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Pipeline Dreams: Occupational Plans and Gender Differences in STEM Major Persistence and Completion

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Abstract

In the United States, women are more likely than men to enter and complete college, but they remain underrepresented among baccalaureates in science-related majors. We show that in a cohort of college entrants who graduated from high school in 2004, men were more than twice as likely as women to complete baccalaureate degrees in science, technology, engineering, and mathematics (STEM) fields, including premed fields, and more likely to persist in STEM/biomed after entering these majors by sophomore year. Conversely, women were more than twice as likely as men to earn baccalaureates in a health field, although persistence in health was low for both genders. We show that gender gaps in high school academic achievement, self-assessed math ability, and family-work orientation are only weakly associated with gender gaps in STEM completion and persistence. Gender differences in occupational plans, by contrast, are strongly associated with gender gaps in STEM outcomes, even in models that assume plans are endogenous to academic achievement, self-assessed math ability, and family-work orientation. These results can inform efforts to mitigate gender gaps in STEM attainment.

Keywords

STEM, women in STEM, college major, gender inequality, occupational plans, higher education

In U.S. higher education, young women are more likely than young men to attend and complete college, but they are less likely to earn degrees in science, technology, engineering, and mathematics (STEM) fields and more likely to earn degrees in the humanities and social sciences. In the academic literature, the segregation of men and women across college majors is understood as consequential not only as an indicator of gender disparities in higher education but also as a precursor of gender segregation across occupations and gender inequalities in the valued goods (e.g., income, autonomy, job security, prestige) associated with different occupations. In policy circles, gender segregation in higher education is often framed as a workforce development issue, with the assumption that some women who major in fields other than STEM represent untapped potential to boost the STEM workforce and spark future technological and scientific innovation (e.g., National Academy of Sciences, National

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Academy of Engineering, and Institute of Medicine 2007).

This article makes four contributions to our understanding of women's underrepresentation in STEM majors. First, we use restricted access data from the Educational Longitudinal Surveys of 2002 to 2012 (ELS) to assess the gender gap in STEM major completion among high school sophomores in 2002 who were tracked through 2012. The ELS cohort is one of the first to complete its schooling after women's college completion rates first began to exceed men's and when the gender composition of the STEM workforce became a significant focus of policy and discussions about higher education. It is also the most recent cohort in a longitudinal study for which college outcomes are available. This allows us to update and extend our knowledge of gender differences in patterns of major completion based on data from earlier cohorts (see e.g., Legewie and DiPrete 2014; Xie and Shauman 2003; but see Nix and Perez-Felkner 2019) or from cross-sectional data that lack the richness to evaluate microlevel processes leading to educational segregation (e.g., Charles and Bradley 2009; England and Li 2006). As we will show, even in this relatively young cohort, gender differences in STEM outcomes remain substantial.

Second, we broaden the scope of prior research by assessing four explanations for gender gaps in STEM baccalaureate degree completion: (1) gender differences in academic pipelines, including prior academic achievement, math and reading test scores, and math and science course-taking in high school; (2) gender differences in self-assessed math ability, conditional on prior academic achievement; (3) gender differences in orientation toward family and work; and (4) gender differences in occupational plans held in high school, indicated by the job students plan to have at age 30. The first three explanations prevail in the sociological and psychological literatures on gender segregation in higher education in general and in STEM majors in particular (for a review, see Xie, Fang, and Shauman 2015). The fourth explanation is grounded in a long tradition of education research, where much attention is focused on understanding how students' educational and occupational aspirations affect both short- and long-term educational decisions. Prior studies have assessed predictions drawn from one or more of these theories separately, but we offer a more comprehensive assessment and a modeling framework that allows us to estimate their relative contributions.

Third, we analyze patterns and sources of gender differences in two outcomes that complement existing research. The first outcome, STEM completion conditional on entering college, is consistent with much of the research on gender segregation in higher education that relies on cross-sectional data on college graduates by their field of study (e.g., Charles and Bradley 2009; England and Li 2006). The second outcome, STEM persistence conditional on declaring a STEM major, speaks to long-standing concerns in the ''women in STEM'' literature about leaky pipelines and atypical STEM careers (Xie and Shauman 2003).

Fourth, we adopt a two-part definition of STEM that addresses core concerns of both the ''gender in STEM'' and gender segregation literatures, on one hand, and workforce development issues on the other. Specifically, we differentiate between STEM/biomed majors (e.g., biology, engineering, chemistry) that are educational pathways to doctoral-level medical occupations and health majors (e.g., nursing, physical therapy) that are educational pathways to STEM occupations that typically require a master's degree or less (Morgan, Gelbgiser, and Weeden 2013). This strategy recognizes that first, there is very little agreement in the academic or policy literatures about how to define STEM (Xie et al. 2015); second, the universe of science-related majors extends beyond those traditionally found in the most selective educational institutions; and third, the two types of majors have different gender profiles and are gateways into quite different occupations even though they both require science training.

The rest of this article is organized as follows. We first elaborate four major sources of gender gaps in STEM major completion and persistence posited in the women in STEM and educational attainment literatures. We then discuss the ELS data, our measures of college outcomes, and our measures of key predictors implied by these theories. In the third section, we estimate the minimum and maximum shares of the gender gap in STEM major completion associated with each set of predictors under different assumptions about the underlying causal processes (see Morgan et al. 2013). In the fourth section, we turn to STEM/biomed persistence and attrition throughout college, providing descriptive outflow tables and multivariate models of the sources of gender gaps, now applied to the subset of respondents who declared a STEM/biomed major by their sophomore year. We conclude by discussing the implications of our results for efforts to understand and mitigate women's underrepresentation in STEM degrees and occupations.

SOURCES OF THE GENDER GAP IN STEM MAJOR PERSISTENCE AND COMPLETION

In the academic literature on educational segregation, women's underrepresentation in STEM is often understood as an outcome of general social processes that create gender inequalities of many forms (Correll 2001, 2004; Thébaud and Charles 2018; Xie and Shauman 2003). In this article, we consider four proximate explanations for gender differences in STEM educational outcomes: academic pipelines and prior academic achievement, family-work orientation, self-assessed math ability, and occupational plans.[1]

Precollege Academic Preparation and Math and Science Course-Taking

One of the most common explanations for gender differences in STEM outcomes, especially among lay observers, points to gender differences in prior academic achievement as indicated by grades, math tests scores, and math and science course-taking in high school (e.g., Ayalon 2003; Hyde et al. 2008; Turner and Bowen 1999). Although women's grades exceed men's, on average, their mean math test scores still fall slightly below men's in the United States, and they are underrepresented among students who leave high school with the strongest academic preparation in science and math (Ellison and Swanson 2010; Penner and Paret 2008). Because of these gender differences, women are less likely to select or be selected into majors that require substantial math skills or prior academic preparation in math or science and less likely to complete them. According to this argument, academic achievement and coursework in high school have lingering effects on the likelihood of persisting in STEM fields in college, whether because math and science courses tend to be highly sequential or because academic achievement and coursework in high school reflect relatively stable underlying traits (e.g., math ability, academic orientation, study skills) that are also beneficial in college (Phelps, Camburn, and Min 2018).

Prior research offers limited support for this ''academic pipeline'' explanation for the gender gap in STEM. Gender differences in standardized math test scores, math course-taking, and science course-taking have declined in the United States, and they are currently too small to account for much of the gender gap in initial STEM major selection (Hyde et al. 2008; Mann and DiPrete 2013; Morgan et al. 2013; Riegle-Crumb and King 2010; Riegle-Crumb et al. 2012; Xie and Shauman 2003). Less evidence is available on the impact of standard achievement metrics on STEM major persistence and completion than on initial selection, but we see little theoretical reason to think academic pipeline explanations fare better in accounting for persistence and completion. Even so, the prevalence of the ''academic achievement'' argument in public discourse about women's underrepresentation in STEM makes it worth evaluating.

Family-Work Orientation

A second prominent set of arguments about the gender gap in STEM focuses on gender-differentiated preferences for high levels of involvement in childrearing and other family activities combined with the perceived or actual incompatibility between these activities and scientific careers (Almquist, Angrist, and Mickelson 1980; Gerson 1985; Weisgram and Diekman 2017). For example, Ceci and Williams (2011; see also Williams and Ceci 2012) argue that ''differing biological realities'' between the sexes, including inherent skills (e.g., object orientation), cause them to make different sets of educational and occupational choices. This essentialist argument echoes Hakim's (2002) preference theory, which claims women's preferences for nurturing lead them to invest in educational pathways that will, in turn, lead them into occupations compatible with childrearing and caregiving. A sociological variant of this argument emphasizes gender-differentiated socialization and normative pressures on women to conform to sex-typical work and family roles (e.g., Jacobs 1989) rather than biologically based gender differences or deep-rooted preferences but nonetheless offers similar predictions. All three variants imply that young men and young women will differ in their stated preferences for family over work, there will be a strong association between family-work orientation and STEM/biomed major completion, and a nontrivial share of the gender gap in STEM/biomed completion will be associated with gender differences in family-work orientation.

Prior research shows mixed support for the ''family-work orientation'' explanation. Students do express concern that STEM majors are gateways to careers that are difficult to combine with family (Ganley et al. 2018). For both male and female students, these perceptions are associated with a lower probability of majoring in science, particularly physical sciences, engineering, and math (Valentino et al. 2016; Wiswall and Zafar 2018). However, nationally representative data from older cohorts than the ELS students show only trivial effects of gender differences in family and work orientation on the gender gap in STEM major selection (Mann and DiPrete 2013; Morgan et al. 2013; Perez-Felkner et al. 2012; Riegle-Crumb et al. 2012; Xie and Shauman 2003). As with the academic pipeline argument, our a priori expectation is that gender differences in family-work orientation will contribute little to the gender gap in STEM persistence and completion.

Self-Assessed Math Ability

Within sociology, the theory of status expectation states provides an encompassing explanation of gender inequality across a host of domains, including higher education (Correll 2001, 2004; Ridgeway 2014). According to this theory, cultural beliefs about men's and women's task competencies lead to gendered self-assessments of a range of abilities, including math and science ability: Women assess their math ability less positively than do men even given the same test scores or grades (Correll 2001, 2004; Thébaud and Charles 2018). These self-assessments affect students' decisions about whether to enter STEM majors, and they may also affect students' persistence in STEM. For example, men who fail a math course but not other types of courses are more likely than women to retake it (Penner and Willer 2019; Sanabria and Penner 2017); moreover, men's greater confidence in their math ability partially accounts for their overpersistence in math (Penner and Willer 2019).

Closely related models appear in the psychological and career development literatures. In psychology, Eccles's (2011) expectancy-value model argues that adolescents who develop self-concepts as ''math people'' come to value math and science more than other adolescents and as a result are more likely to choose STEM majors. Boys are more likely than girls to develop math self-concepts because these self-concepts are linked to gendered cultural beliefs and socialization, cues about abilities from significant others, and students' prior academic achievement in math and science. In the career development literature, arguments focus on gender differences in self-confidence and domain-specific mathematics self-efficacy (Moakler and Kim 2014). Although there are subtle differences between math self-concept, self-assessed math ability, and math self-efficacy (Penner and Willer 2019), these subtleties cannot be captured with the questions available in the ELS, so we group them together under the rubric of self-assessed math ability.

The empirical implication of these arguments is that the gender gap in STEM/biomed persistence and major completion is partially due to men's greater self-assessed math ability conditional on math test scores and other objective measures of ability. One might also expect women's greater persistence in and completion of health-related majors is associated with their greater self-assessed nurturing ability given gender-essentialist beliefs in women's nurturing and caretaking ability. Unfortunately, the ELS lacks relevant measures to test this latter hypothesis.

Prior empirical work shows mixed support for self-assessed math ability and closely related arguments. Some studies find gender differences in perceived mathematical ability are associated with gender differences in persistence in high school course-taking, intent to major in STEM as of the last year of high school, and initial STEM major selection (Correll 2001; Ma 2011; Moakler and Kim 2014; Perez-Felkner, Nix, and Thomas 2017). However, Riegle-Crumb and King (2010) concluded that math attitudes do not contribute to gender disparities in the likelihood of initially selecting a physical science or engineering major. More recently, Nix and Perez-Falkner (2019) found that gender differences in students' perceptions of the difficulty of mathematics are associated with gender differences in declaring a physics, math, engineering, or computer science major but that associations with completing one of these majors are dependent on model specification. These disparate results could be driven by differences in how the outcome variable is defined (e.g., broad STEM intentions vs. narrow physical science/engineering major selection), the wording of the question used to measure self-assessed ability or confidence, the timing of the predictor variable relative to the outcome, or sample definitions and model specifications.

Occupational Plans

In much of the theoretical literature on gender differences in STEM major completion, gender differences in occupational plans are either implicit or wholly predicted by the focal abilities, preferences, or tastes that are assumed to precede the formation of occupational plans. The status expectation states and expectancy value models, for example, assume that young women who think they are not good at math or science will not aspire to enter math and science occupations or choose these majors in college. In strong-form preference models (Hakim 2002; Williams and Ceci 2012), women self-select out of STEM because of deep and mostly immutable, if not innate, preferences for caretaking or nurturing roles. In the academic pipeline argument, students who lack the ability and prior academic training to excel in math or science either fail to develop aspirations to enter STEM or drop (or are pushed) out of such majors. In all three models, occupational plans are endogenous in the implied causal pathways between objective ability, self-assessed ability, and family-work orientations and STEM majors. The empirical implication is that the association between occupational plans and college outcomes will be eliminated in models that adjust for these other observed predictors.

In marked contrast to theories of gender differences in STEM, the education literature forefronts occupational plans as a key causal pathway between family background and educational outcomes. In this literature, represented by classic models of educational attainment as well as more contemporary rational-choice theoretic models of educational decision-making, occupational plans cannot simply be reduced to outcome differences in ability and academic achievement, self-assessed competence, or family orientation.

Take, for example, Morgan's (2005:101–102) ''stutter-step'' model of educational decision-making. In this model, students make ''prefigurative commitments'' to specific futures (e.g., entering a science occupation) based on the information they have available to them, their beliefs about the costs and benefits of the outcome, imitative processes (e.g., ''what my friends do''), and normative processes (e.g., ''what people like me do''). All of these precursors to a given prefigurative commitment are likely patterned by gender, leading to gender differences in occupational plans. Young women may believe, whether accurately or not, that they will face greater discrimination in STEM occupations (Ganley et al. 2018) and hence that the costs of this potential career are larger. They may also have a more difficult time obtaining information about male-dominated occupations, whether because gatekeepers (e.g., school counselors, teachers) actively discourage their participation in science or because gender-segregated networks make it less likely they will have scientists in their information networks. Young women may also be less likely to have STEM aspirants among their friendship networks, and even women who are initially attracted to science may, through imitative processes, alter their preferences to match those of their friends (Raabe, Boda, and Stadtfeld 2019). Finally, the normative processes that affect young adults' perceptions of ''what people like me'' do are likely influenced by gender-essentialist beliefs that play out in others' expectations, in direct or indirect experiences of discrimination or overt hostility, and in gender-segregated educational networks (Ridgeway 2014; Xie et al. 2015), all of which likely affect students' prefigurative commitments to a STEM future. To be sure, family-work orientation, prior academic achievement, and self-assessed abilities may also influence students' plans to enter STEM occupations. Nevertheless, the implication of the stutter-step and related educational decision-making models is that gender differences in plans to enter STEM occupations will be strongly associated with gender gaps in STEM persistence and completion even in models that condition on these other predictors.

Despite the long tradition of including occupational aspirations in models of educational attainment, relatively few empirical studies of gender segregation in college major or in STEM-related educational outcomes incorporate these measures (e.g., England and Li 2006; Moakler and Kim 2014; Riegle-Crumb et al. 2012; Xie and Shauman 2003). There are important exceptions. Tai and colleagues (2006) found a strong association between science career expectations in 8th grade and majoring in a physical or life science, adjusting for academic achievement and science preparation in high school for the NELS:88 cohort, but they did not assess the contribution of gender differences in career expectations to gender gaps in these majors. Legewie and DiPrete's (2014) analysis of STEM major selection using the NELS:88 data shows substantial shares of the gender gap in STEM are attributable to differences in 8th- and 12th-grade science orientation, where 8th-grade science orientation is measured with an indicator of occupational plans. Studying a more recent cohort, Morgan and colleagues (2013) found that gender differences in high school plans to enter STEM occupations accounted for a larger share of gender differences in initial STEM/biomed major selection among college sophomores than did academic pipeline or family-work orientation. We build on these prior analyses, many of which use data from an older cohort, but we offer models that include a broader range of alternative predictors and focus on STEM major persistence as well as completion.

DATA AND MEASURES

We use the ELS, a nationally representative data set based on a two-stage sample of schools and students that includes four waves of student surveys (2002, 2004, 2006, and 2012) and a secondary school transcript study. Most variables in our analyses are available in the publicly released ELS data, except occupational plans, described in the following, which we extracted and coded from data available only to licensed users.

We focus on the subset of ELS respondents who graduated high school on time, entered a four-year baccalaureate institution within six months of graduating from high school, participated in all four waves of the survey, and have nonmissing information on college outcomes in the 2012 survey. In supplementary analyses (see Appendices K–O in the online Supplemental Material), we relax the constraint of immediate college entry, adding a modest 377 cases, of which 24 are STEM graduates. Because of the timing of the ELS waves and our need for information on major in 2006 (see the following), we cannot evaluate STEM persistence and completion for ''nontraditional'' students who entered college more than 18 months after graduating from high school.

We weight the ELS data by the base-year and third follow-up panel weight developed by the data distributors. We multiply this panel weight sequentially by two estimated inverse probabilities that account for nonparticipation in all four waves of the survey and for nonresponse on type of degree or college major. These estimated probabilities were drawn from logit models that predict inclusion in the relevant restricted sample with demographic characteristics, family background, and base-year indicators of academic engagement. The weighted analytic sample contains 5,160 observations: 2,290 men and 2,870 women.[2]

Our measure of initial college major, which is central to our analysis of STEM persistence, is from the 2006 survey, when most students were college sophomores. Our core predictors are measured in the 2002 and 2004 surveys, when most students in the sample were in 10th and 12th grade, respectively. Some of these predictors are available in the 2006 wave, but the structure of our analysis (see the following) requires consistency in the time lag between the predictors and outcome. We used best subset regression to impute missing values on the predictors.

College Outcomes in 2012

We measure college outcomes using the 2012 survey, collected approximately eight years after students enrolled in a four-year institution. College outcomes are indicated by respondents' self-reports of the type of degrees earned and the major field or fields of their baccalaureate degrees if any were awarded. Based on detailed CIP codes, we coded the field of the baccalaureate degree into three categories following Morgan and colleagues (2013):(1) STEM/biomed degrees (e.g., math, engineering, physical and life sciences), including biomedical programs (e.g., premed, prevet) that lead to doctoral-level occupations; (2) health and related degrees that lead to master's- or baccalaureate-level occupations (e.g., nursing, physical therapy); and (3) non-STEM majors. We cannot separate all students in premed and prevet programs from other STEM degree earners because at many institutions, premed programs are embedded within disciplinary majors (e.g., biology). However, all ELS students who reported ''premed'' or ''prevet'' in their verbatim responses had a CIP code for a traditional STEM field, suggesting inclusion of these programs in the STEM category has no appreciable effect on our results.[3]

Multimajor students who reported at least one major in STEM/biomed are included in the STEM/biomed category, and students who reported at least one major in health but none in STEM/biomed are included in the health category. The fewer than 10 students who reported both a STEM/biomed major and a health major are included in the STEM/biomed category; we allowed STEM/biomed to trump health because of the literature's greater emphasis on the former. The outcome variable also includes categories for students who completed an associate's degree or certificate instead of a bachelor's degree and for students who did not receive a degree or certificate by 2012, the last wave of the ELS survey. We cannot, of course, differentiate students who earned baccalaureate degrees after 2012 from those who never finish their degrees.

Because there is relatively little agreement in the gender in STEM literature on the boundaries of the STEM category, we ran two sensitivity analyses with alternative coding of science majors. In the first, we separated engineering, physics, math, and related physical sciences from the biological sciences while retaining a separate health category. In the second, we combined the biology/biomedical and health categories. In both cases, the patterns of association between gender gaps in the predictors and gender gaps in the core STEM category are very similar to those in our main analysis. We prefer our original coding on theoretical grounds: Biology degrees are science degrees. However, for readers who prefer a less expansive definition of STEM, Part E of the appendix in the online Supplemental Material provides results of this sensitivity analysis.

Table 1 presents gender-specific distributions of college outcomes for the weighted ELS sample using our preferred coding of the science-related fields. Among students who entered college immediately after graduating from high school in 2004, men were more than twice as likely as women (18.0 percent compared to 7.9 percent) to complete a STEM/biomed major from any institution by 2012. Conversely, women were more than twice as likely as men (6.4 percent compared to 2.7 percent) to complete a baccalaureate degree in a health major. Excluding degrees from the second or later institutions decreases the percentages for both genders, but the gender gap is similar to the ''any institution'' sample.[4]

Table 1. Major of Bachelor's Degree Earned from Any Institution by 2012 among Immediate-Entry College Students.

	% of Men	% of Women
STEM/biomed	18.0	7.9**
Health	2.7	6.4**
Other fields	37.3	44.2**
AA/certificate only	10.5	11.6
No degree	31.5	29.9

Source: Educational Longitudinal Study, 2002 to 2012.
Note: Unweighted and rounded $N = 5,160$ (men = 2,290; women = 2,870). Percentages are weighted. See text for explanations of sample and coding of outcomes. Significant gender differences in proportions, based on a z test for equality of proportions, are marked. AA = associate's degree.
$*p < .05$. $**p < .01$.

Academic Preparation and Prior Math and Science Course-Taking

We measure academic preparation using data collected in the 2002 and 2004 waves of the ELS. The available measures include math scores in 10th and 12th grade, reading scores in 10th grade, 12th grade GPA, and six-category measures of both math and science course-taking (Burkam and Lee 2003). Reading test scores in 12th grade are not available in the ELS.

Among the ELS cohort, young women who enter college immediately after high school have higher average GPAs, higher average reading test scores, and lower average math test scores than do young men (see Table 2). They are also less likely to have taken calculus, the highest math course, and both chemistry and physics, the highest science courses. However, the variability around women's mean grades and test scores or modal course-taking attainment is also lower: Women are less likely than men to fall at the very bottom of the grade or test score distribution, more likely to have taken chemistry *or* physics, more likely to have taken precalculus, and less likely to be among the least academically prepared college entrants. This suggests that the effect of gender differences on patterns of STEM/biomed and health major completion will depend, in part, on how far down the distribution of prior academic preparation STEM/biomed and health majors are drawn.

Table 2. Descriptive Statistics for Focal Predictors of College Outcomes among Immediate-Entry College Students.

	Men		Women		
	Mean	SD	Mean	SD	
Academic preparation and math/science course-taking					
Test scores					
Math score, 12th grade	59.46	12.68	55.71	12.24	**
Math score, 10th grade	52.91	12.38	49.76	11.88	**
Reading score, 10th grade	35.20	8.38	35.43	7.81	
GPA	3.08	.68	3.34	.61	**
Math pipeline					
None/low/middle academic	.06		.05		
Middle academic II	.17		.19		
Advanced I	.19		.21		
Advanced II/precalculus	.24		.29		*
Advanced III/calculus	.27		.22		**
Missing transcripts	.06		.05		
Science pipeline					
Low-level science	.13		.11		
Chemistry 1 or physics 1	.29		.35		**
Chemistry 1 and physics 1	.27		.23		**
Chemistry 2 or physics 2 (or other advanced)	.09		.13		**
Chemistry 2 and physics 2 (or other advanced)	.17		.12		**
Missing transcripts	.06		.05		
Family-work orientation					
Family-work orientation scale	−.04	1.15	.20	1.18	**
Math self-assessment					
Factor scores (standardized)	.41	1.14	.05	1.08	**
Occupational plans					
STEM/biomed only	.26		.13		**
Health only	.04		.15		**
Non-STEM only	.39		.44		**
Mixture	.02		.02		
Don't know	.26		.24		**
Missing	.03		.01		**

Source: Educational Longitudinal Survey, 2002 to 2012.
Note: Weighted N = 5,160 (men = 2,350, women = 2,810). All predictors measured in 12th grade unless otherwise indicated. See Appendix B in the online Supplemental Material for distributions of the basic social and demographic predictors. Significant gender differences in the proportions and means are marked by the column for women.
$^*p < .05$. $^{**}p < .01$.

Family-Work Orientation

Our measure of family-work orientation replicates the ''family versus work attitude scale'' used by Xie and Shauman (2003) in their analysis of the NELS:88 data. As high school seniors, all ELS respondents were asked to rate 18 items, many of which are unrelated to work or family, in response to the question, ''How important is each of the following to you in your life?'' We use four of these items to create a scale that sums the two items pertaining to family, subtracts the two items pertaining to work, and standardizes to mean of zero. Robustness checks show no evidence that our results are affected by our decision to create scales of component items.

Nearly all young men (92.8 percent) and young women (94.2 percent) in the analytic sample think it is very important to be successful in one's line of work. Similarly, a supermajority of young men

(83.0 percent) and young women (85.2 percent) think it is very important to marry right and have a happy family life, although we cannot discern whether ''marrying right'' and ''happy family life'' hold the same meaning for all respondents. A higher percentage of young men (37.6 percent) than women (23.2 percent) think it is very important to have a lot of money, and a higher percentage of young women (55.8 percent) than men (47.1 percent) think it is very important to have children. The gender-differentiated responses to these two questions are responsible for the .24 point difference in the standardized family-work scale (see Table 2).

Self-Assessed Math Ability

We construct a measure of self-assessed math ability from five items in the 2004 (12th grade) wave of the ELS. These items ask students to indicate their level of agreement with the following statements: ''I can understand difficult math texts,'' ''I can understand difficult math class,'' ''I can master math,'' ''I can do an excellent job on math tests,'' and ''I can do an excellent job on math assignments.'' From these five questions, we computed a factor score standardized with mean 0 and standard deviation of 1 (Cronbach's α = .92). We imputed scores for respondents who had missing values on one or more of the five questions with a model whose predictors are demographic characteristics and the math self-assessment questions for which we have valid information.

Responses on the individual items and factor scores show the anticipated gender-differentiated patterns. A higher percentage of young men than young women said they can ''almost always'' understand difficult math texts (22.5 percent vs. 12.4 percent, respectively) and math classes (26.6 percent vs. 15.6 percent), master math (35.3 percent vs. 28.2 percent), do an excellent job on math tests (27.0 percent vs. 19.7 percent), and do an excellent job on math assignments (34.3 percent vs. 31.2 percent). Young men have an average value of .41 (SD = 1.14) on the self-assessed math ability factor score compared to .05 for young women (SD = 1.08).

Occupational Plans

Our measures of occupational plans are based on questions in the 2004 ELS student questionnaires that instructed respondents to ''Write in the job or occupation that you expect or plan to have at age 30.'' Students could write in a response, select ''you don't know,'' or skip the question. For this project, we coded the verbatim responses in the restricted access metadata into 1,220 distinct occupational categories that we elaborated from the 2000 Standard Occupational Classification (SOC).[5] Respondents could list multiple occupations, and our coders coded all responses.

We aggregated these detailed codes into a variable that captures qualitatively different types of planned occupations. The categories of this variable are STEM and doctoral-level biomedical occupations (e.g., physicist, engineer, doctor, veterinarian), bachelor's or master's-level health occupations (e.g., nurse, physical therapist), other occupations, a science-related occupation and a nonscience occupation, don't know, and missing. We had to combine STEM (e.g., physicist, chemist, engineer) and doctoral-level biomedical occupations (e.g., doctor) because of sparse cell counts. This likely leads us to underestimate gender differences given that young men are more likely to plan STEM occupations and women more likely to plan biomedical occupations. The ''missing'' category is a mix of students who were not asked the question or whose answers were transcribed illegibly, jokes (e.g., ''drug dealer,'' ''bum''), or too vague to code (e.g., ''helping people,'' ''making lots of money'').

The distribution of occupational plans by gender is presented at the bottom of Table 2. In the 2004 survey, 26 percent of the young men and 13 percent of the young women planned to enter STEM or biomedical occupations, and 4 percent of young men and 15 percent of young women planned to enter master's- or lower-level health occupations. Just 2 percent of young men and women listed both a science-related plan and a nonscience plan (''mixture''). Because this category is too sparsely populated to be included in our multivariate models, we assign these cases to the science-related occupation plan, giving precedence to STEM/biomed over health. A quarter of students responded with ''don't know,'' which we retain as a category.

ANALYTIC STRATEGY

Our analytic strategy, which we borrow from Morgan and colleagues' 2013 analysis of STEM major selection in students' sophomore year, addresses the standard problem of partitioning association where sets of predictors are likely causally related to each other but the causal direction is unclear. If, for example, students form preferences for having a family very early in life and only later develop occupational plans consistent with these preferences (Ceci and Williams 2011; Hakim 2002), family-work orientation is causally prior and should be treated as exogenous; here, plans mediate the relationship between family-work orientation and outcomes. On the other hand, if students interpret external cues about their abilities and talents, plan to enter an occupation where these talents can be expressed, and then form family plans consistent with their perception of the ''family friendliness'' of their chosen occupation, academic achievement should be treated as exogenous and family-work orientation as a mediator. Similar uncertainty surrounds the causal relationship among other sets of predictors.

Instead of assuming a particular order in which to enter covariates in our nested models, we estimate the minimum and maximum share of the gender gap in the outcome that is attributable to each set of predictors under different causal assumptions (Morgan et al. 2013). This entails fitting a series of nested multinomial logit models where the categories of the dependent variable are STEM/biomed baccalaureate degree, health baccalaureate degree, non-STEM baccalaureate degree (the reference category), associate degree or certificate, or no degree.

The first model regresses college outcomes on standard demographic and socioeconomic background measures in models of educational attainment: parental socioeconomic status, family structure, race, region, and locality type in 10th grade (see Appendix A in the online Supplemental Material). This model yields the baseline gender gap in the predicted probability of completing or persisting in a STEM major. To estimate the maximum percentage of this baseline gap that is attributable to prior academic achievement, self-assessed math ability, family-work orientation, or occupational plans, we add each set of predictors to the baseline model individually and recalculate the gender gap in predicted probabilities. To estimate the minimum percentage attributable to each set of predictors, we compare gender gaps in predicted probabilities from a full model with all predictors to the full model minus the focal set of predictors. We scale the change in the gender gap in predicted probabilities to the baseline gender gap.[6]

In our first analysis, we estimate these models for all college students in the ELS who meet our sample restrictions. In our second analysis, of STEM persistence, we begin with simple outflow tables, which present outcomes for students who selected a STEM major as sophomores.[7] We then fit the same set of nested multinomial logit models but applied to the subset of students who had declared a STEM major by 2006. This allows us to assess how well the four sets of predictors account for gender differences in attrition from STEM fields. The caveat is that the observed associations between the predictors and STEM major completion in this subsample will be downwardly biased because students who chose STEM as sophomores are already highly selected on the predictor variables.

PREDICTORS OF GENDER DIFFERENCES IN STEM MAJOR COMPLETION

Table 3 presents coefficients for gender (in log odds form) from a series of multinomial logit models that predict the field of the bachelor's degree if one was earned. The reference category for the outcome variable is ''other [non-STEM] degree.'' The first model in Table 3 predicts college outcomes by gender without adjusting for any other covariates (see also Table 1).

The second, ''baseline'' model in Table 3 adjusts for race, parental education, family income, school region, locality type, and family structure. These background factors improve the overall model fit relative to Model 1, but they have little effect on the gender gap in the likelihood of earning a bachelor's degree in STEM/biomed or health fields compared to the unadjusted model (compare Models 1 and 2 in Table 3). Converted to predicted probabilities, the baseline model shows a gender gap of 9.8 percentage points favoring men in STEM/biomed fields and a gap of 3.7 percentage points favoring women in health fields. Consistent with prior research, we find little evidence of class-based differences in parental investments in higher education for young women compared to young men (Buchmann and DiPrete 2006; but see van de Werfhorst 2017, using Dutch data). Even though they have little effect on the observed gender gaps in STEM attainment, we include these family

Table 3. Coefficients from Multinomial Models Predicting College Outcomes among Immediate-Entry College Students.

	Gender Coefficient (Female = 1)					
	STEM/ Biomed	Health	AA/ Certificates	No Degree	Model χ^2 (*df*)	Pseudo R^2
Model 1: Unadjusted model	−1.00*** (.11)	.70*** (.18)	−.08 (.13)	−.22* (.09)	118.12 (4)	.011
Model 2: Baseline model (social and demographic factors)	−1.00*** (.11)	.68*** (.18)	−.12 (.13)	−.26** (.09)	375.42 (68)	.032
Model 3: full model (baseline + academic preparation + family-work orientation + math self-assessment + occupational plans)	−.69*** (.13)	.25 (.21)	.11 (.14)	−.04 (.09)	1,912.20 (148)	.134

Source: Educational Longitudinal Study of 2002 to 2012.
Note: Weighted and rounded *N* = 5,160. The omitted category for the outcome variable is "other fields." Robust standard errors are in parentheses. AA = associate's degree.
$^*p < .05$. $^{**}p < .01$. $^{***}p < .001$.

background covariates in our baseline model because they are standard in education research.

The full model in Table 3 adds all four sets of the theoretically relevant predictors. Together, these factors improve the overall model fit and reduce gender differences in the predicted probability of completing STEM/biomed and health majors. The gender gap in STEM/biomed major completion declines by 38 percent, from 9.8 to 6.1 percentage points, and the gender gap in health major completion declines by 63 percent, from 3.7 to 1.4 percentage points. As we will discuss further in the conclusion, even the full model leaves much of the gender gap in STEM/biomed completion unaccounted for.

Table 4 presents the lower and upper bounds of the change in the gender gap in college outcomes associated with each set of predictors. High school grades, math and reading test scores, and math and science course-taking are, as a set, associated with a change in the predicted gender gap in majoring in STEM/biomed of between –5 percent and 12 percent of the baseline gap. The negative sign on the minimum estimate implies that gender differences in academic pipelines may suppress the gender gap in STEM completion, perhaps because on average, ELS women compared to ELS men tend to have higher GPAs and are more likely to take at least one college-track math and science course in high school (see Table 2). Gender differences in academic pipelines account for a greater share of the gender gap in health majors (17 percent to 23 percent) but off a much smaller base gap of .037 points.

In the ELS cohort, as in earlier cohorts (Xie and Shauman 2003), gender differences in family-work orientation have little to no effect (0–2 percent) on either the gender gap in STEM/biomed or the gender gap in health major completion (see Table 4). This null result is worth emphasizing given the persistence of gender-essentialist theories and lay explanations that point to women's innate preferences for and competence at nurturing tasks.

We also find a surprisingly modest effect of gender differences in self-assessed math ability on STEM/biomed and health major completion. Gender differences in self-assessed math ability account for between 4 percent and 18 percent of the gender gap in STEM/biomed major completion and between 3 percent and 4 percent of the gap in health major completion. However, the maximum estimate of 18 percent is based on a model that does not include math test scores or other objective indicators of math ability. As a result, it represents an extremely generous interpretation of the self-assessed ability argument, which explicitly claims that self-assessment

Table 4. Contribution of the Predictors to the Gender Gap in the Probability of Earning a Bachelor's Degree in STEM/Biomed or in Health Fields from Any Institution Attended (%).

	STEM/Biomed		Health	
	Minimum	Maximum	Minimum	Maximum
Family-work orientation	0	0	2	2
Academic preparation and math/ science course-taking	−5	12	17	23
Math self-assessment	4	18	3	4
Math self-assessment net of academic preparation and course-taking	4	6	3	3
Occupational plans	19	32	34	40

Source: Educational Longitudinal Survey, 2002 to 2012.
Note: Weighed and rounded *N* = 5,160. We calculate the minimum estimate by removing the predictor from the full model, calculating the gender gap in adjusted predicted probabilities, and scaling the change in the gender gap relative to the baseline gender gap. We calculate the maximum estimate by adding the predictor to the baseline model, calculating the gender gap in adjusted predicted probabilities, and scaling it to the baseline gap.

effects persist after conditioning on math test scores (Correll 2001). We also calculated the minimum and maximum contribution of gender differences in self-assessed math ability to the gender gaps in STEM/biomed and health after adjusting for prior academic achievement and obtained maximum estimates of just 4 percent and 6 percent, respectively. Gender differences in self-assessed math ability in high school contribute very little to the observed gender differences in science-related major completion in college.

Gender differences in occupational plans, by contrast, show strong associations with gender differences in STEM/biomed and health completion (see Table 4). Under the assumption that occupational plans are causally prior to all other predictors, gender differences in plans account for 32 percent of the gender gap in STEM/biomed completion and 40 percent of the gender gap in health major completion. Under the assumption that occupational plans are endogenous to the other observed predictors in our model, their minimum contribution is an estimated 19 percent of the STEM/biomed gap and 34 percent of the health gap. Notably, even under this weaker assumption, gender differences in occupational plans in high school account for the greatest share of gender differences in science-related major completion among the predictors in our model. Moreover, only a small share of their maximum contribution is attributable to associations between plans and family-work orientation, self-assessed math ability, or prior academic achievement.

GENDER DIFFERENCES IN STEM PERSISTENCE

We next turn to the analysis of persistence in attrition from STEM between 2006, when most ELS respondents were sophomores in college, and 2012, the last wave of the ELS.

Attrition from STEM

Table 5 shows the outflow of students who declared STEM/biomed or health majors in 2006. The row margins indicate that 24.3 percent of young men in ELS declared a STEM/biomed major in 2006, more than twice the percentage of young women (11.0 percent). Conversely, the percentage of young women initially declaring a health major (11.7 percent) was approximately three times the percentage of young men (3.5 percent).

As in earlier cohorts (Legewie and DiPrete 2014; Xie and Shauman 2003), gender differences in rates of attrition out of STEM/biomed are striking. Among young men who had declared a STEM/biomed major in 2006, 58.2 percent completed a STEM/biomed degree from any institution by 2012; the second most prevalent outcome

Table 5. Initial Major Selected in 2006 by College Outcome in 2012 from Any Institution Attended among Immediate-Entry College Students.

Major in 2006	Type and Field of Degree by 2012: STEM/ Biomed		Health		Other Fields		AA or Certificate		No Degree		Total Any Outcome	
Men												
STEM/biomed	58.2		.8		9.9		9.9		21.1		24.3	
Health	6.4		37.7		16.2		10.3		29.5		3.5	
Other majors	2.9		1.8		63.1		7.7		24.5		42.5	
Undeclared	11.1		2.7		37.2		11.0		38		15.9	
Missing	4.5		0.0		11.9		19.7		63.8		13.9	
Total	18.0		2.7		37.3		10.5		31.5		100.0	
Women												
STEM/biomed	42.5	**	7.7	**	12.2		9.3		28.3	*	11.0	**
Health	8.3		33.4		9.9		23.3	*	25.2		11.7	*
Other majors	1.3	**	1.2		62.8		7.2		27.5		51.0	**
Undeclared	5.5	**	5.8	*	52.9	**	9.8		26.0	**	14.9	
Missing	6.6		1.9	*	15.9		23.4		52.2	**	11.4	
Total	7.9	**	6.4	**	44.2	**	11.6		29.9		100.0	

Source: Educational Longitudinal Study, 2002 to 2012.
Note: Weighted and rounded N = 5,160. Significant gender differences in the proportions are marked in the rows for women. AA = associate's degree.
$^*p < .05$. $^{**}p < .01$.

was no degree, at 21.1 percent. Among young women who declared STEM/biomed majors in 2006, only 42.5 percent completed STEM degrees, 28.3 percent had not completed a degree by 2012, and another 9.3 percent left with an associate's degree. In other words, a female sophomore in STEM was nearly as likely to not complete any baccalaureate degree by 2012 (37.6 percent) as to complete a STEM degree (42.5 percent). Persistence in STEM is lower for both genders when we limit the outcome to degrees attained from the first institution (see Appendix I in the online Supplemental Material), but the gender differences are still substantial at 51.9 percent of young men compared to 38.4 percent of young women.

Attrition from health majors is even more substantial, but gender differences are less extreme. Only 37.7 percent of young men and 33.4 percent of young women who declared a health major in 2006 completed a health baccalaureate degree by 2012. Another 23.3 percent of female health majors in 2006 completed associate's degrees or certificates by 2012, some of which were likely in health-related fields, compared to 10.3 percent of male health majors. Unfortunately, we lack sufficient cases to model the predictors of attrition from health majors.

Sources of Gender Gaps in STEM/ Biomed Attrition

Table 6 presents the estimates of minimum and maximum contributions of the four sets of predictors of college outcomes for the subsample of students who declared STEM/biomed majors in 2006. (Gender coefficients from the unadjusted, baseline, and full models are available in Appendix C in the online Supplemental Material.) Sparse data in this subsample required us to combine health with ''other fields'' and ''AA degrees or certificate'' with ''no degree.''

As in models fit to the full sample, our results show little effect of gender differences in family-work orientation on gender gaps in STEM major completion conditional on declaring a STEM major by 2006. By contrast, gender differences in academic preparation and prior course-taking have pronounced effects on estimated gender differences in the probability of persisting in

Table 6. Contributions of Predictors to the Gender Gap in the Probability of Earning a Bachelor's Degree in a STEM/Biomed Major by 2012 among 2006 STEM Majors (%).

	STEM/Biomed	
	Minimum	Maximum
Family-work orientation	0	−1
Academic preparation and math/science course-taking	−26	−13
Math self-assessment	2	11
Math self-assessment net of academic preparation and course-taking	2	2
Occupational plans	12	19

Source: Educational Longitudinal Survey, 2002 to 2012.
Note: Weighted and rounded *N* = 890. We calculate the minimum estimate by removing the predictor from the full model, calculating the gender gap in adjusted predicted probabilities, and scaling the change in the gender gap relative to the baseline gender gap. We calculate the maximum estimate by adding the predictor to the baseline model, calculating the gender gap in adjusted predicted probabilities, and scaling it to the baseline gap. See Appendix C in the online Supplemental Material for the estimated gender coefficients from the multinomial logit models from which we calculate the minimum and maximum.

STEM. However, the pattern is reversed from what one would anticipate under the naïve hypothesis that women's greater attrition from STEM is due to inferior academic preparation. Specifically, Table 6 shows that if the young men and women in STEM majors as sophomores had equivalent academic preparation and course-taking in high school, the gender gap in STEM major persistence would be substantially *larger* than under the observed distributions, as indicated by the negative percentage change values (–26 percent and –13 percent). The underlying coefficients suggest this suppressive effect emerges because high school GPA is a strong predictor of STEM persistence past the sophomore year, and the young women who select into STEM majors as sophomores have much higher high school GPAs, on average, than the young men (see Appendix B in the online Supplemental Material).

Looking at STEM persistence, gender differences in self-assessed math ability contribute to a maximum of 11 percent of the gender gap in STEM/biomed persistence in models that do not condition on objective measures of math ability and a mere 2 percent in models that include measures of ability. This result could emerge because gender differences in self-assessed math ability are moderated by college experiences we cannot measure with these data or because the young women who chose STEM majors have ample evidence that contradicts generalized cultural beliefs about women's lower math competence, leading to no effects of self-assessment among this very select group of college students. Unfortunately, the ELS data do not allow us to evaluate these two explanations.

Finally, Table 6 shows that, as in the full sample, occupational plans in high school are the strongest predictor of gender gaps in STEM persistence among the observed covariates, although their estimated contributions to attrition are smaller than to completion (Table 4). Specifically, occupational plans contribute between 12 percent and 19 percent of the gender gap in STEM/biomed persistence. In models (not shown) that allow the effect of occupational plans to differ by gender, the range is similar.

DISCUSSION AND CONCLUSIONS

Despite a two-decade reversal of the gender gap in college enrolment, the weakening of stereotypes about women's appropriate roles at home and in the workplace, and educational and policy initiatives to encourage girls to study science, gender differences in STEM major completion remain substantial. Among ELS students who graduated high school in 2004 and entered college the following year, 18.0 percent of men compared to 7.9 percent of women earned baccalaureate degrees in a STEM/biomed field, and 2.7 percent of men compared to 6.4 percent of women earned baccalaureate degrees in health majors that are pathways to master's-level or lower occupations.

Some of these gender gaps in college outcomes are driven by gender-differentiated selection into science-related majors early in the college career (see Morgan et al. 2013), but our results show that gender differences in attrition exacerbate gender differences in STEM/biomed major selection and perpetuate them in health major selection. Just 42.5 percent of the young women who declare a STEM/biomed major by their sophomore year complete those degrees, whereas 58.2 percent of young men do. Although women's greater attrition from STEM is partially offset by their higher propensity to move into STEM majors after their sophomore year, this late-career entry into STEM is dwarfed, in absolute terms, by gender-differentiated outflow. Attrition from health majors is even more pronounced, with only about a third of declared health majors completing a bachelor's degree in these fields. Although the gender difference in attrition from health majors is not significant, and hence does not exacerbate gender gaps, it does perpetuate them. These results suggest gender equity efforts that focus on getting more women to major in STEM/biomed (or men in health) are insufficient: The problem is as much a matter of persistence, even among the highly select group of young women who choose to major in STEM as sophomores.

We also show that some of the most prominent explanations of gender differences in STEM outcomes receive very little empirical support in the ELS data. Gender differences in prior academic preparation and achievement (including math test scores and course-taking), math self-assessment, and family-work orientation account for between –5 percent and 12 percent of the gender gap in STEM major completion. With the exception of academic preparation, which suppresses observed gender gaps in STEM completion among students who declared STEM majors by sophomore year, these predictors have similarly small or weaker associations with gender differences in STEM persistence.

By contrast, we find that occupational plans held in high school account for the largest relative share of the gender gap in the probability of completing and to a lesser extent, persisting in a STEM major in college. Specifically, between 19 percent and 32 percent of the gender gap in STEM completion is attributable to the gender gap in high school plans to enter a STEM occupation. Notably, even the minimum estimate (19 percent), which is estimated from models that adjust for all other observed predictors, is substantial. Future research should unpack patterns and sources of gender differences in the content, stability, and certainty of occupational plans as they develop through students' educational careers.

Note that even our most highly parameterized models of STEM/biomed and health completion and persistence leave substantial gender gaps unexplained. The large residuals imply we still have a long way to go before we can declare victory in the intellectual battle to understand gender differences in STEM completion and persistence. These residual gender gaps might stem from measurement error in the covariates or from the lag between the predictors and outcomes. However, these residual gaps may also reflect gender-differentiated experiences in college that are not measured in the ELS survey, such as social pressure from peers and roommates, support or discouragement from teachers and other mentors, discrimination or overt hostility, evaluation biases, or reactions to failing a ''weed out'' course (Ganley et al. 2018; Penner and Willer 2019; Raabe et al. 2019; Sanabria and Penner 2017; Seymour and Hewitt 1997).

Without minimizing the potential role of college experiences in shaping patterns of completion and persistence, we think it remarkable that occupational plans measured in high school have such strong and lingering effects throughout the college career. This result may come as little surprise to analysts steeped in the Wisconsin tradition of educational attainment models, but the gender segregation and women in STEM literatures tend to treat occupational aspirations as epiphenomenal, an assumption not supported by our results. If nothing else, our results highlight the potential benefit of a closer integration of these two literatures.

Our results also suggest that to reduce gender differences in STEM major persistence and completion, we do not need to boost young women's math tests scores or confidence in their math ability as much as we need to entice more women to plan to enter science-related occupations. Some of this may be accomplished by exposing more girls and young women to occupations in STEM, female role models in STEM, or the social or environmental relevance of STEM occupations (Blanchard Kyte and Reigle-Crumb 2017; Cheryan, Master, and Meltzoff 2015; Gelbgiser and Albert 2018). At the same time, such interventions are unlikely to eliminate gender differences in STEM-related occupational plans. Plans are also affected by cultural messages that manifest in others' expectations, in vicarious and first-hand experiences of discrimination or evaluation bias, in overt hostility toward women who participate in ''male'' spaces, and in gender-segregated educational and workplace networks (Ridgeway 2014; Xie et al. 2015). This implies a self-reinforcing system of gender inequality in which cultural beliefs about women in STEM perpetuate gendered occupational plans, gendered occupational plans perpetuate gender segregation in educational and occupational outcomes, and gender segregation in outcomes legitimates cultural beliefs about women in STEM (Charles and Bradley 2009; Thébaud and Charles 2018). In such a system, local or school-based interventions to draw more young women into science need to be augmented by broader efforts to eliminate gender gaps in attrition from STEM majors, integrate workplaces, and chip away at essentialist beliefs about who is best suited for scientific careers.

RESEARCH ETHICS

We obtained approval from the institutional review board at the lead author's institution to conduct this research and from the IES Data Security office to publish our results.

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SUPPLEMENTAL MATERIAL

Supplemental material is available in the online version of the journal.

NOTES

1. Some research focuses explicitly on attrition from STEM and in particular on chilly campus climates that disproportionately push women out of STEM. Unfortunately, the ELS data are not ideal for evaluating the chilly climate argument.
2. To meet the conditions of our restricted data license, we round all sample sizes to the nearest 10.
3. We do not code majors by expected earnings, difficulty, perceived family friendliness, or anticipated discrimination (see e.g., Ganley et al. 2018). This approach, although valuable, requires a priori assumptions about the attributes of majors that are salient to students' educational decisions, and it may mask much of the association between predictors and college major.
4. We provide tables for the first institution sample in Appendices F through J in the online Supplemental Material.
5. In an update, the ELS data distributors provided O*NET codes, based on 2010 SOC, for students' occupational plans. We back-coded these to 2000 SOC, checked them against our codes, and found that only 2.4 percent of students had different values on the two versions of the outcome variable. We prefer our coding because it uses students' verbatim descriptions of job duties and information from other waves where coding is ambiguous, incorporates information from all listed plans, and corrects obvious errors and inconsistencies in the ELS-provided codes.
6. We also fit models that allow the association between the predictor and the outcome to differ by gender. This did not appreciably alter our estimates of the minimum and maximum contributions of the predictors of gender gaps in STEM.
7. We provide an inflow table that shows gender differences in late STEM entry in Appendix D in the online Supplemental Material. For clarity, we keep the focus in this article on STEM persistence and attrition.

REFERENCES

Almquist, Elizabeth M., Shirley S. Angrist, and Richard Mickelson. 1980. ''Women's Career Aspirations and Achievements: College and Seven Years After.'' *Work and Occupations* 7(3):367–84.

Ayalon, Hanna. 2003. ''Women and Men Go to University: Mathematical Background and Gender Differences in Choice of Field in Higher Education.'' *Sex Roles* 48(5):277–90.

Blanchard Kyte, Sarah, and Catherine Riegle-Crumb. 2017. ''Perceptions of Social Relevance of Science: Exploring the Implications for Gendered Patterns in Expectations of Majoring in STEM Fields.'' *Social Science* 6:19. doi:10.3390/socsci6010019

Buchmann, Claudia, and Thomas A. DiPrete. 2006. ''The Growing Female Advantage in College Completion: The Role of Family Background and Academic Achievement.'' *American Sociological Review* 71(4):515–41.

Burkam, David T., and Valerie E. Lee. 2003. ''Mathematics, Foreign Language, and Science Coursetaking and the NELS: 88 Transcript Data.'' National Center for Education Statistics Publication No. 2003-01. http://nces.ed.gov/pubs2003/200301.pdf.

Charles, Maria, and Karen Bradley. 2009. ''Indulging Our Gendered Selves? Sex Segregation by Field of Study in 44 Countries.'' *American Journal of Sociology* 114(4):924–76.

Cheryan, Sapna, Allison Master, and Andrew N. Meltzoff. 2015. ''Cultural Stereotypes as Gatekeepers: Increasing Girls' Interest in Computer Science and Engineering by Diversifying Stereotypes.'' *Frontiers in Psychology* 6:49. doi:10.3389/fpsyg.2015.00049

Ceci, Stephen J., and Wendy M. Williams. 2011. ''Understanding Current Causes of Women's Underrepresentation in Science.'' *PNAS* 108(8):3157–62.

Correll, Shelley J. 2001. ''Gender and the Career Choice Process: The Role of Biased Self-Assessments.'' *American Journal of Sociology* 106(6):1691–730.

Correll, Shelley J. 2004. ''Constraints into Preferences: Gender, Status, and Emerging Career Aspirations.'' *American Sociological Review* 69(1):93–113.

Eccles, Jacquelynne. 2011. ''Gendered Educational and Occupational Choices: Applying the Eccles et al. Model of Achievement-Related Choices.'' *International Journal of Behavioral Development* 35(3): 195–201.

Ellison, Glenn, and Ashley Swanson. 2010. ''The Gender Gap in Secondary School Mathematics at High Achievement Levels: Evidence from the American Mathematics Competitions.'' *Journal of Economic Perspectives* 24(2):109–28.

England, Paula, and Su Li. 2006. ''Desegregation Stalled: The Changing Gender Composition of College Majors, 1971-2002.'' *Gender & Society* 20(5): 657–77.

Ganley, Caroline, Casey E George, Joseph R. Cimpian, and Martha B. Makowski. 2018. ''Gender Equity in College Majors: Looking Beyond the STEM/non-STEM Dichotomy for Answers Regarding Female Participation.'' *American Educational Research Journal* 55(3):453–87.

Gelbgiser, Dafna, and Kyle Albert. 2018. ''Green for All? Gender Segregation and Emerging Green Fields of Study in American Higher Education.'' *Social Problems* 65(4):564–83.

Gerson, Kathleen. 1985. *Hard Choices: How Women Decide about Work, Career, and Motherhood*. Los Angeles: University of California Press.

Hakim, Catherine. 2002. ''Lifestyle Preferences as Determinants of Women's Differentiated Labor Market Careers.'' *Work and Occupations* 29(4):428–59.

Hyde, Janet S., Sara M. Lindberg, Linn Marcia C. Linn, Amy B. Ellis, and Caroline C. Williams. 2008. ''Gender Similarities Characterize Math Performance.'' *Science* 321(5888):494–95.

Jacobs, Jerry A. (1989). *Revolving Doors: Sex Segregation and Women's Careers*. Palo Alto, CA: Stanford University Press.

Legewie, Joscha, and Thomas A. DiPrete. 2014. ''Pathways to Science and Engineering Bachelor's Degrees for Men and Women.'' *Sociological Science* 1(4):41–48.

Ma, Yingyi. 2011. ''Gender Differences in the Paths Leading to the STEM Baccalaureate.'' *Social Science Quarterly* 92(5):1169–90.

Mann, Allison, and Thomas A. DiPrete. 2013. ''Trends in Gender Segregation in the Choice of Science and Engineering Majors.'' *Social Science Research* 42(6):1519–41.

Moakler, Jr., Martin W., and Mikyong Minsun Kim. 2014. ''College Major Choice in STEM: Revisiting Confidence and Demographic Factors.'' *The Career Development Quarterly* 62(2):128–42.

Morgan, Stephen L. 2005. *On the Edge of Commitment*. Palo Alto, CA: Stanford University Press.

Morgan, Stephen L., Dafna Gelbgiser, and Kim A. Weeden. 2013. ''Feeding the Pipeline: Gender, Occupational Plans, and College Major Selection.'' *Social Science Research* 42(4):989–1005.

National Academy of Sciences, National Academy of Engineering, and Institute of Medicine. 2007. *Rising above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*. Washington, DC: National Academies Press.

Nix, Samantha, and Lara Perez-Felkner. 2019. ''Difficulty Orientations, Gender, and Race/Ethnicity: An Intersectional Analysis of Pathways to STEM Degrees.'' *Social Sciences* 8(43) doi:10.3390/socsci8020043.

Penner, Andrew, and Marcel Paret. 2008. ''Gender Differences in Mathematics Achievement: Exploring the Early Grades and the Extremes.'' *Social Science Research* 37(1):239–53.

Penner, Andrew, and Robb Willer. 2019. ''Men's Overpersistence and the Gender Gap in Science and Mathematics.'' *Socius* 3. doi:10.1177/23780231 18821836

Perez-Felkner, Lara, Sarah-Kathryn McDonald, Barbara Schneider, and Eric Grogan. 2012. ''Female and Male Adolescents' Subjective Orientations to Mathematics and the Influence of Those Orientations on Postsecondary Majors.'' *Developmental Psychology* 48(6):1658–73.

Perez-Felkner, Lara, Samantha Nix, and Kirby Thomas. 2017. ''Gendered Pathways: How Mathematics Ability Beliefs Shape Secondary and Postsecondary Course and Degree Field Choices.'' *Frontiers in Psychology* 8:386. doi:10.3389/fpsyg.2017.00386

Phelps, L. Allen, Eric M. Camburn, and Sookweon Min. 2018. ''Choosing STEM College Majors: Exploring the Role of Pre-engineering Courses.'' *Journal of Pre-College Engineering Education Research (J-PEER)* 8(1), Article 1. doi:10.7771/2157-9288.1146

Raabe, Isabel, Zsófia Boda, and Christoph Stadtfeld. 2019. ''The Social Pipeline: How Friend Influence and Peer Exposure Widen the STEM Gender Gap.'' *Sociology of Education* 92(2):105–23.

Ridgeway, Cecilia. 2014. ''Why Status Matters for Inequality.'' *American Sociological Review* 79(1): 1–16.

Riegle-Crumb, Catherine, and Barbara King. 2010. ''Questioning a White Male Advantage in STEM: Examining Disparities in College Major by Gender and Race/Ethnicity.'' *Educational Researcher* 39(9):656–64.

Riegle-Crumb, Catherine, Barbara King, Eric Grodsky, and Chandra Muller. 2012. ''The More Things Change, the More They Stay the Same? Prior Achievement Fails to Explain Gender Inequality in Entry into STEM College Majors over Time.'' *American Educational Research Journal* 49(6):1048–73.

Sanabria, Tania, and Andrew Penner. 2017. ''Weeded out? Gendered Responses to Failing Calculus.'' *Social Science* 6(2):47. doi:10.3390/socsci6020047

Seymour, Elaine, and Nancy M. Hewitt. 1997. *Talking about Leaving: Why Undergraduates Leave the Sciences*. Boulder, CO: Westview Press.

Tai, H., Christine Qi Liu, Adam V. Maltese, and Xitao Fan. 2006. ''Planning for Early Careers in Science.'' *Science* 312(5777):1143–44.

Thébaud, Sarah, and Maria Charles. 2018. ''Segregation, Stereotypes, and STEM.'' *Social Science* 7(7):111. doi:10.3390/socsci7070111

Turner, Sarah E., and William G. Bowen. 1999. ''Choice of Major: The Changing (Unchanging) Gender Gap.'' *Industrial & Labor Relations Review* 52(2):289–313.

Valentino, Lauren, Stephanie Moller, Elizabeth Stearns, and Roslyn Mickelson. 2016. ''Perceptions of Future Career Family Flexibility as a Deterrent from Majoring in STEM.'' *Social Currents* 3(3):273–92.

van de Werfhorst, Herman G. 2017. ''Gender Segregation across Fields of Study in Post-secondary Education: Trends and Social Differentials.'' *European Sociological Review* 33(3):449–64.

Weisgram, Erica S., and Amanda B. Diekman. 2017. ''Making STEM 'Family-Friendly': The Impact of Perceiving Science Careers as Family-Compatible.'' *Social Science* 6(2):61. doi:10.3390/socsci6020061

Williams, Wendy M., and Steven J. Ceci. 2012. ''When Scientists Choose Motherhood: A Single Factor Goes a Long Way in Explaining the Dearth of Women in Math-Intensive Fields. How Can We Address it?'' *American Scientist* 100(2):138–45.

Wiswall, Matthew, and Basit Zafar. 2018. ''Preference for the Workplace, Investment in Human Capital, and Gender. *The Quarterly Journal of Economics* 133(1):457–507.

Xie, Yu, Michael Fang, and Kimberlee A. Shauman. 2015. ''STEM Education.'' *Annual Review of Sociology*: 41:331–57.

Xie, Yu, and Kimberlee A. Shauman. 2003. *Women in Science: Career Processes and Outcomes*. Cambridge, MA: Harvard University Press.

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