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## Are 2-Year Colleges the Key? Institutional Variation and the Gender Gap in Undergraduate STEM Degrees

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### ABSTRACT

Studies of gender gaps in science, technology, engineering, and mathematics (STEM) higher education have rarely considered 2-year colleges, despite the fact that most enrollees are women. Situated in an interdisciplinary literature on gender and inequality in students' pathways to STEM higher education, this study used Beginning Postsecondary Students:2004/2009 nationally representative panel data on 5,210 undergraduate students. The primary research question posed was: How does initial college type influence the gender gap in STEM undergraduate degrees? First, we describe and illustrate distinct patterns in the degrees earned by men and women who initially enroll in 2-year and 4-year institutions. Leveraging rich control measures, we estimated a series of multivariate logistic regressions to robustly estimate gender gaps in non-STEM, social/behavioral sciences, life sciences, and natural/engineering sciences degree fields. Results from these degree clusters were distinct and underscored the limitations of "STEM" as an umbrella category. College type was more influential on the life sciences and social/behavioral sciences; effects on natural/engineering sciences degrees were experienced primarily by men, especially among baccalaureate degree earners. Gender gaps among life sciences and natural/engineering sciences bachelor's degree earners were wider among initial 2-year students (favoring women and men, respectively). The discussion contextualizes and offers implications from our findings.

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### KEY WORDS

Higher education; gender; STEM degree; community college; women in STEM

## Introduction

U.S. women now surpass men in university enrollment and degrees earned (e.g., DiPrete & Buchmann, 2013) but remain underrepresented in high-wage natural sciences and engineering fields (National Science Foundation, 2016). This gender disparity may have broader economic implications, as women tend to earn degrees in fields with some of the lowest median earnings (Carnevale, Strohl, & Melton, 2011). Problematically, most studies

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have excluded 2-year college students from their analyses of the gender gap in undergraduate science, technology, engineering, and mathematics (STEM) fields. Instead, existing research has focused on students attending 4-year, residential, and often elite institutions (e.g., Cech, Rubineau, Silbey, & Seron, 2011; Mullen, 2013). It may have been acceptable in the past to dismiss the relevance of 2-year colleges as producers of STEM degrees. Increasingly, however, these institutions are engines of scientific production (Lundy-Wagner & Chan, 2016; Wang, 2013a, 2013b). Fifty percent of STEM jobs require an associate degree or less (Rothwell, 2013). Meanwhile, in 2009, 44.5% of traditional-age college students were enrolled in 2-year colleges (Dunbar et al., 2011). These trends suggest the growing importance of 2-year colleges in U.S. STEM postsecondary education.

Notably, 2-year colleges may play a crucial role in efforts to broaden participation in postsecondary STEM fields among women and women of color in particular (Johnson, Starobin, & Santos Laanan, 2016; Wang, 2013a). White and Asian men continue to be the most likely to pursue these fields (National Science Foundation, 2013). However, 2-year college students are more likely to be women and members of underrepresented minority groups (Horn, Nevill, & Griffith, 2006).<sup>1</sup> It seems then especially important to understand whether and how STEM participation gaps operate among 2-year college students, given the relative dearth of literature on this phenomenon and the importance of aligning students' collegiate training with the labor market. Because research and theory about the gender gap in STEM has so strongly focused on 4-year colleges, it seems essential not only to examine the experiences of 2-year college students but to also consider their experiences alongside their 4-year college peers.

Using the most recent complete cohort of the nationally representative Beginning Postsecondary Students Study (BPS:2004/2009), we investigated the gender gap in STEM undergraduate degrees while distinguishing among degree fields. This study primarily investigated the following question: How does the gender gap differ by college type, if at all? We organized our analysis around four subquestions. First, what is the nature of the postsecondary STEM gender gap? Second, how does the gender gap in STEM majors vary among those beginning in 2-year and 4-year colleges? Third, to what extent do college experiences influence the gender gap in STEM degree fields among those who start college in 2-year and 4-year institutions? Finally, we conducted additional robustness checks on our predictors and outcome measures to pose our final research question: To what extent does the effect of initial college type persist across alternative specifications of our measures and in specific STEM degree fields?

## Literature review

### *Gender inequality in STEM: The stakes and the limitations*

Why does gender inequality in STEM majors matter? Variation in undergraduate major is a principal driver of the gender wage gap, both indirectly through subsequent occupational choices and even directly, independent of work-related factors (Bobbitt-Zeher, 2007; see also Gill & Leigh, 2000). Women are the primary earners for more than 40% of U.S. households with children (Wang, Parker, & Taylor, 2013). Therefore, their degree fields and subsequent economic returns have consequences for society, families, and individual women. Additionally, projected growth in the increasingly scientific and technical global labor force motivates the call for a robustly skilled and inclusive STEM labor force that includes women from all backgrounds (Beede et al., 2011; U.S. Commission on Civil Rights, 2010). There are then both economic and social justice rationales for investigating gender inequality in high-earning fields.

Some have suggested ability and preparation explain gender differences in STEM. However, mathematics ability does not appear to meaningfully vary by gender (Hyde & Linn, 2006). As measured by SAT college placement examination scores, mathematics ability alone does not influence gender differences in undergraduate major, even when focusing on those with the highest levels of ability (Riegle-Crumb, King, Grodsky, & Muller, 2012; Wang, Eccles, & Kenny, 2013). Even though gender gaps in high school mathematics and science course taking have closed (DiPrete & Buchmann, 2013; Nord et al., 2011), the best-prepared and most mathematically able girls remain disproportionately less confident in their mathematics ability and less likely to enter mathematically intensive STEM majors (Perez-Felkner, McDonald, Schneider, & Grogan, 2012; Perez-Felkner, Nix, & Thomas, 2017). Altogether, mathematics and science ability and precollege preparation tend to be positively associated with majoring in a STEM field (e.g., Engberg & Wolniak, 2013), but they do not meaningfully move the needle with respect to gender differences in postsecondary STEM fields.

What about college academic achievement in STEM? There has been limited research on the role of undergraduate STEM grades as predictors of degree persistence (Wang, 2016). Thus far, findings have been mixed. A study of North Carolina freshmen at public universities revealed STEM grade point average (GPA; as compared with non-STEM GPA) did not explain gender differences in choice of STEM or non-STEM majors (Stearns, Jha, Giersch, & Mickelson, 2013). Notwithstanding, other studies have identified a relationship between STEM GPA and college major, albeit less so for women. In an investigation using two national U.S. cohorts, Griffith (2010) found students with a higher ratio of their 1st-year STEM GPA to their total GPA were more likely to continue majoring in STEM. Still, STEM grades appear more important for men's persistence in STEM majors than for women's persistence (Griffith, 2010;

Rask, 2010), if they are influential at all. It is even less clear whether and how STEM postsecondary coursework predicts STEM degrees among 2-year students. In summary then, we do not yet know to what degree precollege and college ability and achievements predict postsecondary gender gaps in STEM.

College experiences seem to differentially steer men and women into STEM fields (Ma, 2011; Sax, 2008). Decades of debate on potential limitations of Tinto's (1987) integration theory notwithstanding (Braxton, 2000; Hurtado & Carter, 1997; Tierney, 1999), academic and social integration continue to be seen as key factors in student success. Academic integration appears to have specific importance for STEM students, including mentors (Seymour & Hewitt, 1997) and academic clubs and organizations (Eisenhart & Finkel, 1998). Although social integration has been studied at 4-year institutions, the effect of it on women's STEM degree attainment is comparatively less clear, perhaps in part as a result of an overly broad definition of STEM (Gayles & Ampaw, 2014). As the precise effects of college experiences remain unclear even among 4-year students, we consider these effects further in the current study, with attention to both 4-year and 2-year college students.

### ***Two-year colleges and diverse student pathways***

Students in 2-year colleges may have particularly distinct experiences and pathways to STEM fields, in part because of differences in who first attends 2-year versus 4-year institutions. Two-year college students are more likely to be socioeconomically disadvantaged and first-generation college students (e.g., Park, 2012). They are more likely to be immigrants or children of immigrants (Teranishi, Suárez-Orozco, & Suárez-Orozco, 2011). Moreover, limited access to 4-year colleges in many states may constrain underrepresented students with close family ties or expectations that they will not attend college far from home (López Turley, 2009).

In addition to personal and family background differences, 2-year and 4-year college students' previous schooling experiences also vary. The high schools they attend tend to be less affluent and college-oriented than those attended by students who begin their postsecondary studies in 4-year colleges (Niu & Tienda, 2013). Students who start in community colleges tend to complete fewer college-level and advanced high school mathematics courses; these factors are associated not only with majoring in STEM, but also with transition to 4-year and selective colleges, especially for students of color (Grubb, 1991; Stearns, Potochnick, Moller, & Southworth, 2008). In sum, initial 2-year college students seem to begin postsecondary education with different resources and preparation than students who begin at 4-year colleges.

Intersectionality theory highlights the importance of considering the interplay of multiple, intersecting identities, particularly with respect to the diverse experiences of women of color and of those from less socioeconomically

advantaged families (Cho, Crenshaw, & McCall, 2013; Crenshaw, 1991). Given the decades-long national interest in broadening the pool of potential STEM talent, demographic blinders may be the biggest problem with the field's over-focus on 4-year college pathways into STEM careers. Women outnumber men across all postsecondary institutional types, but this statement is especially true in the 2-year sector (St. Rose & Hill, 2013). Women's postsecondary STEM outcomes may be conditioned on their racial/ethnic and social class backgrounds (Ma, 2011; Maple & Stage, 1991; Ong, Wright, Espinosa, & Orfield, 2011). Students' multiple identities may influence women's experiences with STEM courses and majors (Carlone & Johnson, 2007; Jones & McEwen, 2000). In addition, women's pathways to STEM degrees may be affected by stereotypic beliefs and implicit biases held by those they encounter in their college environments (Cheryan, Plaut, Davies, & Steele, 2009; Nosek & Smyth, 2011).

### ***Are community colleges chillier for women in STEM?***

The community college pathway into STEM careers has gained recent empirical attention (Lundy-Wagner & Chan, 2016; Wang, 2013a, 2016) but continues to be understudied. Some evidence has suggested 2-year colleges can have a "chilling" effect on students, cooling out their scientific ambitions (Clark, 1960; Hall & Sandler, 1984). Although this "chilly climate" phenomenon is most often used in examining workplace culture and 4-year institutions (e.g., Hurtado et al., 2011), it appears relevant for 2-year colleges as well. For instance, in a study of community college students enrolled in traditionally female- and male-dominated majors, Morris and Daniel (2008) found women were generally more likely to perceive the climate as chilly. They directly compared climate perceptions among nursing, education, engineering, and information technology students but did not examine gender differences across these majors.

Women may experience more hostile STEM climates than their male peers, even in community colleges. In a multi-institutional study, 2-year college women who perceived a chilly climate experienced weaker cognitive growth in scientific and other areas during their 1st year compared with female peers in 4-year colleges (Pascarella et al., 1997). This finding aligns with Reyes's (2011) study of four women of color who transferred from a local community college to STEM majors at a 4-year research university. Women attributed stigma and negative treatment they encountered to their ethnicity, gender, and challenges in the transfer status. Taken together, it seems women who perceive a chillier climate might be dissuaded from majoring and persisting in STEM fields. Although new research has begun to identify strategies for administrators and faculty to help community college STEM students succeed (e.g., Johnson et al., 2016; Rodriguez, Cunningham, & Jordan, 2016), the studies reviewed here suggest the

increasing utilization of 2-year colleges by U.S. students could actually exacerbate the gender gap in STEM majors.

On the other hand, college type may have no effect on the gender gap. Findings on institutional selectivity among 4-year institutions have been mixed. In a study of 23 postsecondary institutions, selectivity rank did not meaningfully explain variation in STEM among women and underrepresented minorities (Smyth & McArdle, 2004). Meanwhile, Gayles and Ampaw (2014) found women at selective 4-year institutions were less likely to complete STEM degrees than their counterparts at nonselective institutions based on BPS:1996/2001 data. By contrast, the gender gap in physical, engineering, mathematics, and computer sciences was smaller at more selective institutions (nearly three to one) than at less selective institutions (nearly four to one; Schneider, Milesi, Perez-Felkner, Brown, & Gutin, 2015). In addition, other studies—although not focusing on gender—have indicated a negative relationship between STEM and institutional selectivity (Engberg & Wolniak, 2013), especially at large and highly selective research universities (Griffith, 2010). Based on these results, college type is an important factor to consider when examining the gender gap in completion of STEM degrees, though it is unclear what role 2-year colleges may play.

### ***Current study: Gender, college type, and specific STEM fields***

This study examined how college type affects the gender gap in undergraduate STEM degree attainment. As demonstrated in the literature review, this gender gap has considerable economic and social consequences for women and for society at large. Two-year institutions have been a particularly relevant and understudied gateway to STEM degrees, especially for women. In a gender wage gap study of two cohorts of students in the 1980s and early 1990s, Gill and Leigh (2000) observed a smaller gender gap in engineering majors among 2-year colleges than among 4-year colleges. However, the more recent studies reviewed in the literature review have suggested 2-year colleges may have a negative effect, despite their associations with postsecondary access and opportunity. This puzzle underscores the importance of better understanding how college type affects women's chances of earning STEM degrees.

Science, technology, engineering and mathematics fields vary. While higher education scholars tend to define STEM broadly, research on postsecondary gender differences has increasingly distinguished between STEM degree field clusters (Ceci, Ginther, Kahn, & Williams, 2014; Perez-Felkner et al., 2012; Riegle-Crumb & King, 2010). Gender inequality differs among postsecondary STEM fields—for example, engineering versus health (Corbett & Hill, 2015; Schneider et al., 2015). Focusing on specific disciplines and disciplinary clusters allows for a more effective examination of gender



inequality's consequences and causes (Ceci et al., 2014; Kanny, Sax, & Riggers-Piehl, 2014). Building on this literature, this longitudinal study compared the completion of specific STEM degrees among 2-year and 4-year students 6 years after enrolling in college. We detail our methodology in the next section.

## Methods

### *Data source*

We used National Center for Education Statistics (NCES) data from the most recent complete BPS Study (BPS:2004/2009), a nationally representative longitudinal cohort of U.S. college students who first attended a postsecondary institution during the 2003–2004 academic school year. The NCES used a two-stage sampling design (Wine, Janson, & Wheeless, 2011). First, they sampled 1,670 institutions eligible for the National Postsecondary Student Aid Study (NPSAS:04) based on U.S. federal aid authorization criteria. From these institutions, 49,410 first-time undergraduate students were identified as (a) enrolled in academic programs and/or credit-generating courses at these institutions and (b) not concurrently enrolled in secondary school or equivalency programs. These respondents were surveyed at the end of their 1st and 3rd years of college (2004, 2006) and 6 years after first starting college (2009). In two follow-up rounds, the NCES then followed 44,670 of these students, selected from multiple compiled data sources ranging from NPSAS:04 base-year information, student-level institutional data, and federal student loan information. From this rich trove of administrative and institutional data, a final round of 18,640 students was selected for inclusion in the BPS:2004/2009 cohort.

### *Sample*

We restricted the sample to women and men who completed an associate or bachelor's degree within 6 years after first starting college (2009). To ensure effective comparisons while using both secondary and postsecondary transcript data in our analysis, we limited the study to students who attended U.S. high schools and earned degrees with a specific major. Respondents were excluded if they: attended K–12 school abroad ( $n = 1,660$ ), were degree noncompleters ( $n = 7,940$ ), and/or had unspecified or otherwise missing information on their major field of study ( $n = 5,010$ ).<sup>2</sup> These exclusions, which were overlapping at times, brought our initial eligible sample down to 6,100 cases. Our final restriction pertained to an additional 890 listwise-deleted cases associated with missing data on any of our independent variables, specifically: parent education ( $n = 50$ ), high school transcript information including standardized test scores ( $n = 450$ ), high school GPA ( $n = 70$ ),



college STEM GPA ( $n = 320$ ), and college type ( $n = 10$ ). These restrictions yielded a final sample size of 5,210 students.

### **Analytic strategy**

After an initial series of descriptive analyses, we used multinomial logistic regression modeling to compare predicted probabilities of graduating with degrees in non-STEM fields as compared to the natural/engineering sciences, life sciences, and social/behavioral sciences. To enhance the generalizability of our results, we used response-adjusted, calibrated bootstrap replicate weights for transcript respondents (BPS:2004/2009 variables wtc001–200) in our analyses, which were compared to and consistent with our unweighted results. We also employed a panel weight (wtc000) to adjust for stratification in the sample design.

Primarily, this study investigated how the gender gap in earned scientific degrees differs among 2- and 4-year college students. We posed the following research questions. First, what is the nature of the postsecondary STEM gender gap? Second, to what extent does the gender gap vary across 2- and 4-year colleges? Third, how do college experiences influence the gender gap in STEM degree fields among those who start college in 2-year and 4-year colleges? Finally, does initial college type similarly predict gender differences in STEM degree fields across alternative specifications of our measures? Across these questions, we also assessed whether these predictions varied across the STEM clusters of natural/engineering sciences, life sciences, and social/behavioral sciences. Our multinomial logistic regression model used to answer our third research question is displayed here; multiple enhancements to the model were made to respond to our final research question.

$$\begin{aligned}
 & \text{Degree field}(2009) \\
 &= \beta_0 + \beta_1(\text{gender}) + \beta_2(\text{income percentile}) \\
 &+ \beta_3(\text{parent education}) + \beta_4(\text{race/ethnicity}) \\
 &+ \beta_5(\text{high school GPA}) + \beta_6(\text{SAT math}) + \beta_7(\text{SAT verbal}) \\
 &+ \beta_8(\text{highest H.S. math course}) + \beta_9(\text{college STEM GPA}) \\
 &+ \beta_{10}(\text{academic integration}) + \beta_{11}(\text{social integration}) \\
 &+ \beta_{12}(\text{two-year college 2004}) + \mu
 \end{aligned}$$

### **Measures**

#### **Degree field**

The outcome variable for this analysis was the highest undergraduate degree field (associate or bachelor's degree) at the end of the study (2009). These fields were categorized into one of four degree field clusters: non-STEM (the

reference category), natural/engineering sciences, life sciences, and social/behavioral sciences. For a more detailed account of which specific majors were categorized into each of these four clusters, see the Appendix. We investigated an alternative specification of this measure in response to our final research question: bachelor's degree field, for those students who earned a bachelor's degree.

### ***Individual background characteristics***

Female gender was indicated by students' self-report; for ease of interpretation, we recoded this binary measure as 1 = women and 0 = men. Race/ethnicity was coded into five groups: White, Asian, Black, Latino, and Other/Multiple Race(s) (e.g., multiple groups, Native Hawaiian, etc.). Socioeconomic status was measured with two distinct variables: family income percent rank in the 2003–2004 school year (range = 0–100) and parental education level (no college, some college, 4-year degree, or graduate/professional degree). Because this study focused on community college students, we included Pell Grant receipt (0 = no Pell Grant, 1 = Pell Grant receipt) in a sensitivity analysis on socioeconomic status.

### ***Precollege science readiness***

We also considered the effects of respondents' academic ability and preparation for scientific majors, as measured by their derived SAT mathematics and verbal scores (range = 200–800) and the highest level of mathematics they completed in high school (1 = less than Algebra II, 2 = Algebra II, 3 = more than Algebra II). We included a measure of high school GPA across all academic courses (ranging from 1 = 0.5–0.9 to 7 = 3.5–4.0), as a domain-general indicator of academic performance in high school, distinct from the domain-specific test scores and postsecondary STEM grades.

### ***College type***

College type was coded according to whether the respondent first enrolled in a 2-year or 4-year college (1 = 4-year; 2 = 2-year) using data from the 2003–2004 school year. We also assessed an interaction term for the combined effect of gender and college type (Gender  $\times$  College Type), as well as an alternative specification described in this section.

### ***College experiences***

The NCES created academic and social integration indices; problematically, these scales were not directly comparable as they are based on different numbers of items and then averaged. Instead, we used weighted factor analysis (weight = wtc000) to derive scaled variables representing 2-year and 4-year college students' self-reported frequency of participation in certain activities at the first institution they attended in the 2003–2004 school

year (0 = never, 1 = sometimes, 2 = often). Our academic integration measure ( $\alpha = .94$ ) indicated how often students: met with an academic advisor, had social contact with faculty members, or spoke with faculty about academic matters. Our social integration measure ( $\alpha = .91$ ) indicated how often students participated in school clubs, school sports, and study groups.<sup>3</sup>

### **STEM GPA**

Additionally, we used transcript data to capture respondents' college STEM GPA (0 = did not have a STEM GPA, 1 = less than 3.0, and 2 = more than 3.0).

### **Alternate postsecondary success indicators**

In response to Research Question 4 and because of the scarcity of information on STEM pertaining to community college starters, we added alternative specifications of our model. Notably, we considered not only at first institution type, but also the last institution attended in 2009, 6 years after the start of the study (1 = 4-year college, 2 = 2-year college). We conducted a final series of models restricting our sample to only those who earned bachelor's degrees at the end of 6 years at any institution, including students who transferred from 2-year to 4-year institutions. Only 520 respondents in our sample stopped at an associate degree and were thus excluded from the (bachelor's degree-only) final analysis ( $n = 4,690$ ).

### **Limitations**

In the interest of most precisely modeling the full set of characteristics distinguishing students who apply to 2-year and 4-year colleges, a previous version of this manuscript used a propensity score design to match respondents sharing a similar likelihood of initially attending 2-year colleges (the treatment) versus 4-year colleges (the control). Respondents were matched based on these propensities, therefore setting up a quasiexperimental comparison to assess the effect of initial enrollment in 2-year colleges on the gender gap in specific scientific fields. Upon presenting and discussing these findings with methodologists and the researchers who designed the BPS:2004/2009 study, we were assured the bootstrap replicate weighting strategy we used was both sufficient and best used alone to avoid over-specifying our analytic models.

Beyond the challenges of best reducing bias in our estimates, other limitations are worth noting. First, our variable selection drew on the current literature, which has focused on 4-year institutions. Accordingly, further research may suggest alternative measures of student integration and pre-college ability (i.e., SAT scores), which are better suited to unbiased

comparisons across 2-year and 4-year college students. Second, nationally representative longitudinal data offered the advantages of generalizability and opportunities to observe respondents' pathways during a 6-year period. Notwithstanding, our statistical power was too limited to examine the gender gap within individual scientific majors rather than degree field clusters. These clusters are arguably more appropriate, however, to assess comparable offerings at 2-year and 4-year colleges.

This study compared the gender gap among 2-year college students and 4-year college students in similar fields of study, including those who did not later transfer to 4-year colleges and earn bachelor's degrees. Our final research question parsed this line of inquiry across various related outcome measures and aimed to distinguish between the final observation of students' degree pathways while acknowledging it may not be their final postsecondary term. Relatedly, we recognize underrepresented minority students were likely disproportionately represented in the excluded group of degree noncompleters. To that end, the race/ethnicity variable described in the Measures section above was designed to retain less well-represented groups in these nationally representative data on undergraduate degree completers. We encourage scholars to pursue inclusive and intersectional large-scale quantitative studies of STEM higher education, data limitations notwithstanding.

## Findings

### ***Research Question 1: What is the nature of the postsecondary STEM gender gap?***

Table 1 describes the variables used in our analysis. To aid interpretation of gender differences in our later model results, we report means and percentages within the subsamples of women and men, rather than for the sample as a whole. Analysis of variance (ANOVA) tests were used to estimate statistical differences by gender on each variable.

We turn first to demographic characteristics. Women earned postsecondary degrees at higher rates than their male peers nationally—as discussed earlier and also observed in this nationally representative sample ( $n = 3,130$  women and  $n = 2,080$  men). Correspondingly, these degree-earning men were slightly more socioeconomically advantaged and less diverse than their female peers. As compared with students at their first postsecondary institution, the family income of men ranked higher than that of women (61.0% vs. 57.8%). Men were also more likely to have a parent who completed more than a bachelor's degree (33.1% vs. 30.4%). Turning to race/ethnicity, more men than women self-identified as White (80.3% vs. 77.6%). Asian students comprised the next highest representation among the sample, representing about 5.9% of men and 7.5% of women. For the remaining racial/ethnic

**Table 1.** Sample characteristics, Beginning Postsecondary Students Study (2004).

Independent Variables	Mean			SD		Range	
	Men	Women		Men	Women	Men	Women
<b>Demographic characteristics</b>							
Family income percent rank	61.0%	57.8%		27.0%	27.3%	0%–100%	0%–100%
Parent education							
High school degree or less	14.8%	17.5%		35.6%	38.0%	0%–100%	0%–100%
Some college	21.2%	23.9%		40.9%	42.6%	0%–100%	0%–100%
Bachelor's degree	30.9%	28.2%		46.2%	45.0%	0%–100%	0%–100%
More than a bachelor's degree	33.1%	30.4%	^	47.1%	46.0%	0%–100%	0%–100%
Race/ethnicity							
White	80.3%	77.6%		39.7%	41.7%	0%–100%	0%–100%
Asian	5.9%	7.5%		23.5%	26.3%	0%–100%	0%–100%
Black	5.6%	6.8%		22.9%	25.1%	0%–100%	0%–100%
Latino	3.7%	3.9%		18.8%	19.3%	0%–100%	0%–100%
Other/Multiracial	4.6%	4.3%	^	20.9%	20.2%	0%–100%	0%–100%
<b>Precollege characteristics</b>							
High school GPA (1 = < 1.0; 7 = 3.5–4.0)	6.24	6.41	***	1.0	0.8	1–7	1–7
SAT Math Score	560.2	525.8	***	105.1	99.8	200–800	220–800
SAT Verbal Score	541.0	538.3	**	101.1	100.6	200–800	200–800
Highest level of high school math							
Less than Algebra II	4.2%	5.0%		20.0%	21.7%	0%–100%	0%–100%
Algebra II	16.2%	18.7%		36.9%	39.0%	0%–100%	0%–100%
More than Algebra II	79.6%	76.3%	^	40.3%	42.5%	0%–100%	0%–100%
<b>College characteristics</b>							
Initial Enrollment Type							
2-year college	15.2%	16.6%		35.9%	37.2%	0%–100%	0%–100%
4-year college	84.8%	83.4%	^	35.9%	37.2%	0%–100%	0%–100%
Pell Grant recipient	20.2%	24.5%		20.4%	43.0%	0%–100%	0%–100%
College STEM GPA							
No STEM GPA	17.5%	23.3%	^	38.0%	42.3%	0%–100%	0%–100%
Less than 3.0	47.0%	40.6%	***	49.9%	49.1%	0%–100%	0%–100%
More than 3.0	35.4%	36.1%	*	47.8%	48.0%	0%–100%	0%–100%
Academic integration index	0.4	0.4	***	0.4	0.4	–0.4	1.5
Social integration index	0.5	0.5	***	0.5	0.5	–0.2	1.7

Source: Beginning Postsecondary Students Study:2004/2009.  $N = 5,210$  students who earned associate or bachelor's degrees (women = 3,130; men = 2,080).

Note. GPA = grade point average; STEM = science, technology, engineering, and mathematics. Descriptive figures are rounded to nearest 10th and  $N$  of cases is rounded to the nearest 10, in accordance with National Center for Education Statistics restricted data use confidentiality procedures. An analysis of variance (ANOVA) was used to estimate the statistical significance of gender differences in this set of variables plus the dependent variable ( $R^2 = .16$ ,  $p < .000$ ), including for individual variables. Reference categories selected by the ANOVA model are indicated with “^.” The reference category for Pell Grant recipient (nonrecipient) is not shown here because of space constraints. Stars indicate significance: \*  $p < .05$ . \*\*  $p < .01$ . \*\*\*  $p < .001$ . Data are based on unweighted counts.

groups, 5.6% of men and 6.8% of women identified as Black; 3.7% of men and 3.9% of women identified as Latino/a; and 4.6% of men and 4.3% of women identified as either more than one race or another race.

Turning to precollege characteristics, degree-completing men scored higher and were better prepared in mathematics than their female peers. More specifically, these men performed better on the college preparatory SAT mathematics (men (mean) = 560.2; women (mean) = 525.8;  $p < .001$ ) and even the SAT verbal (men (mean) = 541.0; women (mean) = 538.3;

$p < .01$ ) examinations. Again, these results are representative of those men who complete university degrees (noted earlier as somewhat more socio-economically advantaged than their female peers), not the population of U.S. youth as a whole. In a related finding, women were less likely than men to have completed more than Algebra II in high school (men = 79.6%; women = 76.3%). However, with respect to academic performance across all academic courses, women earned higher grades ( $p < .001$ ).

Notably, Table 2 shows the male advantages we observed in personal and precollege characteristics were less consistent in college. Still, slightly more women than men first enrolled in 2-year colleges (16.6% vs. 15.2%). More women than men did not take STEM courses for credit: 23.3% of women and 17.5% of men had no STEM GPA. But although men were more likely to take STEM classes than women, women who completed these classes earned higher grades: 36.1% of women earned greater than a 3.0 STEM GPA, as compared with 35.4% of men ( $p < .05$ ). The gender gap was wider for those with a STEM GPA less than 3.0 and favored women: 40.6% of women earned

**Table 2.** Gender gap in scientific degree attainment among college graduates, by college characteristics.

Predictors	Gender Gap in Degree Field							
	Non-STEM (reference)		Natural/Engineering Sciences		Life Sciences		Social/Behavioral Sciences	
	%	Std. Err.	%	Std. Err.	%	Std. Err.	%	Std. Err.
<i>All other predictors at means</i>	-0.66%	2.71%	-11.79%	*** 1.21%	8.36%	*** 1.65%	4.09%	* 1.79%
College STEM GPA								
Less than 3.0 (reference)	-1.11%	2.80%	-10.51%	*** 1.16%	7.38%	*** 1.57%	4.24%	1.99%
More than 3.0	0.52%	2.84%	-14.06%	*** 1.71%	9.58%	*** 1.90%	3.96%	1.49%
No STEM GPA	-2.01%	2.67%	-10.05%	*** 1.47%	8.04%	*** 1.70%	4.01%	2.06%
Academic index (75th percentile)	-1.08%	2.61%	-10.66%	*** 1.19%	7.64%	*** 1.64%	4.10%	* 1.82%
Social Index (75th percentile)	-0.61%	2.77%	-12.13%	*** 1.29%	8.60%	*** 1.66%	4.14%	* 1.83%
F Statistic	6.54	***						

Source: Beginning Postsecondary Students Study:2004/2009.  $N = 5,210$  students who earned associate or bachelor's degrees (women = 3,130; men = 2,080).  $N$  of cases is rounded to the nearest 10, in accordance with National Center for Education Statistics restricted data use confidentiality procedures.

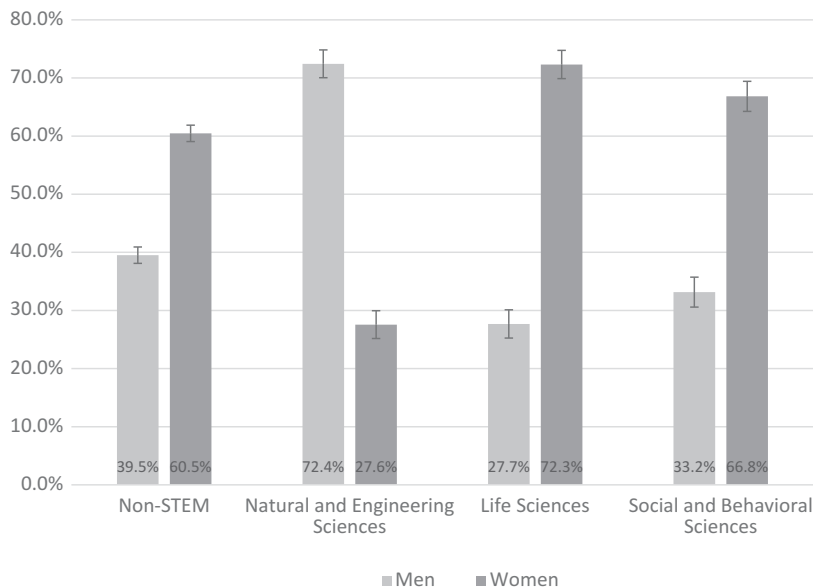
Note. GPA = grade point average; STEM = science, technology, engineering, and mathematics. Predicted probabilities were calculated using the margins commands in Stata 14, indicating the effect of the individual predictor, with all other predictors (besides gender) held constant at their means. For ease of interpretability, we multiplied the probabilities by 100 to report them in the form of estimated percentages. As noted in the Methods section of the manuscript, our estimates included the following covariates, which were not shown to maximize space: race/ethnicity, family income rank, parent education, SAT mathematics score, SAT verbal score, highest high school mathematics completed, high school GPA, and college type. Full models are available from the authors by request. The gender gap was calculated using pairwise comparisons of predictive margins and evaluating the magnitude and statistical significance of estimated differences between men and women in each degree field category.

\*  $p < .05$ . \*\*  $p < .01$ . \*\*\*  $p < .001$  (two-tailed tests).

less than 3.0 as compared with 47.0% of men ( $p < .001$ ). Notably, women were also more academically and socially integrated than men, albeit this finding is difficult to observe in the NCES-restricted figures ( $p < .001$ ); an alternative table with numerically transformed values is available from the authors by request.

These descriptive gender differences in students' demographic and pre-college characteristics suggest why we might see more men than women in natural/engineering science majors. On average, men were better prepared for these majors at the end of high school because they completed more advanced mathematics courses and scored higher on the mathematics (and verbal) sections of the SAT. Once in college, however, women who enrolled in STEM courses performed just as well as men or better. They were also more socially and academically integrated. Next, we examine the gender gap by STEM major.

Figure 1 shows the weighted distribution of men and women by their undergraduate degree fields as of 2009. These descriptive statistics indicated 39.5% of men and 60.5% of women graduated with non-STEM degrees. Men earned natural/engineering sciences degrees at a rate of more than 2.5 times higher than women: 72.4% of men and 27.6% of women earned their highest



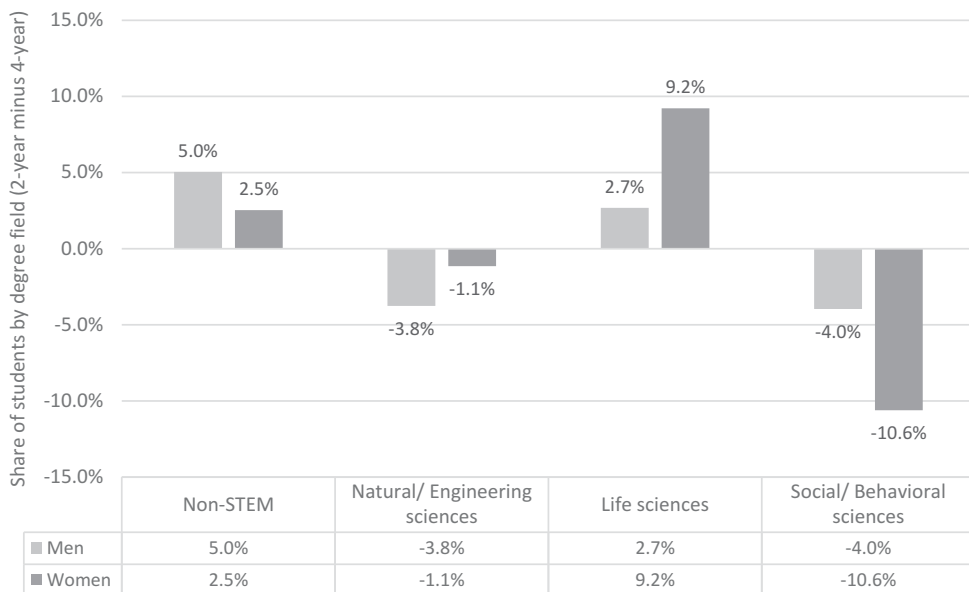
**Figure 1.** Undergraduate degree field (2009), by gender.  
Source: Beginning Postsecondary Students Study: 2004/2009.  $N = 5,210$ , representing a weighted population of 389,560 degree-earning men and 586,700 degree-earning women. Descriptive figures are rounded to the nearest 10th for results and nearest 10 for  $N$  of cases, in accordance with National Center for Education Statistics restricted data use confidentiality procedures. Error bars represent weighted standard errors. Results represent the field of study for the highest associate and bachelor's degrees earned. Data are weighted using replicate weights (wtc000, wtc001–wtc200).



undergraduate degrees in these fields. However, a mirror opposite pattern existed with life sciences degrees: 27.7% of life sciences degree earners were men and 72.3% were women. Relatedly, women's rate of earning social/behavioral degrees was 2 times higher than that of men: 33.2% for men versus 66.8% for women. Looking across the graph, gender differences in degree fields were substantial; the only degree cluster where the gender balance tipped against women was the natural/engineering sciences. In sum, gender imbalances in STEM are not uniform. Next, we discuss how these gender gaps in degree fields varied by college type.

### **Research Question 2: Gender differences in STEM among 2-year and 4-year college students**

Figure 2 builds on the previous graph, displaying the weighted distribution of earned degrees among men and women, as varied among those who started in 2-year and 4-year institutions. We subtracted the proportion of women and men in 4-year colleges from the proportion in 2-year colleges to arrive at the difference by college type. For example, 16.0% of men in 2-year colleges earned natural/engineering science degrees compared with 19.7% of men in 4-year colleges. As shown, the difference by college type equaled  $-3.8\%$ ; the negative sign indicates 4-year colleges have more men in natural/engineering sciences compared with 2-year colleges. Turning to women, there was a 1.1% difference in natural/engineering sciences degree share by college type: 5.0% of women in 4-year colleges earned these degrees compared with 3.9% of women in 2-year colleges.



**Figure 2.** Differences in degree field between 2-year and 4-year college students, by gender.

The array of results across the graph reinforces the importance of STEM field specificity. The negative relationship between 2-year college enrollment and natural/engineering sciences degrees was noted earlier. The largest numerical difference for women was in social/behavioral sciences; 4-year college students were better represented compared with 2-year college students (−10.6% for women, −4.0% for men). Two-year colleges had more students in the non-STEM and life sciences fields compared with 4-year colleges. The difference by college type was larger for women in the life sciences (+9.2%) than for men (+2.7%); college type differences in non-STEM majors were smaller for women (+2.5%) than men (+5.0%). Now that we understand national patterns in the gender gap in STEM degrees by degree cluster and college type, we turn to our subsequent research questions examining potential explanations for these differences, while leveraging our longitudinal survey-weighted data and statistical controls.

### ***Research Question 3: How do college experiences and characteristics influence the STEM gender gap?***

From this point onward, our results represent weighted estimates of our outcomes and are reported as predicted probabilities to enhance their interpretive clarity. Generated using the margins command in Stata 14 (see Long & Freese, 2014), these probabilities represent the chance of earning degrees in one of the four postsecondary degree clusters at a particular value (e.g., STEM GPA > 3.0) when holding all other variables either at a set value or at their means. Tables and figures report on our full model, as shown in the Methods section earlier. Statistical significance is reported for gender differences. Reporting focuses on college experiences and characteristics. The multivariate logistic regression models from which these estimates were based were highly significant.

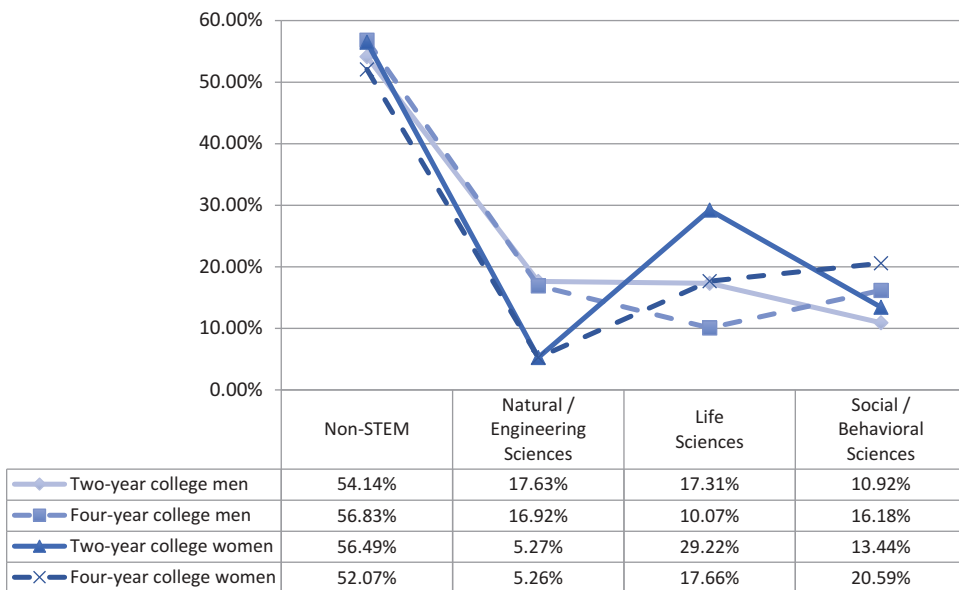
First, we describe the primary model, with all predictors other than gender at their mean values. Consistent with the descriptive results reported earlier, gender gaps varied by degree field and were largest in the natural/engineering sciences (−11.8%) and life sciences (+8.4%). The negative sign indicates the natural/engineering sciences gap favored men, while the plus sign indicates the life sciences gap favored women. Women also had an advantage in attaining social/behavioral sciences degrees, although the significance and magnitude were smaller (+4.1%).

Second, the gender gap in the natural/engineering and life sciences varied by STEM GPA. As compared with the primary model estimates reported earlier, the gender gap in the natural/engineering sciences was wider among students with STEM GPA greater than 3.0 (−14.1%). Correspondingly, the gap was smaller among those with a STEM GPA less than 3.0 (−10.5%). Turning to the relationship between GPA and the life sciences gender gap,

the same pattern held, although to a lesser degree and favoring women rather than men. The gender gap was wider when estimated for students with STEM GPAs greater than 3.0 (+9.6%), as compared with the primary model. It seems the higher the GPA, the wider the gender gap.

Finally, we turn to academic and social integration, with predicted probabilities estimated for students at the 75th percentiles of these measures. The gender gap in the natural/engineering sciences was a percentage point narrower among students in the 75th percentile of academic integration (−10.7% vs. −11.8%). Similarly, the life sciences gender gap was about a percentage point narrower among students in the 75th percentile of academic integration (+7.6% vs. +8.4%). By contrast, social integration was associated with a 0.3% increase in the width of both the natural/engineering and life sciences gender gaps. In sum, in these fields, academic integration was associated with a narrower gender gap and social integration was associated with a modestly wider gender gap. Neither academic nor social integration affected gender gaps in the non-STEM and social/behavioral sciences fields.

Having examined college experiences, we turn to college type. Figure 3 displays the probability of earning degrees in these fields for men and women at 2-year and 4-year institutions. While natural/engineering sciences varied widely by gender, as noted earlier, there was limited within-gender variation by college type: a 0.7% difference among men favoring 2-year colleges.



**Figure 3.** Predicted probability of degree field, by gender and college type.

Source: Beginning Postsecondary Students Study:2004/2009, restricted-use data.

Note. The gender gap within college types is measured as  $\text{Probability}_{\text{women}} - \text{Probability}_{\text{men}}$ . For ease of interpretation, probabilities were multiplied by 100 and reported as percentages.

Overall, college type differences were widest in the social/behavioral sciences and especially in life sciences: Two-year college men and 4-year college women had nearly the same likelihood of earning life sciences degrees (17.3% and 17.7%, respectively). By contrast, 2-year college men had a 10.1% chance of earning life sciences degrees, and 4-year college women had a 29.2% chance. Students' share of degrees in social/behavioral sciences ranged from 10.9% of 2-year college men to 20.6% of 4-year college women. Women were more likely to earn social/behavioral sciences degrees than were men, and 4-year college students were more likely than 2-year college students to earn these degrees.

Table 3 reports further on how the gender gap in these degree fields varied by college type and uses pairwise comparisons between the predicted probabilities. Bonferroni tests were used to compare the statistical significance of these comparisons. The two field clusters with the widest gender gaps across our previous analyses—natural/engineering sciences and life sciences—continued to have highly significant gender gaps. Notably for both, the gender gap was smaller at 4-year colleges than at 2-year colleges. For the natural/engineering sciences, the difference in the gender gap was less than 1 percentage point:  $-12.4\%$  (2-year colleges) compared with  $-11.7\%$  (4-year colleges). The college type difference was greater in the life sciences:  $+11.9\%$  (2-year colleges) versus  $+7.6\%$  (4-year colleges). Reading Figure 3 and Table 3 together provides an explanation for the college type effect. In the natural/engineering sciences, men's probability of earning these degrees was higher at 2-year institutions; women's probability was near identical across institutional types. In the life sciences, however, the probability of earning these degrees was higher for women in 2-year colleges and lower for men in 4-year colleges; indeed, the likelihood for 2-year college men and 4-year college women was quite similar.

Altogether then, we found mixed results for the effect of college type on the gender gap in obtaining STEM degrees. Women's chances of earning

**Table 3.** Gender gap in probability of degree, by college type.

College Type	Non-STEM	Natural/Engineering Sciences	Life Sciences	Social/Behavioral Sciences
2-year college	$-2.07\%$	$-12.36\%$ ***	$11.90\%$ ***	$2.53\%$
4-year college	$-0.34\%$	$-11.66\%$ ***	$7.59\%$ ***	$4.41\%$

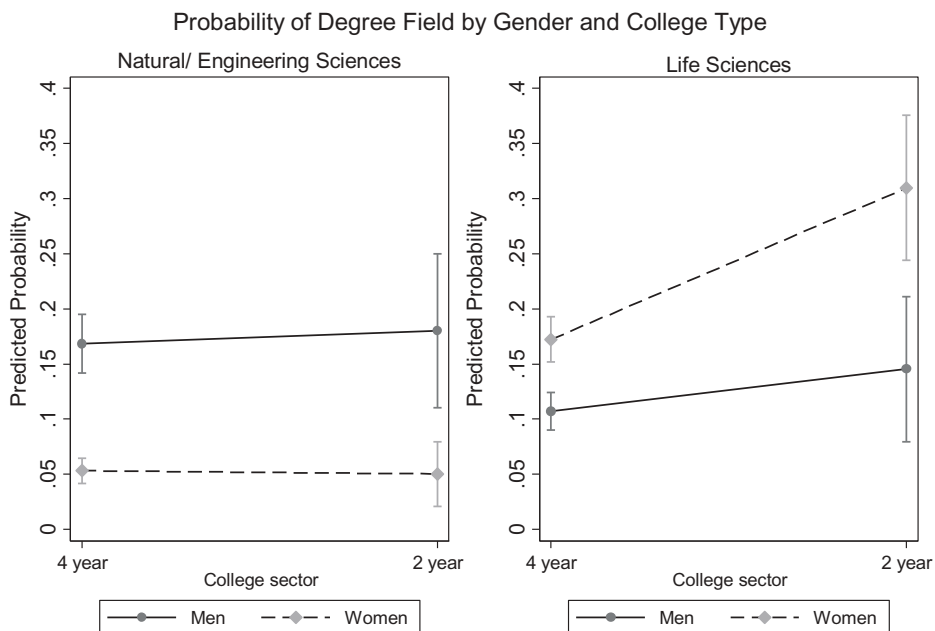
Source: Beginning Postsecondary Students Study:2004/2009, restricted-use data.  $N = 5,210$ .  $N$  of cases is rounded to the nearest 10, in accordance with National Center for Education Statistics restricted data use confidentiality procedures.

Note. STEM = science, technology, engineering, and mathematics. The gender gap within college types is measured as  $\text{Probability}_{\text{women}} - \text{Probability}_{\text{men}}$ . For ease of interpretation, probabilities were multiplied by 100 and reported as percentages. Bonferroni tests were used to compare the significance of gender differences in these predicted effects. As noted in the Methods section of the manuscript, our estimates included the following covariates, which were not shown to maximize space: race/ethnicity, family income rank, parent education, SAT mathematics score, SAT verbal score, highest high school mathematics completed, high school grade point average, and college type. Full models are available by request from the authors. \*  $p < .05$ . \*\*  $p < .01$ . \*\*\*  $p < .001$  (two-tailed tests).

natural/engineering sciences degrees did not differ, although men were more likely to earn degrees in these fields at 2-year colleges rather than 4-year colleges. Non-STEM degrees did not vary meaningfully by gender or college type. Social/behavioral fields varied across both indicators, but the modest gender differences did not reach statistical significance. Notwithstanding, life sciences degrees varied widely by gender as well as college type, and the gender gap in these fields was one third smaller at 4-year colleges.

**Research Question 4: How sensitive are these effects to alternative specifications of our measures?**

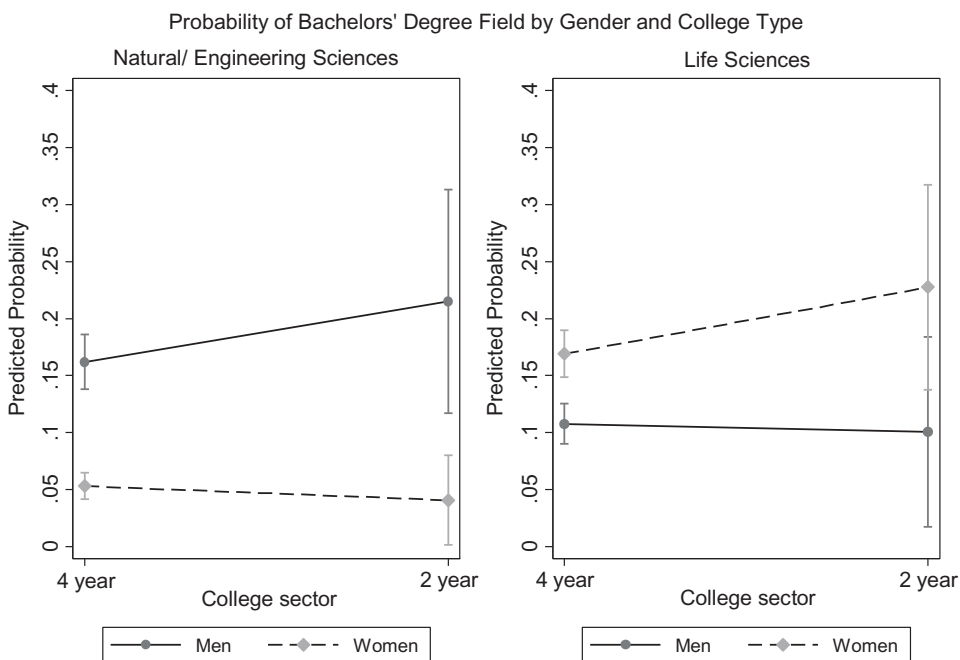
We conducted additional sensitivity analyses. First, we investigated the possibility of a potential interaction between gender and college type on degree field by adding an interaction term (Gender  $\times$  College Type) to the previous model. Although the interaction term was insignificant across our multinomial logistic model, Figure 4 indicates the previous pattern in the natural/engineering and life sciences fields continued to hold. For women, the difference in the gender gap by college type remained minor (5.3% at 4-year colleges and 5.0% at 2-year colleges after transforming the probabilities into percentages). Still, the gender gap in the natural/engineering sciences among initial 2-year students widened slightly, up to  $-13.0\%$ . As with the natural/engineering sciences, the predicted gender gap among 2-year college



**Figure 4.** Probability of degree field by gender and college type.

students also widened by nearly 5 percentage points to 16.4% with the addition of the interaction between gender and college type. By contrast, the gender gap among initial 4-year college enrollees was 1 point narrower, at 6.5%.

Next, we examined the extent to which the STEM gender gap in 2-year and 4-year colleges varied specifically among those who earned bachelor's degrees by the end of the study (6 years after starting college). Building on the previous multinomial logistic regression model, we restricted our analytic sample to bachelor's degree recipients only ( $n = 4,690$ ,  $F = 8.94$ ,  $p < .000$ ). We again focused on the probability of earning degrees in the natural/engineering sciences and life sciences, the degree field clusters with statistically significant gender differences. Notably, [Figure 5](#) shows a change for both the natural/engineering and life sciences in the relationship among gender, college type, and predicted probability of degree. Intriguingly, this change occurred in opposite directions. As compared with [Figure 4](#), the gender gap in the natural/engineering sciences *increased* among those who started at 2-year colleges. The widening of the gap can be attributed to changes among men and women, with more initial 2-year college men earning bachelor's degrees in the natural/engineering sciences and slightly fewer women earning bachelor's degrees as compared with earning either an associate or bachelor's degree in this field (5.0%), as reported earlier. Meanwhile, the gender gap in the predicted probability of earning bachelor's degrees in the life sciences was



**Figure 5.** Probability of bachelor's degree field by gender and college type.

*smaller* among initial 2-year students (22.8% for women, 10.1% for men) compared with the gender gap among initial 2-year college students in earning either an associate or bachelor's life sciences degree. The probability of 2-year college starters earning bachelor's degrees in the life sciences was lower for both women and men.

Two additional supplemental robustness checks bear mention but are not shown for space constraints. We tested the degree to which Pell Grant receipt in the 1st year of the study affected our results. This measure—an indicator of socioeconomic status and a blunt measure of financial aid receipt—did not significantly predict earned degrees across the degree field clusters nor did it affect the relationship among gender, degree field, and college type. We also investigated the degree to which our model results varied when using *last* (2009) in addition to *initial* (2004) college type. Results were generally consistent with our previous findings.

## Discussion

Although women have surpassed men in earning bachelor's degrees, they have yet to achieve parity in certain STEM fields, most notably in the natural/engineering sciences. Research has indicated the biggest determinant of the wage gap between men and women has been undergraduate degree field (Bobbitt-Zeher, 2007). Notably, the gender wage gap in STEM careers is smaller than in non-STEM careers (Beede et al., 2011). Because women are more likely to attend 2-year colleges (Horn et al., 2006), it is important to consider the role of 2-year colleges in affecting or maintaining the gender gap in the natural/engineering sciences. This is especially true given the traditional role of 2-year colleges: to enhance college access and opportunity (Doyle & Gurbunov, 2011).

We expected to find a college type effect. Instead, we found the gender gap in STEM degrees did not consistently vary among initial 2-year college and 4-year college enrollees. Results indicated that 2-year colleges neither increased nor decreased women's chances of earning natural/engineering sciences degrees, those associated with the highest financial returns to degree (Carnevale et al., 2011). Rather, college type primarily affected the gender gap in the life sciences and, to a lesser extent, the social/behavioral sciences as well. In the next section, we indicate how our findings might advance the literature on gendered inequality in STEM in higher education more broadly.

### ***Gendered inequality in specific STEM fields***

Notable findings on non-STEM and social/behavioral sciences degree outcomes notwithstanding, the discussion here focuses on natural/engineering



and life sciences degrees. We narrowed the discussion because of important differences in status, earnings, and perceived difficulty among these field clusters (Cheryan, 2012; Corbett & Hill, 2015). Once male-dominated, life sciences undergraduate programs have increasingly become attractive and heavily utilized pathways for women's career advancement, certainly in allied health fields commonly offered as majors at 2-year colleges. By contrast, the natural/engineering sciences generally continue to be primarily male domains, including at 2-year colleges. The findings reported here illustrate the importance of parsing "STEM" into its component fields and degree clusters to better investigate how gender functions across postsecondary institutional categories.

Our first research question focused on descriptive gender differences among U.S. undergraduate degree earners, the population to whom this nationally representative study generalizes. U.S. cohort studies have shown women with non-college-educated fathers experienced the biggest gains in degree attainment (Buchmann & DiPrete, 2006). However, our descriptive findings indicated precollege factors favored men, especially socioeconomic resources and academic preparation. Once they were in college, we found women were more integrated than men and earned higher STEM grades, both notable findings for conceptualizing the social and academic levers for potential interventions aimed at broadening women's participation in STEM fields.

In addition, we found starkly inverse participation gaps in the natural/engineering and life sciences. Of those earning their highest undergraduate degrees in the natural/engineering sciences, 72.4% were men and 27.6% were women. Among life sciences degree earners, 27.7% were men and 72.3% were women. Women were also twice as likely to earn social/behavioral degrees as compared with men (33.2% vs. 66.8%). Indeed, "STEM" is a category limited in its utility. We also investigated differences by college type. Descriptively, the share of men in the natural/engineering sciences was 3.8 percentage points lower in 2-year institutions than at 4-year institutions. The share of women in these fields was 1.1% lower in 2-year institutions than at 4-year institutions. Overall, however, the share of men and women by college type varied more widely in the non-STEM, life sciences, and social/behavioral sciences fields.

Multivariate logistic regression analyses estimated men's and women's chances of earning STEM degrees, with attention to college experiences and characteristics. Turning first to college experiences, the gender gap was smaller among highly academically integrated students who met with an academic advisor, had social contact with faculty members, and spoke with faculty about academic matters. This finding suggests that academic integration for women in the natural/engineering sciences may be one strategy used to decrease the gender gap in these fields. Gender gaps were also slightly wider among highly socially integrated natural/engineering and life sciences students. With respect to the debate about how grades in STEM coursework influence persistence to STEM

degrees, we found a wider gender gap in the natural/engineering and life sciences among those with a STEM GPA greater than 3.0, a considerable feat in many STEM fields. This finding conforms with research indicating the gender gap in STEM fields is not attributable to differences in innate mathematical ability (Hyde, 2014; Perez-Felkner et al., 2017), but it may be better explained with further research on postsecondary STEM classrooms, departmental and institutional climates, and indeed college type.

### ***Conceptualizing the STEM gender gap***

Across our predictive models, the relationship between the STEM gender gap and college type varied across our measures in both magnitude and direction. We observed the following across a series of estimates. First, initial college type did not meaningfully influence women's likelihood of completing natural/engineering sciences degrees. Even when we examined only bachelor's degree recipients in our final model, women who initially enrolled in 2-year colleges were only marginally less likely than their 4-year counterparts to earn these degrees. This finding suggests women's increasing use of 2-year colleges is not diminishing their likelihood of obtaining natural/engineering sciences degrees.

Future research should examine more carefully the undergraduate component of the pipeline to STEM degrees and mechanisms to curb talent loss among women, especially at 2-year institutions. The access mission at 2-year colleges aligns with the aim of broadening access to high-status and high-earning fields—especially in natural/engineering sciences; this especially rings true for the diverse and often less economically advantaged women who typically attend these colleges (Corbett & Hill, 2015; St. Rose & Hill, 2013).

While research on STEM higher education has tended to overlook 2-year college students, our findings show promise. With respect to undergraduate gender disparities in degrees earned, we found these were neither static across STEM degree fields nor isolated to 4-year and elite colleges. Given how little is known about STEM pipelines at 2-year institutions and policy levers directing students into these courses and majors (Gaertner, Kim, DesJardins, & McClarty, 2014; Schiller & Muller, 2003), it is imperative we better understand the mechanisms for reducing inequality in STEM across postsecondary institutional types.

### **Notes**

1. The terms “underrepresented groups” and “underrepresented minorities” refer to individuals who are underrepresented in the STEM educational system and workforce, in particular those from one or more of the following racial or ethnic groups: Black or African American, Latino or Hispanic, American Indian or Alaska Native, and Native Hawaiians or other Pacific Islanders (see, e.g., National Science Foundation, 2013).

2. Each of our reported numbers ( $N$ ) of cases is rounded to the nearest 10, in accordance with NCES restricted data use confidentiality procedures. For this reason, figures reported here may not add perfectly.
3. Although participation in study groups is at times and was in fact in NCES's original index grouped with the measures of academic integration listed earlier, it held more closely with social integration measures in our analyses of the data, perhaps because of studies noting the inconsistent association between study group participation and academic performance (e.g., Arum & Roksa, 2011).

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## Appendix A: Coding the Dependent Variable

**Non-STEM** includes the following degree programs: architecture and related services; area, ethnic, cultural, gender, and group studies; visual and performing arts; business, management, marketing, and related support services; communication, journalism, related programs, and technologies; construction trades; education; English language and literature/letters; foreign languages, literatures, and linguistics; legal professions and studies; mechanic and repair technologies/technicians; multi/interdisciplinary studies; parks, recreation, leisure, and fitness studies; precision production; personal and culinary services; philosophy and religious studies; public administration and social service professions; homeland security, law enforcement, firefighting, and related protective services; transportation and materials moving; and liberal arts and sciences, general studies, and humanities.

**Natural/engineering sciences** include: computer and information sciences and support; engineering; mathematics and statistics; physical science; science technologies/technicians; and engineering technologies and engineering-related fields.

**Life sciences** include: agriculture, agriculture operations, and related sciences; biological and biomedical sciences; and health professions and related programs.

**Social/behavioral sciences** include: family and consumer sciences/human sciences; psychology; social sciences; and history.