mathematics in 10th grade. Women 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 women 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 women's 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 women who major in PEMC, their engagement in mathematics and valuing of mathematics closely resembles that of men. Women 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 women are less likely to succeed in mathematics.

Altogether, our results suggest that increasing women's mathematics course completion is important in addressing gender disparities in PEMC careers. However, our results suggest that course taking alone is insufficient. While the women who select PEMC majors are those who complete the most advanced courses, the women with the highest mathematics ability early in high school go on to pursue those other scientific fields in which women have either gained parity or are eclipsing men (biological sciences, social and behavioral sciences, and clinical and health sciences). PEMC majors attract those women who are the 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 that women's mathematics ability scores (measured here in the 10th grade) improved by the time they graduated from secondary school. It is also possible that women's 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 women continue to leave PEMC fields at greater rates than do men. One concern is that additional attention may need to be placed on helping girls 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 women's performance, even when their value structures are similar to those of men.

We cannot determine in this study whether women who major in PEMC are underachieving. It may be that PEMC fields attract women confident in their abilities, irrespective of their skills. Given that women who major in PEMC look more like men, 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 women with higher ability scores in mathematics. PEMC careers are often perceived as solitary, dominated by men, 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 women 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 women's performance in these areas is still lagging behind that of men.

References

Adelman, C. (2006). *The toolbox revisited: Paths to degree completion from high school through college.* Washington, DC: U.S. 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,* 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.

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.

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,* 392–414. doi:10.1002/tea.20006

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

Committee on Maximizing the Potential of Women in Academic Science and Engineering. (2007). *Beyond bias and barriers: Fulfilling the potential of women in academic science and engineering.* Washington, DC: 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,* 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,* 93–113. doi:10.1177/000312240406900106

Crisp, G., Nora, A., & Taggart, A. (2009). Student characteristics, precollege, college, and environmental factors as predictors of majoring in and earning a STEM degree: An analysis of students attending a Hispanic serving institution. *American Educational Research Journal, 46,* 924–942. doi: 10.3102/0002831209349460

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,* 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, NY: 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* (Report No. NCES 2007–312). Washington, DC: National Center for Educational Statistics, Institute of Education Sciences, U.S. 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,* 497–514. doi: 10.3102/00028312035003497

Dweck, C. (2006). *Mindset: The new psychology of success.* New York, NY: 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, DC: American Psychological Association. doi:10.1037/11546-004

Eccles, J. S. (1987). Gender roles and women's achievement-related decisions. *Psychology of Women Quarterly, 11,* 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,* 585–609. doi:10.1111/j.1471-6402.1994.tb01049.x

Eccles, J. S. (2005). Subjective task value and the Eccles et al. model of achievement-related choices. In A. J. Elliot (Ed.), *Handbook of competence and motivation* (pp. 105–121). New York, NY: Guilford Press.

Eccles, 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, CA: W. H. Freeman.

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* (Vol. 1, pp. 367). Chicago, IL: 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,* 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,* 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,* 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,* 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,* 133–156. 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*. Thousand Oaks, CA: Sage.

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,* 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,* 1–17. 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,* 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, USA, 106,* 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* (Report No. NCES 2008–347). Washington, DC: National Center for Education Statistics, U.S. Department of Education. 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, NY: 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,* 1247–1266. 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,* 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,* 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,* 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,* 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,* 357–371. doi:10.1023/B:SERS.0000018891.88889.c9

National Science Foundation. (2009). *Women, minorities, and persons with disabilities in science and engineering: 2009* (Report No. NSF 09–305). Arlington, VA: National Science Foundation.

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

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, NY: 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,* 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,* 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,* 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,* 206–228. doi:10.1177/003804070607900302

Riegle-Crumb, C., & King, B. (2010). Questioning a White male advantage in STEM. *Educational Researcher, 39,* 656–664. doi:10.3102/0013189X10391657

Schmitt, C. A. (2009). *NCES–Barron's admissions competitiveness index data files: 1972, 1982, 1992, 2004, 2008* (Report No. NCES 2010-331). Retrieved from National Center for Education Statistics website: http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2010331

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

Schoon, I., & Parsons, S. (2002). Teenage aspirations for future careers and occupational outcomes. *Journal of Vocational Behavior, 60,* 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, DC: U.S. Department of Education, National Center for Education Statistics. Retrieved from http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2007467

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

Stearns, E., Potochnick, S., Moller, S., & Southworth, S. (2010). High school course-taking and post-secondary institutional selectivity. *Research in Higher Education, 51,* 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 No. 1018). Washington, DC: Author.

U.S. Department of Education, National Center for Education Statistics. (2006). *Educational longitudinal study of 2002 (ELS: 2002): Second follow-up.* Washington, DC: Author.

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

Ware, N. C., & Lee, V. E. (1988). Sex differences in choice of college science majors. *American Educational Research Journal, 25,* 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,* 305–322. doi:10.1080/13803610600765562

Appendix

Table A1
Characteristics of the Analytic Sample: Descriptions, Weighted Means, and Standard Deviations

Study variable	Definition and range	Weighted *M*s	*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 = *marriagelike relationships*)	Dummy variable = 1 for married or marriagelike 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

(*Appendix continues*)

Table A1 (*continued*)

Study variable	Definition and range	Weighted *M*s	*SD*
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 hours*	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 (*0.00–0.50*) to 8 (*more than 4.00*), includes only academic courses, honors weighted	5.86	1.45
High school characteristics			
% Minority	Percentage minority refers to the percentage of non-White 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
% 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
% Enrolled 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

Note. From our analyses of the Educational Longitudinal Study of 2002 (ELS: 2002; U.S. Department of Education, National Center for Education Statistics, 2006) restricted-use data file. Data have been weighted to population means. PEMC = physical sciences, engineering, mathematics, or computer science; AP = advanced placement; IB = international bacculaureate.

(*Appendix continues*)

Table A2
Gender Differences in Likelihood of Declaring Specific Science Majors Versus Other Majors, 2 Years After High School Graduation

Predictor variable	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 (9th–12th)	0.104***	0.001	0.475***	0.003	0.017***	0.001	−0.057***	0.002
Science sequence completion (9th–12th)	0.200***	0.001	0.326***	0.001	0.060***	0.001	0.032***	0.001
Grade point average (9th–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	−4,165,700***		−2,846,506***		−4,798,950***		−4,992,703***	
N observations	2,990		2,990		2,990		2,990	
N clusters	575		575		575		575	

Note. From our analyses of the Educational Longitudinal Study of 2002 (ELS: 2002; U.S. Department of Education, National Center for Education Statistics, 2006) restricted-use data file. Data are weighted to population means. Unstandardized beta coefficients and standard errors are reported. PEMC = physical sciences, engineering, mathematics, or computer science.
*** $p < .001$.

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