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Why Students Choose STEM: A Study of High School Factors That Influence College STEM Major Choice

Dr. Joyce B. Main, Purdue University

Joyce B. Main is Associate Professor of Engineering Education at Purdue University. She received an Ed.M. in Administration, Planning, and Social Policy from the Harvard Graduate School of Education, and a Ph.D. degree in Learning, Teaching, and Social Policy.

Tram Dang, Purdue University

Tram Dang is a PhD student of Engineering Education at Purdue University as well as a tenured professor of physics and engineering at Santa Monica College (SMC), a two-year transfer-focused Hispanic serving institution in California. Her research interests lie in using mixed methods techniques to understand the factors leading to STEM and engineering student retention and university transfer at the community college level. Tram Dang currently holds her Master's in Materials Science and Engineering as well as her Bachelor's in Physics from UCSD.

Beata Johnson, Campbell University

Beata Johnson is an Engineering Education Ph.D. student at Purdue University and recipient of an NSF Graduate Research Fellowship. She received her BS in Chemical Engineering from Purdue University. Her research interests include extracurricular and exper

Qian Shi, Purdue University

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Dr. Cesare Guariniello, Purdue University

Cesare Guariniello is a Research Scientist in the School of Aeronautics and Astronautics in Purdue University. He holds two Master's degrees, in Automation and Robotics Engineering and in Astronautical Engineering, from the University of Rome "La Sapienza", and a PhD in Aeronautics and Astronautics from Purdue University. His research ranges from System-of-Systems design and architecting to space applications, cybersecurity, and defense and includes projects with NASA, the US DoD, the US Navy. Cesare recently expanded his research in the field of Earth Sciences, where he is pursuing a Master's degree in Planetary Geology. He is a senior member of IEEE and AIAA, and member of INCOSE.

Daniel Delaurentis, Purdue University

Dr. Daniel DeLaurentis is a Professor at the School of Aeronautics and Astronautics, Purdue University, where he also serves as Vice President for Discovery Park District (DPD) Institutes. His research centers on design and system engineering methods for aerospace systems and systems-of-systems. Dr. DeLaurentis is Chief Scientist in the DoD Systems Engineering Research Center (SERC) and a Fellow of both INCOSE and AIAA.

High School Student Academic Factors Associated with College-Going and STEM Major Choice

Abstract

As our national workforce needs continue to grow, attracting and retaining postsecondary students in the science, technology, engineering, and mathematics (STEM) fields remains a priority. A student's interest in a STEM major often begins at the precollege level, and their precollege experience can determine their later academic trajectory. While this interest often develops in middle school or earlier, a student's high school experience can affect whether a student maintains or loses their interest. In order to understand a student's high school experience, this study focuses on the high school factors, student demographic characteristics, and academic achievement factors that inform college-going and STEM major choice. For this study, data come from the High School Longitudinal Study of 2009 (HSLS:09), which is a nationally representative longitudinal study following over 23,000 students from 2009 to 2016. The data were analyzed using multiple regression analyses to correlate high school, demographic, academic achievement factors from the 2009 and 2012 data collection waves to a student's likelihood of attending college and majoring in a STEM field. The high school level factors that were found to be significant predictors for college STEM major declaration include the student's family background, high school STEM GPA, and measures for math/science identity. The findings are mixed and suggest further research is needed, particularly in disaggregating the math/science self-efficacy, identity, and utility measures, as well as in investigating potential differences in major choice by field separately, rather than STEM in the aggregate. Research findings can be used to inform policies and programs aimed at increasing diversity and inclusivity in STEM fields, as well as to identify areas where additional support and resources may be needed to help students succeed.

Introduction

Despite recent dips in the economy due to COVID-19, the U.S. expects to see considerable occupational growth over the next decade. More specifically, the U.S. Bureau of Labor Statistics predicts that STEM occupations will grow at over twice the rate (10.8%) of non-STEM occupations (4.9%) between 2021-31 [1]. As our national workforce needs continue to grow, attracting and retaining postsecondary students in science, technology, engineering, and mathematics (STEM) fields remain a top priority.

Methods for attracting and retaining students in STEM fields has been debated for decades and remains a focus of the U.S's current educational policies; the recent passage of the CHIPS and Science Act of 2022, for example, reaffirms the White House's commitment to growing a pool of STEM workforce graduates by investing in STEM education and training at all educational levels [2]. Despite the dedication of resources towards STEM, many students still fall behind in academic achievement, particularly in math. While these educational policies have led to increasing secondary school science literacy in the U.S., the average U.S. math achievement scores still falls below the international averages and has remained largely unchanged since 2003 [3]. Findings regarding math and science interest and confidence seem to convey a similar story; in one study, while science interest remained unchanged throughout a student's high school years, significant losses occurred in science confidence and math interest and confidence during these years [4]. These are alarming results, as these high school level math and science courses act as gatekeepers to STEM degrees and careers.

One step towards overcoming this issue is to develop an understanding of what impacts a student's choice to attend college and to major in a STEM field. It is well understood that a student's interest in STEM develops through exposure at an early age [5]. While this interest is maintained through middle school, loss of interest often occurs during a student's high school years [6]. It becomes imperative that educators, researchers, and policymakers understand the high school factors that influence college-going and STEM major declaration. Many studies have looked at the high school experience and its implications on STEM major declaration in college (e.g. [7]), but few studies follow students longitudinally to examine their pathways from high school through college. We help address this gap by examining the high-school level factors, student demographic characteristics, and academic achievement factors that are associated with college-going and STEM major declaration to contribute to the conversations regarding how we can collectively help promote STEM workforce talent development. Specifically, we address the following research questions:

1. Which high school-level factors, student demographic characteristics, and student academic achievement factors are associated with college-going?
2. Among students who attend a four-year college institution, which high school-level factors, student demographic characteristics, and student academic achievement factors are associated with STEM major choice?

Our research findings contribute to the literature that investigates the factors that promote STEM major choice by leveraging comprehensive, nationally representative data that provide insights into students' longitudinal trajectories from high school through postsecondary education. Identifying the factors that are associated with college-going has the potential to increase participation in higher education and to expand the pool of students who might be interested in STEM majors. Examining STEM major choice factors provides stakeholders with critical information regarding which potential interventions may be more likely to promote STEM interest, major declaration, and persistence. Our research findings can inform the development of programs and contribute to our national commitment to growing and diversifying the STEM workforce.

Literature Review

The focus of this investigation is on student high school experiences, student demographics, and high school characteristics as factors for predicting a student's declaration of a STEM major in postsecondary education. Previous studies using nationally-represented data that have investigated the relationship between student and high school characteristics on STEM major choice have drawn data from the Educational Longitudinal Survey of 2002 (ELS:2002) (e.g., [8]–[10]). Wang [10], for example, studied student demographics and student high school experiences in 10^{th} and 12^{th} grades as factors for entrance into a STEM field at the postsecondary level. Her findings showed that math and science exposure, as well as 12^{th} grade math efficacy and achievement were predictors for STEM major intention. Similar to our study, other studies draw data from HSLS:09 to study similar high school factors (e.g., [11]–[15]).. Much like studies drawn from ELS:2002, these studies found similar results; for example, high school students with an interest in math and science and math ability were more likely to have an intention to major in STEM at the postsecondary level [12]. Many of the studies using HSLS:09 data, however, are limited to using data from the first, second, and third waves of data collection, which do not include information on postsecondary STEM major enrollment and instead provides information on STEM major aspirations.

Our study extends the literature by incorporating longitudinal data from the HSLS from the first data collection wave in 2009 through the fourth and final data collection wave in 2016. Using this data, we examine student demographics, student experiences, and high-school level factors that lead to a declaration of a STEM major in their postsecondary years.

A. Student high school experience and STEM major choice

High school STEM course taking

Studies on the relationship between high school STEM courses and STEM major choice highlight the importance of STEM course participation over STEM course availability. Having a wide variety of STEM courses available at the high school level does not necessarily ensure student participation or course taking. As a result, having more STEM courses available at the high school alone does not increase the proportion of students selecting a STEM major later, which is confirmed by numerous studies [16], [17].

Student participation in STEM courses, however, is an important factor for STEM major selection later [18]–[22]. Crisp et al. (2009), for example, shows that exposure to math and science at the high school level is a strong predictor of STEM major choice even when compared to other strong predictors, such as math achievement. It follows, then, that greater participation in STEM courses would lead greater odds of STEM major selection. Previous research supports this trend. Wang [10], for example, found that the number of STEM courses in high school was a strong indicator of STEM major choice, while Zhang et al. [15], found that earning more credits in STEM-related courses was significantly related to STEM major choice. Specific to engineering, Jewitt and Chen [24] showed that students taking more AP STEM courses increased the odds of becoming an engineering major later. Existing literature suggests, then, that high school student STEM course taking is a greater indicator of STEM major selection than high school STEM course offerings alone.

Math and science identity and efficacy

Research on identity and efficacy shows a relationship between math and science identity and efficacy with STEM major choice. It is possible that a student's math and science identity is related though STEM exposure, which in turn can predict a student's likelihood of declaring a STEM major later. One study, for example, identified the role of science identity in STEM participation, which found that science identity significantly predicts student participation in optional science learning experiences in secondary students [25]. Science identity, in turn, predicts a commitment to science careers [26]. In addition, students reporting higher math- and science-related interest and higher self-assessment were more likely to declare a STEM major later in life [27].

STEM achievement scores

Interestingly, research shows that a student's identity plays an important role in academic achievement [28]–[30]. It follows, then, that a student's science and math identity can affect a student's STEM achievement scores. Current research supports this idea as well; math identity are strongly and positively associated with math high school GPA in Black [31] and Latine [32] secondary school students. Since a student's math and science identity is linked to STEM major choice, a case can also be made for linking math and science scores to STEM major choice. This relationship has been confirmed in many studies [10], [14], [15], [20].

B. Student demographic characteristics and STEM major choice

Gender and Race/Ethnicity

The relationship between STEM major choice and gender is well-studied. Studies agree that gender is a significant predictor of STEM major selection. Mau and Li (2018) showed that being White and male are strong predictors for selecting STEM majors. Other studies support this finding, such as from Zhang et al. [15], which showed that half as many females choose STEMS compared to their male counterparts.

Studies, however, are inconsistent with their findings regarding race as a predictor for STEM major selection. One study, for example, showed that female, Black, and Hispanic students are less likely to develop and maintain an interest in STEM careers in high school [33]. In contrast, another study found that Asians are more likely to enter in STEM, but that there are otherwise no measurable differences between White, Black, and Hispanic students [34], [35]. The inconsistency may be because demographic factors can have a complex relationship with outcomes such as STEM major choice, and instead mediate other factors such as identity. In one study, for example, Black female students see lower science identity in secondary school, and in turn, lower participation in science activities [31, p. 202]. The link between identity, participation, and STEM major choice is discussed in a previous section.

Parents' Education

Most studies agree that there is a correlation between a parent's education level and a student's STEM major choice. Many studies report that a parent's education level is a strong predictor for STEM degree selection [7], [20]. Other researchers, such as Moakler Jr. and Kim [35], reported that parental education level is not a strong predictor of STEM major selection, as the correlation was not significant. Interestingly, this complex relationship may be explained through other student experience factors such as science and math identity and efficacy. The same study by Moakler Jr. and Kim [35] noted that students with parents in occupations requiring STEM degrees are more confident in their math abilities, which in turn, is a statistically significant indicator for STEM major selection.

Socioeconomic Status

Most researchers agree that there is a positive correlation between a student's socioeconomic status (SES) and STEM major selection. G. Saw et al. [33] showed that students with lower SES are less likely to show, maintain, and develop an interest in STEM during high school. This agrees with other studies showing that students with low SES are less likely to select a STEM degree [14], [21]. In contrast, Sahin et al. [36] saw no correlation between parents' education and houshold income on STEM degree selection. As seen with parent education and race and ethnicity, SES may have a complex relationship with STEM major selection. This is support by Niu [37], who showed that family SES does not predict STEM enrollment by itself, but that it interacts with several other predicting factors, such as gender, race, and achievement scores.

C. High school characteristics

Studies on the relationship between a high school's urbanicity and a student's interest in STEM highlight the varying access and availability of resources in rural areas. For example, our previous discussion shows that student STEM participation is a strong factor for later STEM major selection; as such, students attending STEM-oriented high schools are more likely to declare a STEM major later [38]. The availability of STEM-oriented high schools, however, vary by an area's urbanicity and are less common in rural areas [39, p. 201], [40]. In agreement with this, Saw and Agger [41] found that high schools in rural and small-town settings have less AP math and science class; have less math and science fairs; are less likely to sponsor after school programs; and are less likely to inform students about extracurricular math and science programs. Students attending rural high school, then, tend to have less opportunities to engage in STEM-related activities, and therefore, lower STEM participation.

Conceptual Framework

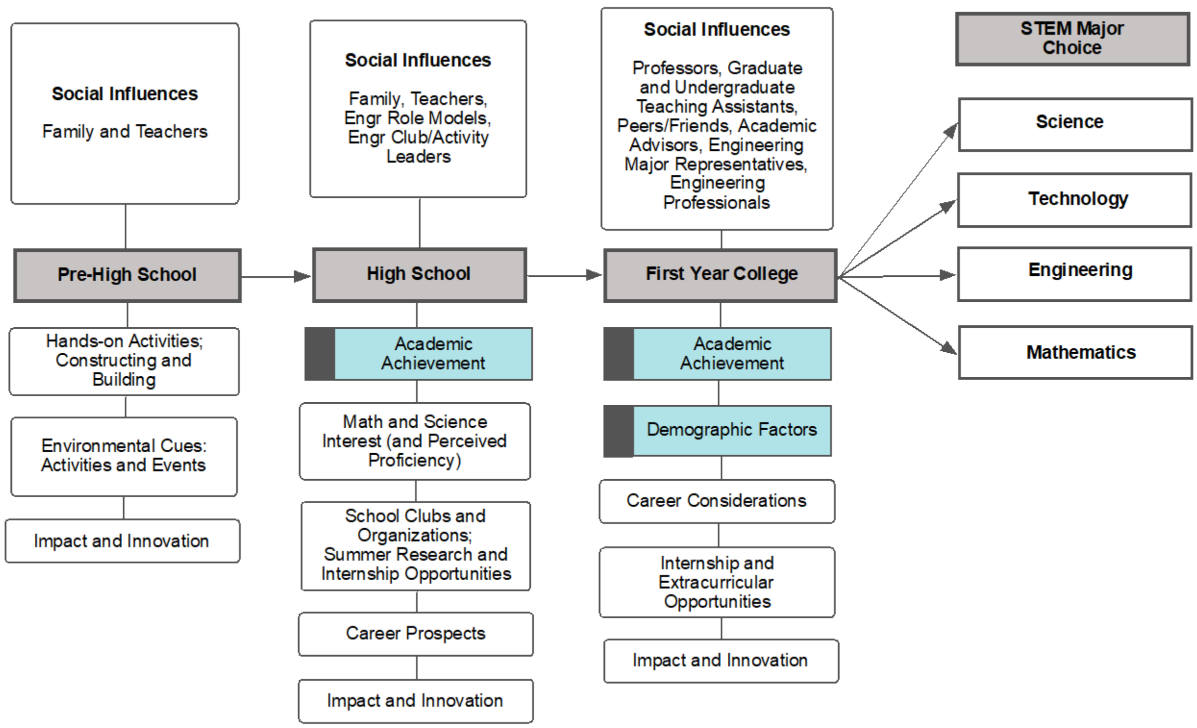
We draw on Main et al.'s [42] conceptual framework on the factors associated with engineering major choice across life stages to inform this study. Whereas Main et al.'s framework focuses on engineering major choice, this study focuses on college-going and STEM major choice, and thus, we adapt the framework accordingly. The adapted framework is summarized in Figure 1. Consistent with the life course perspective, we also emphasize the importance of the different stages of the student pathway from high school through college in contributing to STEM major choice [43], [44]. Together with findings from previous studies highlighted in the literature review, Main et al.'s [42] conceptual framework informs the factors to investigate for this study. Thus, our regression models include factors related to the student's demographic characteristics, family background, high school characteristics, academic achievement, and attitudes and perspectives toward math and science.

Our conceptual framework (Figure 1) highlights the importance of demographic characteristics and family background on STEM major choice, and we therefore include the following variables in our regression models: gender, race/ethnicity, parental education, and family income. We also investigate high school-level factors, including high school level of urbanicity, percentage of racially minoritized students enrolled at the high school, whether the high school is public or private, and the percentage of students eligible for free or reduced-priced lunch (e.g.,[10], [16], [41]). The conceptual framework also indicates that individual student academic achievement and math and science interest and perceived proficiency are important to STEM major choice. To model this, we include several variables drawn from the second wave of HSLS data (11^{th} grade): math identity, math utility, math self-efficacy, science identity, science utility, and science self-efficacy. We also include academic achievement variables, such as STEM grade point average, 9^{th} grade math scores, SAT math score, SAT reading score, whether the student took an Advanced Placement math course during high school, and whether the student took and Advanced Placement science course during high school.

Figure 1

Factors Associated with STEM Major Choice Across Life Stages

Adapted from Main et al. (2022)



Methods

Our study addresses two research questions surrounding student STEM participation: First, which high school-level factors, student demographic characteristics, and student academic achievement factors are associated with college-going? And among students who attend a four-year college institution, which high school-level factors, student demographic characteristics, and student academic achievement factors are associated with STEM major choice? Our data come from the High School Longitudinal Survey, which includes a nationally-representative sample of students followed longitudinally from their 9th grade year (2009) through postsecondary education (2016) with transcript information (2017-2018).

We use linear probability models to identify factors that are associated with (1) college-going and (2) STEM major choice. College-going is defined as whether the student attended any type of postsecondary institution, 4-year college-goin is whether the student attended a four-year academic institution, and STEM major choice is whether the student enrolled in a four-year college declared a major in science, technology, engineering, or mathematics during the 2016 survey wave. The resulting sample size for the linear regression model on college-going is 19,770, which includes all students in the HSLS sample who enrolled in any type of postsecondary institution (e.g., community college, four-year institution). The outcome variable for the 4-year college-going model is enrollment at a four-year institution, and the resulting sample size is 13,050. For the model on STEM declaration, the resulting sample size is 8,890, which includes all students attending a four-year college and declared any major. The models were weighted using the "student longitudinal analytic weight" provided by the HSLS.

Following our conceptual model (Figure 1), our explanatory variables are related to the student's demographic characteristics, family background, high school characteristics, academic achievement, and attitudes and perspectives toward math and science. Explanatory variables include gender, race/ethnicity, parents' education level (at least one parent who completed high school, associate's degree, bachelor's degree, or master's degree) with no high school degree as the comparison group, whether parents have a STEM degree, and categories for family income in 2012 (< $35k, $35-$75k, $75-$155K, and >$155K) with <$35K as the base category. The HSLS indicates male and female for gender, and the following groups for race/ethnicity: White, Black/African American, Asian American/Asian, Hispanic/Latine, and Other Race/Ethnicity. In terms of high school level factors, our models include whether the school is public or private, the percentage of URM students, percentage of students eligible for free or reduced-price lunch, and level of urbanicity (city, suburban, town, and rural) with city as the base category.

We also included indices that measure student math identity, math utility, and math self-efficacy, as well as science identity, science utility, and science self-efficacy [45]. Identity measures the level of agreement with statements associated with being a "math person" or "science person," whereas utility indicates the students' perceptions of the usefulness of math, as well as the usefulness of science. Finally, higher self-efficacy represents a higher sense of competence in the given subject—math or science. These indices are normed with a standardized mean of 0. For the individual student academic achievement variables, we include STEM high school grade point average (GPA) on a scale from 0 to 4.0, 9th grade math score ("mathematics standardized theta score," which is a norm-referenced measurement of math achievement in the 9th grade), and SAT verbal and math scores, each measured from a scale of 200 to 800 and normalized for analyses. We also considered whether the student took at least one Advanced Placement course in math, as well as at least one Advanced Placement course in science, during high school. We used the same explanatory variables for both models, except that for the model focusing on college-going, we excluded SAT math and SAT reading because taking these tests are strongly correlated with college-going. That is, most students who take the SAT have intentions to pursue postsecondary education. We also did not include the variables associated with taking advance placement courses because they are also strongly correlated with college-going.

Data

The HSLS is comprised of a nationally representative sample of 23,000 high school students from 944 high schools in the U.S. The HSLS provides comprehensive longitudinal data collected during multiple time points (1) Base Year: 9th grade (2009); (2) First Follow-up: 11th grade (2012 spring); (3) 2013 Update: high school graduation (2013); (4) Second Follow-up: 3rd year of college (2016), and (5) Postsecondary Transcripts (2017-2018). For this study, we primarily draw on the second follow-up wave (2016) to investigate factors associated with college-going and STEM major choice. In particular, we focus on students who attended college (n = 13,050) at four-year institutions (n = 8,890). Among students who attended four-year academic institutions, 2,590 declared a STEM major.

Table 1 presents the summary statistics of our analytic sample. Column 2 includes summary statistics for all students who enrolled in college. The values indicated are proportions, except for the following normalized variables, which are shown as means: math/science self-efficacy, math/science utility, math/science identity, grade point average, math scores, and SAT scores for math and science. Column 3 includes summary statistics for the sample of students who attended four-year academic institutions, and column 4 focuses on those who attended four-year academic institutions and declared a STEM major. Overall, the summary statistics are consistent with those reported from previous studies and from the National Science Foundation. Women comprise 49% of students majoring in STEM at four-year colleges, while 9% of STEM students identified as African American/Black, 7% as Asian American/Asian, and 13% Hispanic/Latine (Column 4). Students who declared STEM majors at a four-year institution are more likely to have parents with a bachelor's degree (33%) and to have parents with a Master's degree (28%) compared to students who declared other majors or who attended other types of postsecondary institutions. Notably, 38% of parents of STEM students have a STEM degree. STEM students are also more likely to have higher SAT math and reading scores and to have taken AP math and science courses compared to students attending four-year colleges in other majors.

Table 1
Summary Statistics

	Column 1	Column 2	Column 3	Column 4
	All students	Attended college	Attended 4-year college	Attended 4-year college & declared STEM major
Women	49.9	52.9	54.1	48.5
African American/Black	12.9	11.8	11.2	8.6
Asian American/Asian	3.5	4.5	5.2	6.6
Hispanic/Latine	22.0	19.9	15.1	13.4
Other Race/Ethnicity	8.6	8.3	7.7	6.7
Parents' Education: Less than High School	6.5	4.8	2.3	1.4
Parents' Education: High School	36.0	30.4	24.8	21.4
Parents' Education: Associate's Degree	15.1	16.1	14.9	14.2
Parents' Education: Bachelor's Degree	20.9	25.0	29.1	32.5
Parents' Education: Master's Degree or Higher	14.7	19.0	24.6	27.4
Parents have STEM Degree	24.3	28.3	32.0	37.7

Family Income in 2012: <$35K	31.2	28.6	22.2	17.6
Family Income in 2012: $35-75K	31.3	28.7	27.6	29.1
Family Income in 2012: $75-155K	28.4	31.4	36.1	37.8
Family Income in 2012: $155K+	9.1	11.2	14.1	15.5
Public School	92.3	89.8	86.0	86.9
Urbanicity: City	31.6	32.3	30.8	29.5
Urbanicity: Suburban	33.5	24.7	37.3	37.1
Urbanicity: Town	11.5	10.5	9.4	9.8
Urbanicity: Rural	23.3	22.4	22.5	23.6
Percentage URM Students	33.0	28.8	25.5	22.9
Percentage Students Eligible for Free/Reduced Lunch	39.3	32.7	28.8	26.8
11th Grade Math Identity Index	0.0	0.1	0.2	0.6
Math Utility Index	0.02	0.06	0.11	0.30
Math Self-Efficacy Index	0.02	0.10	0.19	0.45
Science Identity Index	0.04	0.10	0.21	0.61
Science Utility Index	0.00	0.00	0.01	0.03
Science Self-Efficacy Index	0.03	0.08	0.16	0.37
STEM GPA	2.44	2.62	2.88	3.08
9th Grade Math Score	50.8	53.0	55.7	58.3
SAT Math			534	568
SAT Reading			530	550
Taken AP Math Course(s)			13.2	20.4
Taken AP Science Course(s)			18.5	26.3
N	19,770	13,050	8,890	2,590

Notes. The sample sizes have been rounded to the nearest 10. The values indicated are proportions, except for the following normalized variables, which are shown as means: math/science self-efficacy, math/science utility, math/science identity, grade point average, math scores, and SAT scores for math and science.
Data source: U.S. Department of Education, National Center for Education Statistics, High School Longitudinal Study of 2009 (HSLS:09), Second Follow-up, 2016.

Results

Table 2 shows the marginal effects regression coefficients for our models with column 2 showing the results for whether the student attended a four-year college and column 3 showing the results for whether students enrolled at a four-year college declared a STEM major versus another major. We present our findings by research question below.

Research Question 1: Which high school-level factors, student demographic characteristics, and student academic achievement factors are associated with college-going?

We found that African American/Black students are 13.5 percentage points more likely than White students to attend a four-year college, all else held constant. Compared to students whose parents did not receive a high school degree, students whose parents completed high school or a postsecondary degree are also more likely to attend college. Family income is also positively associated with college-going. Students who had higher grade point averages from their high school STEM courses, as well as have higher 9^{th} grade math scores, are also more likely to pursue STEM majors. The results related to the measures on math/science self-efficacy, utility, and identity indices are mixed, with the findings suggesting that students who score higher on math identity, math self-efficacy and science identity are more likely to attend a four-year academic institution.

Research Question 2: Among students who attend a four-year college institution, which high school-level factors, student demographic characteristics, and student academic achievement factors are associated with STEM major choice?

Among students who attended a four-year college, women are less likely than men to choose a STEM major by 3.1 percentage points, all else held constant. Consistent with previous studies, students whose parents have a STEM degree are more likely than students whose parents have a degree from another field to pursue STEM. Again, the results for the math/science self-efficacy, utility, and identity indices are mixed, where higher math identity and math self-efficacy, as well as higher science identity and science utility, are associated with STEM major choice. Higher STEM GPA, higher SAT math scores, and taking at least one advance placement course in math and science are positively associated with STEM major choice.

Table 2

Regression coefficients on college-going, 4-year college going and STEM major declaration

	Column 1		Column 2		Column 3	
	College-going model		4-year college going model		STEM major declaration at a 4-year college model	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
Women	0.039***	0.007	0.013	0.009	-0.031**	0.011
African American/Black	0.080***	0.012	0.135***	0.015	0.011	0.019
Asian American/Asian	0.079***	0.019	0.015	0.021	0.026	0.024
Hispanic/Latine	0.051***	0.010	0.015	0.013	0.032	0.017
Other Race/Ethnicity	0.031*	0.013	0.013	0.016	-0.009	0.020
Parents' Education: High School	-0.002	0.015	0.057**	0.022	0.057	0.036
Parents' Education: Associate's Degree	0.103***	0.017	0.119***	0.023	0.086*	0.038
Parents' Education: Bachelor's Degree	0.089***	0.017	0.147***	0.023	0.086*	0.037
Parents' Education: Master's Degree or Higher	0.088***	0.018	0.169***	0.024	0.072	0.038
Parents have STEM Degree	0.013	0.008	0.002	0.010	0.034**	0.012
Family Income in 2012: $35-75K	0.033***	0.009	0.038**	0.012	0.050**	0.016
Family Income in 2012: $75-155K	0.080***	0.010	0.068***	0.013	0.014	0.016
Family Income in 2012: $155K+	0.094***	0.015	0.054**	0.017	-0.001	0.021
Public School	-0.050***	0.014	0.139***	0.016	0.041*	0.017
Urbanicity: Suburban	-0.010	0.009	0.040***	0.011	0.014	0.013
Urbanicity: Town	-0.037**	0.012	0.058***	0.016	0.031	0.020
Urbanicity: Rural	-0.044***	0.010	0.001	0.012	0.028	0.015
Percentage URM Students	0.140***	0.019	0.010	0.024	-0.027	0.029
Percentage Students Eligible for Free/Reduced Lunch	-0.187***	0.022	0.014	0.027	-0.071*	0.034
11th Grade Math Identity Index	-0.016***	0.005	0.026***	0.006	0.042***	0.007
Math Utility Index	0.004	0.004	0.005	0.005	-0.007	0.007
Math Self-Efficacy Index	0.011*	0.005	0.012*	0.006	0.026***	0.007
Science Identity Index	0.006	0.005	0.017**	0.006	0.079***	0.007
Science Utility Index	-0.010	0.067	0.137	0.084	0.627***	0.105
Science Self-Efficacy Index	0.000	0.004	0.002	0.005	-0.009	0.007

STEM GPA	0.192***	0.005	0.181***	0.007	0.060***	0.010
9th Grade Math Score	0.031***	0.004	0.088***	0.006	-0.003	0.008
SAT Math					0.056***	0.011
SAT Reading					-0.029**	0.010
Taken AP Math Course(s)					0.065***	0.017
Taken AP Science Course(s)					0.030*	0.015
N	19,770		13,050		8,890	

*p<0.1; **p<0.05; ***p<0.01

Notes. The sample sizes have been rounded to the nearest 10.

Data source: U.S. Department of Education, National Center for Education Statistics, High School Longitudinal Study of 2009 (HSLS:09), Second Follow-up, 2016.

Discussion and Conclusion

Consistent with our conceptual model, we found that demographic characteristics, math and science academic achievement, and family characteristics, are correlated with STEM major choice. Overall, our results related to math/science self-efficacy, utility, and identity are mixed. We found that 11^{th} grade math identity, math self-efficacy, and science identity are each positively associated with attending a four-year institution and pursuing a STEM major at a four-year institution. Previous studies that have investigated the impact of these constructs on STEM major choice tend to focus on only one or two measures, and it may be the combination of the six different measures that have led to the mixed results (e.g., [25], [26]). It may also be due to the nature of the sample representing over 944 high schools and a variety of college contexts, which differs from many previous studies, which often focus on single or multiple institutions. Future work should unpack the interaction effects of these measures.

Women's lower likelihood of pursuing STEM majors is consistent with previous studies and statistics typically reported by the National Science Foundation (e.g., [45]). We also found that family background—whether parents have a STEM degree—and family income matters in STEM major choice. This is consistent with literature on intergenerational transfer and the importance of social and economic capital on students' academic trajectories, especially parents' educational levels (e.g., [7], [20], [35]). The findings suggest further research is needed, particularly in disaggregating the math/science self-efficacy, identity, and utility measures, as well as in investigating potential differences in major choice by field separately, rather than STEM in the aggregate. Our research findings can be used to inform policies and programs aimed at increasing diversity and inclusivity in STEM fields, as well as to identify areas where additional support and resources may be needed to help students succeed.

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