Shattering monolithic myths: gender gaps in STEM major selection across Asian American ethnic subgroups

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ABSTRACT

Investigations into fostering gender parity in STEM have proliferated, yet the specific situation of Asian American women has been largely overlooked. Harnessing data from the High School Longitudinal Study of 2009 (HSLS:09), the analysis scrutinizes gender disparities in STEM major selections within distinct Asian American ethnic cohorts, accentuating the pivotal role of math self-efficacy. Pronounced gender disparities were discerned among Vietnamese/Thai and Filipino constituencies, as contrasting with their Chinese, Indian/Sri Lankan, and Japanese/Korean counterparts. For Vietnamese/Thai females, the disparity is partly attributable to diminished math self-efficacy, a dynamic not seen in Filipino disparities. These findings necessitate targeted interventions that foster female interest in STEM, while underscoring the imperative of ethnic specificity. It is paramount that strategies bolster the math confidence of Vietnamese/Thai females, thereby mitigating the deleterious effects of stereotypical expectations and ensuring equitable participation and outcomes.

Keywords: Asian Americans, ethnicity, gender, minority myth, STEM, self-efficacy in math and science

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Introduction

The gender gap in science, technology, engineering, and mathematics (STEM) education has been a focal point of scholarly and policy discussions for years, underscored by the critical role of STEM disciplines in securing economic benefits and advancing career prospects (Creusere et al. 2019; Day and Martinez 2021; Deming and Noray 2020; Webber 2014). Despite this attention, the specific experiences of Asian American women along their educational and professional paths in STEM have not been thoroughly explored. Traditional analyses of racial disparities in the STEM pipeline often mistakenly treat the Asian demographic as a uniformly overrepresented entity, thereby overlooking the nuanced realities of Asian American women's experiences. This oversimplification obscures the challenges they face, effectively rendering them invisible within debates on equity and inclusion in the STEM fields (Teranishi et al. 2004). This oversight is particularly concerning given evidence of Asian American women's underrepresentation in leadership roles within the STEM workforce, which suggests a complex interplay of racial and gender biases and outcomes. Wu and Jing (2011) elucidate this point by noting that Asian American female scientists and engineers hold fewer management and leadership positions than their Black and Hispanic counterparts, a phenomenon attributed to the dual barriers of racial stereotyping (the 'bamboo ceiling') and gender discrimination (the 'glass ceiling').

The critical examination of disparities in STEM major selection among various Asian American ethnic subgroups further emphasizes the importance of a detailed focus on the experiences of Asian American women. For example, using a nationally representative longitudinal dataset, Jang (2018) found that female students from Southeast Asian backgrounds are disproportionately less likely to engage in higher education within STEM fields, despite exhibiting high levels of achievement in mathematics. Such findings underscore the imperative to delve deeper into the specific obstacles encountered by Asian American female students from distinct ethnic subgroups, who are systematically underrepresented in STEM. This nuanced approach is essential to uncovering and addressing the unique challenges these students face, thereby enriching our understanding of these processes and fostering more equitable representation within STEM disciplines.

This study seeks to explore the intricacies of gender inequality within various Asian American ethnic subgroups in the STEM pipeline, particularly focusing on the unique challenges faced by Asian American women. These challenges are conceptualized within the framework of *the double bind,* a term that encapsulates the distinct difficulties that lie at the intersection of gender and race/ethnicity as encountered by Asian American women in STEM (Wu and Jing 2011). This exploration is set against the backdrop of the pervasive stereotype of Asians as a model minority, a notion that often oversimplifies and obscures the realities of diverse Asian American experiences and outcomes. Previous research in the field of gender inequality in STEM has extensively examined the development of mathematical and scientific attitudes and their influence on career choices (e.g., Bottia et al. 2015; Eccles et al. 1993; Wigfield et al. 1997). Drawing upon these foundational studies, our current research delves into various aspects that shape the experiences of underrepresented Asian American women in STEM. These aspects include academic performance, individual and school background characteristics, and the crucial role of self-efficacy in these subjects.

In undertaking this study, we aim to shed light on the nuanced complexities faced by Asian American students in STEM fields, with a specific focus on the unique challenges encountered by female students from this group. Our investigation is driven by two central objectives. First, we seek to provide empirical evidence of the 'double bind' experienced by Asian American female students when choosing STEM majors. This phenomenon exhibits varying degrees of intensity across different Asian American female ethnic subgroups. Here, the 'double bind' refers to the combined challenges related to both racial and gender identities and associated experiences. Second, we explore the extent to which social-psychological factors contribute to the observed gender disparities in STEM major choices among these subgroups. By examining these dimensions, our research challenges the conventional one-size-fits-all approach to understanding and addressing gender inequality in STEM. It highlights the importance of recognizing and catering to the diverse needs and experiences of various underrepresented Asian American female subgroups. This nuanced approach is crucial for devising more effective strategies to promote inclusion and success in STEM fields across female subgroups. Therefore, this study not only contributes to the theoretical understanding of gender and ethnic disparities in STEM but also has significant implications for policy-making and educational practice, guiding the development of targeted measures to encourage the participation of these underrepresented groups in STEM education and careers.

To conclude this section, we delve into the exploration of gender disparities in STEM major selection among Asian American students, with a particular focus on variations across different ethnic subgroups. Our inquiry is structured around three pivotal research questions, which aim to guide our analysis.

1. What is the average gender gap in STEM major choice among Asian Americans?
2. What are the variations in the choice of STEM majors between male and female students within different Asian American ethnic subgroups?

3. To what extent are academic achievement and STEM-related self-efficacy related to variations in gender disparities in STEM major selection across Asian American ethnic subgroups?

Literature Review

Heterogeneity in Asian American Populations and Asianization

The demographic composition of Asian Americans encompasses over 48 distinct ethnic subgroups, each characterized by unique cultural, and linguistic attributes, deeply rooted in varied historical, political, and religious milieus (Ghaffar-Kucher 2012; Museus 2014; Ngo and Lee 2007). Despite this inherent diversity and multiplicity within the Asian American community, as highlighted by scholars such as Lowe (1991) and King (2000), the heterogeneity of this population has often been overlooked or oversimplified in discourse and research. A poignant illustration of this oversight is found in the work of Teranishi and colleagues (2004), who revealed significant disparities in educational attainment among different Asian ethnic subgroups through an analysis of data from the 1997 Cooperative Institutional Research Program Freshman Survey. Their findings demonstrate that Korean and Chinese American students are more likely to attend prestigious colleges, private institutions, and four-year universities, as opposed to their Southeast Asian and Filipino counterparts in the United States. In addition, Snyder and colleagues (2019) reported that Southeast Asian American groups, including Cambodian, Laotian, Hmong, Burmese, and Vietnamese, exhibit lower levels of attainment of bachelor's degrees or higher, in stark contrast to the national average. Conversely, South and East Asian American subgroups show educational achievements significantly above the national average. These studies collectively underscore the fallacy of homogenizing the Asian American population as educationally and economically privileged, thereby bringing to light the pressing need to delve deeper into the unexplored and unexplained disparities existing within these multifaceted ethnic subgroups.

In their seminal work, Chen and Buell (2018) highlight the criticality of dissecting Asianization, as conceptualized by Museus (2014), which incorrectly amalgamates Asian Americans of diverse cultural and socioeconomic origins into a single racial classification. This process is central to a neoliberal racial agenda that fortifies the foundations of White supremacy through the doctrines of meritocracy and producerism.[1] The paradigm of meritocracy, which posits that an individual's societal standing and compensation are contingent upon their capabilities, juxtaposed with the approach of producerism, which contends that an individual's social echelon and remunerations are a direct corollary of their economic output, collectively serve to legitimize the structure of social disparity culminating in racial stratification. This confluence not only perpetuates but also provides a veneer of justification for the entrenched hierarchies that delineate socioeconomic divides, thereby reinforcing the systemic inequities manifested in racial categorizations. Initially, this agenda, masquerading under the guise of colorblindness (Bonilla-Silva 2006), misleadingly credits individual achievements and social ascension to personal diligence and merit, overlooking the systemic racial biases at play. This framework diminishes the urgency for acknowledging and addressing the deep-seated systemic injustices faced by Black, Latino, and Native American communities, a result of entrenched

[1] Producerism delineates the worth of an individual's life by their economic value. Irrespective of any perceived or material advantages certain Asian (Americans) may have gained within STEM, the discipline has consistently functioned and continues to function as a platform for perpetuating ideologies such as meritocracy and producerism. These ideologies are foundational to the neoliberal racial agenda, which accumulates resources primarily for White Americans (Chen and Buell 2018).

White supremacy and linked racial discrimination. Concurrently, this same neoliberal framework has also facilitated the obscuration of Asian Americans within the national dialogue on racial equity and disparity (Teranishi et al. 2004). Furthermore, the notion of Asianization is intertwined with producerism, which judges individuals by their ability to contribute to national prosperity. Notably, the surge in the significance of STEM education for national competitiveness and security (US President's Counsil of Advisors on Science and Technology 2010), as well as the significant growth of the Asian American population in STEM fields, served to spread the image of model minority as a racial stereotype of Asian Americans due to their socioeconomic rewards.

In contrast, the prevalent belief in the overrepresentation of Asian Americans in STEM disciplines serves as a pretext for disregarding the experiences and perspectives of those within the community who are underrepresented and, as a result, deemed unworthy of contributing to discussions on STEM inequality. This situation emerges from a confluence of colorblind ideology and neoliberalism (Omi and Winant 2015), whereby the process of Asianization masks the diversity among Asian Americans and, ultimately, facilitates the maintenance of existing White supremacist structures. This is achieved by systematically ignoring or minimizing the contributions and needs of underrepresented groups *within* the Asian American community, thus perpetuating their marginalization.

Specifically, Asian American women find themselves ensnared in a particularly precarious situation, embodying a stark example of how this framework exacerbates their vulnerability. Their predicament, often described as a double bind (Wu and Jing 2011), underscores the intersectional discrimination they face. For example, as Asian immigrant women enter the STEM fields within the United States, they are frequently relegated to, and perceived as, submissive and low-cost laborers. This not only undermines their contributions but also rationalizes the advancement of White women into senior management and leadership roles (Hossfeld 1990, 1999; Hu-Dehart 2007). This dynamic illustrates a systemic bias that privileges certain demographics while concurrently stifling the upward mobility and visibility of Asian American women in professional hierarchies. This segment of the argument calls for a more nuanced discussion of the experiences and outcomes of Asian-American women in STEM.

Gender Inequality, Academic Achievement, and Self-Efficacy in STEM

A considerable body of research has illuminated the effect of psychological factors on the entry of students into STEM disciplines, highlighting the minimal role of prior achievement in mitigating gender disparities within these fields (Bottia et al. 2015; Guo et al. 2015; Kanny et al. 2014; Ma 2011). So too, Xie and Shauman (2003) and Riegle-Crumb and colleagues (2012) present compelling evidence that prior academic achievements do not adequately account for the gender imbalances observed in STEM entry rates. The interplay of various elements—student attitudes towards higher education and STEM majors, educational and career aspirations, interest in STEM disciplines, a sense of belonging within these fields, and personal experiences in environments that either foster or impede STEM engagement—has been identified as critical to fostering student motivation for STEM, and, consequently, outcomes in STEM education.

In a foundational study, Eccles et al. (1983) introduced the expectancy-value model as a theoretical framework to analyze achievement-related decisions, offering insights into gender-specific behaviors in STEM choices driven by motivational and social considerations. This model has served as a cornerstone for understanding the dynamics at play in gender disparities within STEM fields. Further research has solidified the connection between social-psychological factors, such as math and science self-efficacy, and gender inequalities in STEM disciplines.

Also, Eccles (1993) demonstrated how gender-based stereotypes undermine female students' confidence and interest in mathematics, often steering them towards non-STEM careers. Similarly, Wang (2013) found that self-efficacy in math and science is a significant predictor of actual engagement in STEM fields, suggesting that enhancing self-confidence in mathematics could foster greater interest among females in STEM careers, particularly for those whose math achievement parallels that of their male counterparts. Additionally, studies have identified a pronounced gender bias in self-efficacy perceptions related to math and science, which is not as evident in other STEM related attitudes, such as the intrinsic and utility values of mathematics (Fan 2011; Wigfield and Eccles 2002).

Furthermore, Correll (2001) investigates the association among factors including academic achievement, societal gender norms on self-perceptions of mathematical ability, and career decisions within STEM disciplines. Her research articulates that self-evaluation in math plays a crucial role in the selection of a STEM career path. She posits that adherence to traditional gender stereotypes exacerbates the gender divide in these self-assessments. This disparity is evident, as males, even with similar levels of mathematical achievement as females, are more inclined to overestimate their mathematical prowess. This overestimation among male students contrasts with females' tendency to underestimate their capabilities, thereby influencing the likelihood among females to pursue careers in STEM fields less frequently. Building on this framework, Correll (2004) further conducted an experimental assessment of a model that sheds light on how cultural beliefs regarding gender constrain the development of career-relevant aspirations among men and women. Participants were exposed to two different conditions. In one condition, male and female undergraduate participants completed an experimental task after being exposed to the belief that men outperform women in this task. In the other condition, participants were exposed to the belief that both genders possess equal task abilities. The study reveals that male undergraduates exposed to a gender-biased ideology rated their task-related competencies and occupational aspirations higher than their female counterparts, despite both groups receiving identical, average performance scores. In contrast, when exposed to the notion that task abilities are gender-neutral, no significant differences in self-assessment or career aspirations were observed between genders. These studies provide illuminating examples of how gender stereotypes shape self-efficacy and career orientation in STEM fields. Specifically, they reveal the mechanisms by which and through which narratives about gender can influence individuals' assessments of their abilities and, consequently, their professional choices.

Furthermore, the relationship between deeply ingrained gender narratives and individuals' perceptions of their abilities, which subsequently influences their career choices within STEM fields, may differ among subgroups of Asian Americans. Cultural and societal narratives about gender could shape individuals' self-assessment of their capabilities in distinct ways across different Asian American ethnic groups, thereby guiding their professional paths in various divergent directions (Jang 2018; Mukkamala and Suyemoto 2018). These narratives may particularly influence women's confidence in their STEM abilities in certain subgroups more than others, subtly steering them towards traditionally gendered roles and away from STEM careers. Recognizing the nuanced relationship between gendered narratives and the career choices of different Asian American subgroups is crucial for devising targeted interventions. Such interventions aim to lessen their potential negative impacts, thereby promoting greater gender equity in STEM professions.

Data and Method

Data

This study analyzed the High School Longitudinal Study of 2009 (HSLS:09) derived by the U.S. National Center for Education Statistics (NCES). It contains a nationally representative sample of 9th grade in 2009 through eight years after high school graduation. This dataset has several advantages. First, it is the most up-to-date nationally representative U.S. dataset, including college students' STEM majors, socio-demographic background, and school characteristics. Second, this dataset oversamples Asian American students, enabling us to analyze national representatives of this demographic group. To measure the gender differences in STEM major choice across Asian American subpopulations, we focus only on students enrolled in four-year institutions by 2016.

HSLS:09 provides an intricate breakdown of Asian American subgroups by their geographic regions and countries of origin. Despite the wealth of data, the way race/ethnicity and national origin questions are framed within national educational databases restricts our capacity to delve into educational experiences based on finely differentiated ethnic categories and national origins. Specifically, HSLS:09 categorizes Asian Americans into five subgroups based on geographical location and origin country, namely (1) Chinese, (2) Filipino, (3) Vietnamese, Thai, and other Southeast Asian regions excluding the Philippines (Vietnamese/Thai), (4) Indian, Sri Lankan, and other South Asian regions (Indian/Sri Lankan), and (5) Japanese and Korean (Japanese/Korean). The analytic sample size is 1,310 students; 313 Chinese, 200 Filipino, 222 Vietnamese/Thai, 338 Indian/Sri Lankan, and 237 Japanese/Korean, respectively. Geographically, the Chinese and Japanese/Korean groups are classified as part of the East Asian region, while the Filipino group is associated with Southeast Asia. This study, however, goes beyond mere geographical classifications to further distinguish these subgroups by their countries of origin. This approach is crucial for investigating the nuances of gender disparities in STEM major selection among Asian American subgroups, with the country of origin serving as a key differentiator of subgroup characteristics (Kang et al. 2023; Hoeffel et al. 2012). One limitation of our study, however, stems from the lack of more specific geographic and ethnic subgroup details in the data. This raises questions regarding the adequacy of grouping Japanese and Korean subgroups together, for example. Nonetheless, to our knowledge, there exists no national-level dataset that simultaneously accounts for students' family and school characteristics along with STEM major selection, while also providing detailed ethnic/geographic information for Asian American subgroups. Given this context, we assert that the analysis of the HSLS:09 dataset, despite its limitations, offers valuable insights into the heterogeneity of gender disparities in STEM major choice across Asian American subgroups.

Method

To address research questions, the following model building is carried out in steps. We first utilized a logistic regression model to predict the probability of choosing STEM majors among Asian American students. The logistic regression model incorporates various explanatory factors identified in previous literature, which are sequentially added to the logistics regression. Sequential logistic regression analysis has the advantage of identifying how variations in each explanatory factor predict gender disparities in the likelihood of choosing STEM majors. Initially, we input individual and high school backgrounds variables as control variables, gradually adding aggregated explanatory factors thereafter. They are (1) students' high school achievement level, and (2) students' self-efficacy in math and science. HSLS:09 used a stratified, two-stage random sample design with schools selected in the first stage and students randomly selected from the sampled schools in the second stage. To take into account this sampling strategy and produce generalizing results among Asian American students, we utilized a fourth follow-up longitudinal weight variable and clustered standard errors. The full model of the sequential logistic regression is as follows;

$$ln\left(\frac{P_{STEM}}{1-P_{STEM}}\right) = \beta_0 + \beta_1(Asian\ American\ subgroup) + \beta_2(Female) + \beta_3(Bacgkround)$$
$$+ \beta_4(Students'achievement\ level) + \beta_5(Math\ /\ science\ self - efficacy)$$

where $ln(P_{STEM}/1\text{-}P_{STEM})$ represents the log odds of the probability of choosing STEM majors divided by the probability of choosing non-STEM majors; β_1 indicates a vector of coefficients of a set of dummy variables for Asian American subgroups; β_2 represents a coefficient of gender difference; β_3 reflects the control variable; β_4, and β_5 indicate each vector of the coefficients of the aggregated explanatory factors. Finally, to enhance the intuitive understanding of the logit regression results, we present the marginal effects for each model. These marginal effects delineate the differences in the probabilities of selecting STEM majors by gender, when all covariates are held at their mean values.

In addition, if we find an aggregated explanatory factor explaining the gender disparity in STEM major choice, we investigate which specific variable within the aggregated explanatory factor mediates the gender difference. To this end, we utilize the Sobel test, which assesses whether a factor significantly mediates the association between gender and the likelihood of STEM major choice (see MacKinnon and Dwyer 1993).

To address the second and third research questions, we conduct subgroup analyses across five distinct Asian American ethnic subgroups. In these analyses, we employ sequential logistic regression models, excluding race/ethnicity variables to specifically focus on within-group dynamics. The purpose of these subgroup analyses is to investigate the presence and variability of gender disparities in STEM major selection among various Asian American ethnic subgroups. Furthermore, we seek to identify and elucidate the factors that may explain the observed gender differences within these subgroups. This methodological approach facilitates a nuanced understanding of the interplay between gender and ethnicity in the context of STEM education, offering insights into the complex mechanisms driving gender disparities in STEM major selection.

Measure

The dependent variable is whether or not a student chose a STEM major. We defined a student as having chosen a STEM major if they selected a STEM major during the first and second year of college, or upon entering a four-year institution with a STEM major. STEM majors include Computer Science, Physical and Life Sciences, Engineering, and Technology. The major is coded using the NCES 2010 Classification of Instructional Programs taxonomy (Duprey et al. 2018). STEM has been defined in various ways because there is no consensus on the ideal way to define what constitutes STEM (Riegle-Crumb and King 2010). In this study, STEM majors do not include Agricultural Sciences and Social Science disciplines, such as Economics, Sociology, and Psychology, because they are excluded from STEM majors in many federal and state legislative documents in the United States and are considered potentially different from Physical Science (Riegle-Crumb et al. 2012).

In this dataset, a students' gender was derived from self-reported surveys, where the questionnaire only asked, "Are you male or female?" Thus, we cannot account for diverse gender and unfixed identities. Despite the dichotomous nature of the response, we decided to use the term gender rather than sex since the gender variable is based on students' responses rather than biological information. A male student is a reference group, and a female student is coded as 1.

The background control variables include the socioeconomic status (SES) index score, immigrant status, high school location, and type. SES is a continuous and composite variable derived from NCES based on family income, parental education, and occupation. The immigrant status indicates whether both parents and students were born in the U.S. or not. Lastly, school urbanicity and type are dichotomous variables. School urbanicity comprises a set of dummy variables representing whether the school is located in urban, suburban, or rural areas. School type indicates public or private. Several other school context factors, such as the proportion of female high school math and science teachers (Bottia et al. 2015), a high school's Advanced Placement-level course offering in STEM, and gender segregation of extracurricular activities (Legewie and DiPrete 2014), are associated with gender inequality in STEM major choice. Due to a very small sample size per each Asian ethnicity subgroup, however, we limited our school-level variables to these two variables that capture school-level characteristics.

Second, we consider students' achievement levels using two measures: math achievement scores from the last semester of eleventh grade and their high school grade point average (GPA). The standardized math scores, derived from NCES, serve as a proxy for mathematics performance of readiness to proceed into STEM courses and careers (Duprey et al. 2018). High school GPA represents the weighted GPA reflecting the difficulty of Advanced Placement/International Baccalaureate coursework. However, the math score should be interpreted cautiously. These scores are influenced by various factors, including earlier socialization and encouragement in STEM subjects, which are crucial in understanding gender differences (Lee, Shin, and Bong 2020; Wang and Degol 2013). Female students may have received less encouragement in STEM throughout their education (Legewie and DiPrete 2014), potentially affecting their scores. Consequently, using these scores as a gender-neutral measure of attainment could obscure pre-existing gender disparities in STEM engagement and interest (Jacobs 2005). While we include this variable in our analysis, we acknowledge its limitations and interpret the results carefully, considering how this measure might overestimate or underestimate gender differences in the likelihood of choosing a STEM major (Simpkins, Price, and Garcia 2015).

Third, the measures of math self-efficacy and science self-efficacy consist of students' perceived capabilities of successful educational attainment in mathematics and science, respectively. NCES provides standardized index scores of math and science self-efficacy that reflect recent work in self-efficacy theory, respectively (see Ingels and Dalton 2013). Each index score was derived from four questions about students' perception of their capabilities in math (Cronbach's alpha=.89) and science (Cronbach's alpha=.92) at the eleventh-grade level. The questions are: (1) you are confident that you can do an excellent job on mathematics (science) tests; (2) you are certain that you can understand most difficult material presented in mathematic (science) textbooks; (3) you are certain that you can master mathematics (science) skills; and (4) you are confident that you can do an excellent job on mathematics (science) assignments. The answers consist of four-point Likert scales from strongly disagree to strongly agree. Higher values indicate higher self-efficacy in math and science, respectively.

Table 1 presents means of covariates used in this study by Asian American subgroups and gender. It appears that Vietnamese/Thai students generally have more disadvantaged family backgrounds compared to other groups. In addition, female students tend to exhibit lower math and science self-efficacy than male students across all Asian American subgroups.

Table 1. Mean values of covariates by sub-ethnicity and gender

	Chinese		Filipino		Vietnamese/Thai		Indian/Sri Lankan		Japanese/Korean	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Socioeconomic status	.44	.47	.45	.51	-.49	-.45	.59	.50	.48	.25
	(.11)	(.08)	(.07)	(.09)	(.09)	(.09)	(.08)	(.08)	(.09)	(.09)
First-generation immigrant	.26	.53	.21	.27	.20	.20	.48	.35	.41	.41
	(.04)	(.04)	(.04)	(.05)	(.05)	(.05)	(.04)	(.04)	(.05)	(.05)
Urban school[a]	.36	.36	.53	.45	.45	.47	.31	.33	.38	.40
	(.05)	(.04)	(.05)	(.06)	(.06)	(.06)	(.04)	(.04)	(.05)	(.05)
Suburban school[a]	.42	.42	.26	.35	.28	.36	.39	.45	.45	.33
	(.05)	(.04)	(.05)	(.06)	(.05)	(.06)	(.04)	(.04)	(.05)	(.05)
Rural school[a]	.22	.21	.21	.20	.27	.17	.30	.22	.17	.27
	(.04)	(.03)	(.04)	(.05)	(.05)	(.04)	(.04)	(.04)	(.04)	(.05)
Private school[a]	.23	.23	.36	.35	.23	.12	.16	.23	.19	.17
	(.04)	(.03)	(.05)	(.06)	(.05)	(.04)	(.03)	(.04)	(.04)	(.04)
Math score at 11th grade	68.13	63.50	59.20	57.85	60.95	56.56	64.97	62.05	63.27	60.54
	(.88)	(.68)	(1.03)	(.89)	(1.07)	(1.09)	(.78)	(.71)	(.89)	(.84)
High school grade point average	3.43	3.31	2.94	3.13	3.05	3.02	3.17	3.17	3.03	3.13
	(.06)	(.04)	(.08)	(.08)	(.08)	(.08)	(.06)	(.05)	(.08)	(.07)
Math self-efficacy	.61	.23	.40	.22	.39	.29	.72	.29	.43	.01
	(.09)	(.08)	(.09)	(.13)	(.09)	(.10)	(.08)	(.08)	(.10)	(.09)
Science self-efficacy	.43	.14	.40	-.01	.35	-.15	.43	.10	.31	-.05
	(.09)	(.08)	(.10)	(.11)	(.10)	(.13)	(.08)	(.09)	(.09)	(.10)
N	129	184	107	93	106	116	166	172	116	121

Note: The standard errors are reported in parentheses.

a. These variables are binary. Therefore, mean values of these variables should be interpreted as a proportion.

The dataset reveals various degrees of missing data: STEM major choice (5.5%), SES index (4.12%), immigration status (11.98%), science self-efficacy (8.17%), math self-efficacy (6.87%), and eleventh-grade math test scores (4.73%). Other variables are entirely complete. To address the significant amount of missing data for certain variables, we utilized the multiple imputation by chained equations technique to fill in the gaps, ensuring the retention of as many cases as feasible. Post-imputation, no variables had missing data. We derived coefficients and standard errors from 20 imputed datasets to enhance the statistical robustness of our analysis (Graham, Olchowski, and Gilreath 2007)

Results

Figure 1 presents the adjusted margin effects of female students for all Asian American students, indicating the difference between male and female students in the predicted probability of choosing STEM majors. The four bars represent the values of the margin effect sequentially when explanatory variables are added to logistic regression models. Without considering any factor, Asian American female students exhibited a significantly 16-percentage-point lower likelihood than Asian American male students in choosing STEM majors. This gender gap barely decreased and remained significant, even after controlling for differences in individual and high school background characteristics between male and female students in the analysis. Even after assuming the high school achievement levels (measured by high school average GPA and standardized math test scores at eleventh grade) are similar across genders, the gap narrowed by about 3 percentage points, and the difference was still statistically significant. Furthermore, the Sobel test results did not find any significant mediating effect among the academic achievement variables at a 95% confidence interval.

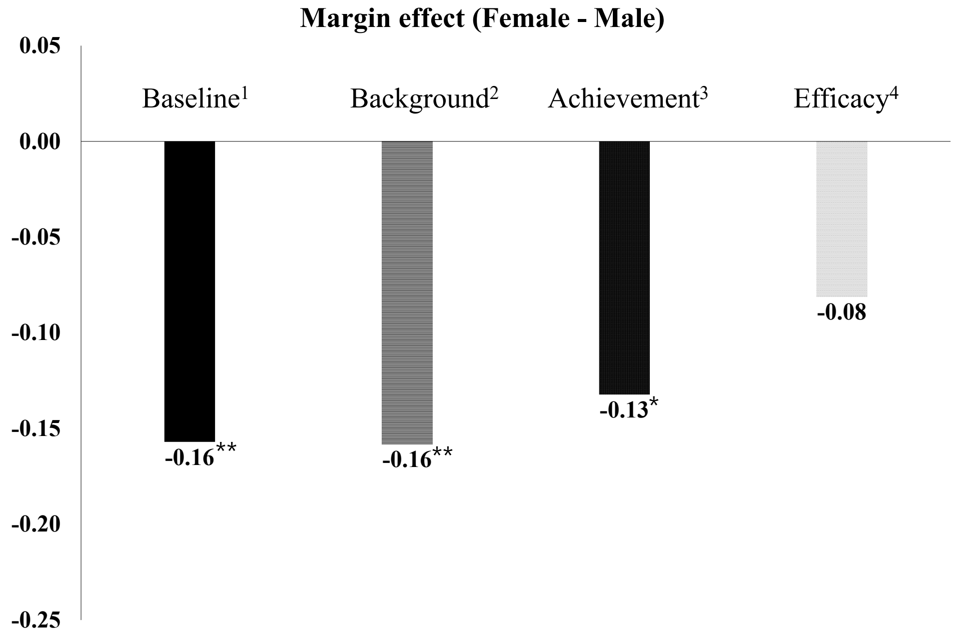

Figure 1. The adjusted marginal effect of gender on the probability of STEM major choice in Asian American four-year college students

Note. [1]The Baseline model includes only gender and Asian American subgroups. [2]The Background model adds socioeconomic status index score, first-generation immigration status, high school type, and location variables to the Baseline model. [3]The Achievement model adds math achievement scores at the eleventh grade and high school GPA variables to the Background model. [4]The Efficacy model adds math and science self-efficacy variables at the eleventh grade to the Achievement model. All variables are fixed at their mean value in each model. N=1,310. $^{**}p<.01$, $^{*}p<.05$

However, when we added self-efficacy in math and science, there was no statistically significant gender difference in STEM major choice. This suggests that assuming similar levels of self-efficacy in math and science for both males and female students–indicating an individual's ability to succeed in math and science related tasks or situations–there is no difference between male and female students in the predicted probabilities of choosing STEM majors. The results of the Sobel test further indicate that only math self-efficacy negatively mediates the gender gap in STEM major choice at a 95% confidence interval, implying that a substantial degree of gender disparity in STEM major choice can be explained by the difference between male and female students in math self-efficacy.

Next, we conducted a subgroup analysis to examine the gender differences in choosing STEM majors for each Asian American ethnic subgroup. Table 2 presents the probability of choosing STEM majors by Asian American subgroups without considering any other factors. The marginal effects of females indicate the extent to which each Asian American subgroup shows a gender gap in STEM major choice. First, among the five Asian American subgroups, a significant gender difference in STEM major choice was found in the Vietnamese /Thai and Filipino groups. The gender gap in Vietnamese/Thai group was approximately 40 percentage points. About 56 percent of Vietnamese/Thai male students chose STEM majors, while only 16 percent of Vietnamese/Thai female students chose STEM majors. Interestingly, the predicted probability of choosing STEM majors for Vietnamese/Thai male students is relatively high compared to other Asian American male ethnicity/subgroups. In contrast, Vietnamese/Thai female students' probability of choosing STEM majors is relatively low compared to other Asian American female subgroups.

Table 2. The difference in the likelihood of choosing STEM majors by gender and Asian American subgroup

	The likelihood of STEM major choice		The difference in the likelihood of STEM major choice[1] (Female-Male)	95% confidence interval	
	Male	Female		Lower bound	Upper bound
Chinese (n=313)	.45(.10)	.38(.10)	-.07(.16)	-.38	.25
Filipino (n=200)	.37(.08)	.11(.04)	-.26(.09)	-.43	-.10
Vietnamese/Thai (n=222)	.56(.10)	.18(.06)	-.38(.10)	-.58	-.19
Indian/Sri Lankan (n=338)	.57(.08)	.46(.10)	-.11(.10)	-.30	.07
Japanese/Korean (n=237)	.34(.09)	.30(.09)	-.04(.12)	-.28	.19

Note. [1]Marginal effect of female without any adjustment. The standard errors are reported in parentheses.

Furthermore, among Asian Filipino students, the gender gap in STEM major choice was approximately 26 percentage points. Although the gender gap in the Filipino group was smaller than the Vietnamese/Thai group, only 11 percent of Filipino female students chose STEM majors, representing the lowest probability of choosing STEM majors across the five female Asian American subgroups.

Meanwhile, there is no significant gender difference in the probability of choosing STEM majors for Chinese, Indian/Sri Lankan, and Japanese/Korean groups. In particular, Indian/Sri Lankan male and female students show the highest probabilities of choosing STEM majors across all Asian American female subgroups; the probabilities of choosing STEM majors were 57% and 46% for males and females in this group, respectively.

Comparison of the baseline model in Figure 1 and Table 2 reveals several noteworthy findings. Overall, the gender difference in STEM major choice among Asian Americans masks heterogeneity in the magnitude of gender gaps across the subgroups. Our analyses also suggest that the variation in STEM major choice across Asian American subgroups is larger for female students than for male students. For male students, the probabilities of choosing STEM majors ranged from 34 percentage points in Japanese/Korean to 57 percentage points in Indian/Sri Lankan. In contrast, for female students, the probabilities of choosing STEM majors ranged from 11 percentage points in Filipino to 46 percentage points in Indian/Sri Lankan.

Table 3. The estimation of the likelihood of STEM major choice, by sub-ethnicity groups

	Chinese (n=301)				Filipino (n=189)				Vietnamese/Thai (n=206)				Indian/Sri Lankan (n=328)				Japanese/Korean (n=219)			
Variables	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Gender	-.23	-.16	-.44	-.46	-1.60**	-1.85**	-1.98***	-1.70**	-1.91***	-2.06***	-1.82***	-1.74**	-.45	-.46	-.43	-.27	-.20	-.06	.23	.45
(ref. = male)	(.66)	(.68)	(.55)	(.53)	(.54)	(.59)	(.57)	(.61)	(.46)	(.47)	(.50)	(.54)	(.38)	(.41)	(.52)	(.52)	(.55)	(.55)	(.58)	(.57)
Socioeconomic status		-.09	-.34	-.08		.64	.27	.25		.62	.59	.78		.35	.49	.49*		.36	.08	-.03
		(.22)	(.24)	(.25)		(.50)	(.55)	(.52)		(.35)	(.36)	(.45)		(.24)	(.27)	(.24)		(.30)	(.35)	(.34)
First-generation																				
immigrant (FGI)		-.65	-.40	-.24		1.00	1.56*	1.81*		.99	1.23	.67		.15	.21	.05		.07	.10	-.06
(ref. = non-FGI)		(.51)	(.54)	(.55)		(.71)	(.72)	(.78)		(.78)	(.89)	(.82)		(.52)	(.53)	(.46)		(.61)	(.62)	(.61)
School urbanicity																				
(ref.= urban)																				
Suburban		.48	.94	.93		-.17	.09	-.02		.72	.93	.88		-.77	-1.06	-.91		.84	.86	.85
		(.52)	(.62)	(.62)		(.67)	(.71)	(.72)		(.66)	(.72)	(.76)		(.58)	(.65)	(.57)		(.64)	(.71)	(.73)
Rural		.41	1.22	1.10		.62	.39	.35		1.09	1.33	1.57*		.03	-.53	-.42		1.36	1.01	.90
		(.64)	(.71)	(.78)		(.69)	(.86)	(.89)		(.70)	(.77)	(.77)		(.62)	(.68)	(.60)		(.73)	(.69)	(.74)
School type																				
(ref.= public)		-.40	-.26	-.48		.89	1.82*	1.89**		.84	1.51*	1.92*		-1.51**	-1.72**	-1.62**		-.10	-.45	-.37
		(.35)	(.33)	(.41)		(.80)	(.74)	(.73)		(.71)	(.71)	(.77)		(.52)	(.54)	(.56)		(.85)	(.84)	(.89)
Math score at 11th grade			.08	.05			.11	.12			.06	.06			-.02	-.01			.08	.08
			(.04)	(.04)			(.06)	(.07)			(.04)	(.03)			(.04)	(.04)			(.05)	(.05)
High school GPA			.60	.36			-.13	-.42			-.33	-1.01*			1.14*	.73			.56	.45
			(.56)	(.54)			(.45)	(.64)			(.46)	(.43)			(.49)	(.44)			(.49)	(.52)
Math self-efficacy				.50				.54				1.16**				.60*				.53
				(.33)				(.37)				(.39)				(.30)				(.43)
Science self-efficacy				.85*				.19				-.03				.12				.08
				(.36)				(.38)				(.38)				(.36)				(.39)
Constant	-.24	-.29	-7.31*	-4.94	-.53	-1.01*	-7.66*	-7.56*	.23	-.05	-2.80	-1.47	.30	.56	-1.56	-1.77	-.69	-1.38*	-8.11*	-8.05*
	(.40)	(.62)	(3.19)	(2.98)	(.33)	(.43)	(3.09)	(3.32)	(.39)	(.57)	(2.20)	(2.08)	(.31)	(.54)	(1.78)	(1.52)	(.37)	(.55)	(3.15)	(3.19)

Note. (1) Baseline model, (2) Background model, (3) Achievement model, (4) Efficacy model. The standard error is presented in parentheses.
***p<.001, **p<.01, *p<.05

Table 3 summarizes the results of the sequential logistic regression analysis for predicting STEM major choice by Asian American subgroups. The baseline model result, which contains only the gender variable without any other factors, confirms the previous descriptive patterns that only Filipino and Vietnamese/Thai student groups show significant gender differences in the likelihood of choosing STEM majors. Even in the models where other factors are considered, there are no significant gender gaps in STEM majors in three Asian American subgroups: Chinese, Indian/Sri Lankan, and Japanese/Korean.

Noticeably, the gender gap of Filipino students is not substantially explained by the considered explanatory factors, unlike the results from the total Asian American sample. Even after considering all the aggregated explanatory factors, including students' background, achievement level, and self-efficacy in mathematics and science, the gender disparity in STEM major choice in the Filipino group remained significant. These results suggest that the gender gap in STEM major choice within Filipino groups is driven by other factors rather than educational achievement and self-efficacy in mathematics and science. The Sobel test also confirmed that no factors are significantly related to the gender gap in STEM major choice within the Filipino group.

In contrast, for the Vietnamese/Thai group, the gender gap in STEM major choice remains significant after considering math and science self-efficacy, which refers to an individual's ability to succeed in math and science related tasks or situations at the eleventh grade. Unlike the Filipino group, the Sobel test further confirms that math self-efficacy significantly mediates the negative relation between gender and the likelihood of choosing STEM majors. It indicates that within the Vietnamese/Thai group, female students tend to have lower math self-efficacy than their male counterparts, even if they have similar academic achievements compared to male students. Importantly, it appears that Vietnamese/Thai female students' lower probability of choosing STEM majors as compared to their male counterparts is partially attributed to the gender difference in math self-efficacy within the Vietnamese/Thai group.

Discussion

The first contribution of this study is that it constitutes the first attempt to analyze large-scale nationally representative data to identify the gender gap in STEM major choice *across* Asian American subgroups. By examining the nuanced differences across various subgroups, our results suggest that the gender gap of STEM major choice in Asian Americans is not monolithic across ethnic and regional origin. Furthermore, this study challenges the societal myth that Asian American female students generally occupy a large share of STEM education opportunities. This myth, rooted in the model minority stereotype, obscures the reality of significant gender disparities within certain subgroups. By debunking this stereotype, we highlight the importance of addressing unique challenges faced by different ethnic groups to achieve genuine gender equality in STEM fields (Steele 1997). Asian American female students were relatively less likely to enter the STEM degree pathway than Asian American male students, but these differences were only significant in two Asian American subgroups: Vietnamese/Thai and Filipino. For the other three subgroups–Chinese, Indian/Sri Lankan, and Japanese/Korean–no significant gender differences were found in STEM major choice.

The pervasive stereotype portraying Asian-origin students as a "model minority" with uniformly exceptional performance in STEM fields obscures the nuanced realities of gender disparities within these groups, thus hindering policymakers and educational researchers from effectively identifying and addressing the barriers to achieving gender equality in STEM education. A comprehensive understanding of these disparities necessitates ethnicity-specific analyses of the STEM pipeline, similar to the approach we have undertaken in this study. This approach reveals varied patterns of gender inequality in STEM fields among different Asian American student subgroups. In our previous research (Kang et al. 2023), we observed that Vietnamese/Thai and Filipino students were less likely to opt for STEM majors in four-year institutions compared to their counterparts in two-year institutions. Extending these findings, our current study highlights that this trend is particularly pronounced among female students in these groups, indicating that Vietnamese/Thai and Filipino female students face significant challenges in accessing STEM majors. This revelation points to a critical need for targeted policy interventions aimed at enhancing educational opportunities in STEM for these specific subgroups.

To address these disparities, specific policy measures should be considered. These could include increasing funding for STEM programs in communities with high populations of these subgroups, developing mentorship and support networks for female students in these communities, and creating initiatives that specifically address the unique challenges faced by Vietnamese/Thai and Filipino female students in STEM fields. Additionally, it is imperative to recognize that beyond policy efforts, addressing these disparities may also require tackling broader structural conditions, such as socioeconomic factors and cultural norms, which could contribute to the lower propensity of these groups to pursue STEM majors. These comprehensive approaches are essential to create an equitable and inclusive environment in STEM education for all student subgroups.

While prior research has delineated the gender distribution in STEM degree programs among Asian American students (Ma and Liu 2017; Sassler, Michelmore and Smith 2017; Tao 2018), the current study endeavors to unearth the factors contributing to gender disparities in the selection of STEM majors within this demographic. A significant finding from our comprehensive analysis is that differences in mathematics self-efficacy are a key contributor to the gender gap in STEM major choices. Particularly notable is that this trend is predominantly observed within the Vietnamese/Thai subgroup. Here, we discovered a substantial gender disparity in the choice of STEM majors among Vietnamese/Thai students, which persisted despite equalizing high school academic achievements. This indicates that even after accounting for factors such as high school GPA and the eleventh-grade mathematics test scores—factors potentially influenced by early socialization and encouragement in STEM—there were still notable differences in the likelihood of choosing a STEM major among Vietnamese/Thai students.

This phenomenon could manifest in various ways within educational settings. Vietnamese/Thai students may avoid advanced mathematics or science courses, despite possessing the academic capabilities to succeed. This avoidance behavior can significantly limit their exposure to and engagement with STEM fields during crucial formative years. In classroom environments, these students often demonstrate reduced participation in STEM-related activities and are less likely to pursue STEM-focused extracurricular opportunities, further reinforcing their lower self-efficacy in these domains (Wang, Degol, and Ye 2015). The absence of targeted encouragement from teachers or mentors who recognize their potential exacerbates this issue, as these students may not receive the necessary positive reinforcement to build confidence in STEM subjects. Consequently, the cumulative effect of these factors is evident in college, where lower rates of enrollment in STEM majors among Vietnamese/Thai female students, compared to their male counterparts, are observed. Despite possessing the requisite academic background, these students often gravitate towards fields where they perceive greater self-efficacy, thereby perpetuating the underrepresentation of this demographic in STEM disciplines (Stout, Grunberg, and Ito 2016).

Moreover, Vietnamese/Thai female students exhibit greater reservations about their capabilities in STEM fields compared to their male counterparts. This hesitancy can be attributed to the confluence of societal biases regarding gender roles and the model minority myth, which affect these students' self-perceptions, regardless of their actual academic accomplishments in mathematics (Mukkamala and Suyemoto 2018). Patriarchal cultural norms, such as an emphasis on early marriage and childcare, may dampen educational aspirations for female students (Jang 2018). Additionally, our research found that even in four-year institutions, Vietnamese/Thai female students were less inclined to opt for STEM majors compared to other Asian subgroups (Kang et al. 2023). These social pressures, stemming from both home and educational environments, potentially place Vietnamese/Thai students at a disadvantage in pursuing high-quality STEM education, thereby impacting their opportunities for income and social mobility.

These insights underscore the importance of future research focusing on the interplay of social psychological factors in influencing STEM pathways, particularly among Vietnamese/Thai male and female students. Moreover, there is an imperative for policymakers and educational researchers to develop initiatives that provide professional development for STEM educators and school counselors. Such efforts should aim to support and enable Vietnamese/Thai female students to navigate the challenges posed by model minority stereotypes and the intersection of these stereotypes with gender issues. Understanding these dynamics is essential for fostering a more positive engagement with mathematics and science among female students in specific ethnic subgroups, such as the Vietnamese/Thai community in this instance.

In our study, we also observed a notable gender disparity in the selection of STEM majors among Filipino groups. This disparity, however, could not be accounted for by differences in academic achievement or self-efficacy in mathematics and science. Similar to the limitations of interpreting the math achievement scores, other factors such as socialization and encouragement in STEM throughout education may play a significant role. Female students might have experienced less encouragement in STEM, potentially influencing their academic and career choices (Lee, Shin, and Bong 2020; Legewie and DiPrete 2014; Wang and Degol 2013). Consequently, using academic achievement and self-efficacy as sole indicators may obscure other critical influences on STEM major selection (Jacobs 2005). Therefore, while we include these variables in our analysis, we recognize their limitations and interpret the results with caution. The lower propensity of Filipina students to enroll in STEM degree programs might be influenced by factors beyond our current analysis, such as cultural expectations, social norms, or differing career interests. As such, any attempts to pinpoint the exact causes of the gender gap in STEM among Filipino students must be approached carefully, acknowledging these broader influences (Simpkins et al. 2015).

One plausible explanation for this observed gender gap could be the pronounced inclination of Filipino female students towards health-related majors. Historical analysis of Filipino migration patterns to the United States reveals a significant trend of Filipino women taking up employment in healthcare occupations, such as nursing and other health practitioner roles (Espiritu 2005). Further supporting this trend, Min and Jang (2015) noted that Filipino female students in more recent generations are more likely to graduate from health-related majors compared to their counterparts from other Asian backgrounds. In our data analysis, we found that 26% of Filipino female students opted for healthcare-related majors, a figure notably higher than the approximately 16% observed among other Asian-American female students. This strong preference for health majors could be a contributing factor to the gender disparity in STEM major selection observed in the Filipino group. Interestingly, despite their affinity for health majors, Filipino female students demonstrated a lower tendency to choose fields like biology, which are traditionally seen as stepping stones to high-paying medical professions such as becoming a medical doctor. This trend might suggest that Filipina students are less likely to pursue higher-status career paths, given their lower likelihood of selecting certain STEM majors. Future research should aim to investigate whether the reduced participation of Filipino female students in STEM majors is a result of their concentrated interest in specific occupational sectors within the health field.

We further observed minimal gender gaps in STEM major selection among Chinese, Japanese/Korean, and South Asian subgroups. Although our analysis does not provide concrete evidence to explain the negligible differences, it could be posited that the relatively minor STEM gap observed among these groups might be influenced, to some degree, by a synergy of factors such as cultural value placed on education, educational practices aimed at inclusivity, and economic motivations (Chan 2022; Loyalka et al. 2017). These communities appear to share a collective acknowledgment of education as a pivotal route to success, likely supported by educational systems that highlight the significance of science and mathematics from an early stage, potentially creating an environment that minimizes gender disparities in STEM. The choice to pursue STEM careers in these cultures could also be perceived as driven by expected economic gains and societal prestige, possibly resulting in a more gender-balanced representation within these fields. To further understand this, future research should examine the underlying cultural, educational, and socioeconomic mechanisms in greater detail. Investigating the role of family influence, peer networks, and mentorship within these communities could offer deeper insights into the minimal gender gaps observed. Such inquiries could provide valuable strategies for promoting gender equality in STEM fields.

While this study focused on disaggregating STEM education opportunities by gender and ethnicity, future research should investigate the specific experiences at home and school that contribute to these findings. For instance, examining how family culture and adherence to traditional gender roles influence the STEM pathway choices of Asian American female students could provide deeper insights. Family expectations and cultural norms might either bolster or impede female students’ pursuit of STEM fields. Furthermore, understanding the ramifications of the model minority myth, which often imposes unrealistic academic expectations on Asian American students, is imperative. This myth can engender considerable social pressures, detrimentally affecting students’ self-esteem and interest in STEM careers (Conchas 2006; Ngo and Lee 2007).

Additionally, the model minority myth can also be associated with the influence of teachers and the school environment, both of which play a crucial role in STEM education. In other words, it is imperative to examine how educators’ perceptions and biases towards Asian American female students influence their encouragement and support for pursuing STEM disciplines. For example, if teachers hold stereotypical views regarding these students’ capabilities, they may unwittingly offer less encouragement or support, potentially undermining students’ confidence and interest in STEM. Moreover, exploring the role of peer interactions and the school climate in shaping students’ STEM aspirations will illuminate the broader social dynamics at play. By addressing these areas, future research can provide a comprehensive understanding of the multifaceted factors influencing Asian American female students' participation in STEM education. This understanding is crucial for devising targeted interventions and policies aimed at reducing gender disparities in STEM among this demographic and ensuring equitable opportunities for all students.

Data availability statement

The data analyzed in this study is derived from the High School Longitudinal Study of 2009 and is accessible via a restricted-use data application through the National Center for Education Statistics in the United States.

References

Bonilla-Silva, Eduardo. 2006. *Racism without racists: Color-blind racism and the persistence of racial inequality in the United States,* 2nd edition. New York, NY: Rowman & Littlefield Publishers, Inc.

Bottia, Martha C., Elizabeth Stearns, Roslyn A. Mickelson, Stephanie Moller, and Ashley D. Parler. 2015. "The relationships among high school STEM learning experiences and students' intent to declare and declaration of a STEM major in college." *Teachers College Record* 117 (3): 1-46. doi:10.1177/016146811511700308.

Chan, R. C. (2022). "A social cognitive perspective on gender disparities in self-efficacy, interest, and aspirations in science, technology, engineering, and mathematics (STEM): the influence of cultural and gender norms." *International Journal of STEM Education* 9 (1): 1-13. https://doi.org/10.1186/s40594-022-00352-0

Chen, Grace A., and Jason Y. Buell. 2018. "Of models and myths: Asian (Americans) in STEM and the neoliberal racial project." *Race Ethnicity and Education* 21 (5): 607-625. doi:10.1080/13613324.2017.1377170.

Conchas, Gilberto Q. 2006. *The color of success: Race and high-achieving urban youth*. New York, NY: Teachers College Press.

Correll, Shelley J. 2001. “Gender and the career choice process: The role of biased self-assessments.” *American Journal of Sociology* 106 (6): 1691-1730. doi:10.1086/321299.
Correll, Shelley J. 2004. “Constraints into preferences: Gender, status, and emerging career aspirations.” *American Sociological Review* 69 (1): 93-113. doi:10.1177/000312240406900106.
Creusere, Marlena., Hengxia Zhao, Stephanie Bond Huie, and David R. Troutman. 2019. “Postsecondary education impact on intergenerational income mobility: Differences by completion status, gender, race/ethnicity, and type of major.” *The Journal of Higher Education* 90 (6): 915-939. doi:10.1080/00221546.2019.1565882.
Day, Jennifer C., and Anthony Martinez. 2021. *Does majoring in STEM lead to a STEM job after graduation?* Suitland, MD: U.S. Census Bureau. Retrieved from https://www.census.gov/library/stories/2021/06/does-majoring-in-stem-lead-to-stem-job-after-graduation.html
Deming, David J., and Kadeem Noray. 2020. “Earnings dynamics, changing job skills, and STEM careers.” *The Quarterly Journal of Economics* 135 (4): 1965-2005. doi:10.1093/qje/qjaa021.
Duprey, M.A., Pratt, D.J., Jewell, D.M., Cominole, M.B., Fritch, L.B., Ritchie, E.A., Rogers, J.E., Wescott, J.D., Wilson, D.H. (2018). *High School Longitudinal Study of 2009 (HSLS:09) Base-Year to Second Follow-Up Data File Documentation* (NCES 2018-140). National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education. Washington, DC. Retrieved from https://nces.ed.gov/pubsearch.
Eccles (Parsons), Jacquelynne., Terry F. Adler, Robert Futterman, Susan B. Goff, Caroline M. Kaczala, Judith L. Meece, and Carol Midgley. 1983. “Expectations, values and academic behaviors.” In *Perspective on achievement and achievement motivation*, edited by J. T. Spence, 75-146. New York, NY: W. H. Freeman.
Eccles, J., Allan Wigfield, Rena D. Harold, and Phyllis Blumenfeld. 1993. “Age and gender differences in children’s self- and task perceptions during elementary school.” *Child Development* 64 (3): 830-847. doi:10.1111/j.1467-8624.1993.tb02946.x.
Eccles, Jacquelynne. 1993. “School and family effects on the ontogeny of children’s interests, self-perceptions, and activity choice.” In *Nebraska symposium on motivation, 1992: Developmental perspectives on motivation,* edited by Janis E. Jacobs, 145-208. Lincoln, NE: University of Nebraska Press.
Espiritu, Yen L. 2005. “Gender, migration, and work. Filipina health care professionals to the United States.” *Revue européenne des migrations internationales* 21 (1): 55-75. doi:10.4000/remi.2343.
Fan, Weihua. 2011. “Social influences, school motivation and gender differences: An application of the expectancy-value theory.” *Educational Psychology* 31 (2): 157-175. doi:10.1080/01443410.2010.536525.
Ghaffar-Kucher, Ameena. 2012. “The religification of Pakistani-American youth.” *American Educational Research Journal* 49 (1): 30-52. doi:10.3102/0002831211414858.
Graham, John W., Allison E. Olchowski, and Tamika D. Gilreath. 2007. “How many imputations are really needed? Some practical clarifications of multiple imputation theory.” *Prevention science* 8: 206-213. doi: 10.1007/s11121-007-0070-9.
Guo, Jiesi, Philip D. Parker, Herbert W. Marsh, and Alexandre J. S. Morin. 2015. “Achievement, motivation, and educational choices: A longitudinal study of expectancy

and value using a multiplicative perspective." *Developmental Psychology* 51 (8): 1163-1176. doi:10.1037/a0039440.

Hoeffel, Elizabeth M., Sonya Rastogi, Myoung O. Kim, and Hasan Shahid. 2012. *The Asian Population: 2010* (C2010BR-11). Washington, D.C.: U.S. Census Bureau. Retrieved from https://www.census.gov/content/dam/Census/library/publications/2012/dec/c2010br-11.pdf

Hossfeld, Karen J. 1990. "'Their logic against them': Contradictions in sex, race, and class in Silicon Valley." In *Women workers and global restructuring,* edited by Kathryn Ward, 149-178. Ithaca, NY: Cornell University.

Hossfeld, Karen J. 1999. "Hiring immigrant women: Silicon Valley's 'simple formula'". In *Race and ethnic conflict: Contending views on prejudice, discrimination, and ethnoviolence* (2nd ed), edited by Fred L. Pincus and Howard J. Ehrlich, 162-179. New York, NY: Routledge.

Hu-Dehart, Evelyn. 2007. "Surviving globalization: Immigrant women workers in late capitalist America." In *Women's labor in the global economy: Speaking in multiple voices,* edited by Sharon Harley, 85-102. New Brunswick, NJ: Rutgers University Press.

Ingels, Steven J. and Ben Dalton. 2013. *High School Longitudinal Study of 2009 (HSLS:09) First Follow-up: A First Look at Fall 2009 Ninth-Graders in 2012* (NCES 2014-360). Washington, D.C.: U.S. Department of Education. Retrieved from https://nces.ed.gov/pubs2014/2014360.pdf

Jacobs, Janis E. 2005. "Twenty-five years of research on gender and ethnic differences in math and science career choices: what have we learned?." *New directions for child and adolescent development* 110: 85-94. doi:10.1002/cd.151.

Jang, Sung T. 2018. "The implications of intersectionality on Southeast Asian female students' educational outcomes in the United States: A critical quantitative intersectionality analysis." *American Educational Research Journal* 55 (6): 1268-1306. doi:10.3102/0002831218777225.

Kang, Chungseo, Hyunmyung Jo, Seong Won Han, and Lois Weis. 2023. "Complexifying Asian American student pathways to STEM majors: Differences by ethnic subgroups and college selectivity." *Journal of Diversity in Higher Education* 16 (2): 215-225. https://doi.org/10.1037/dhe0000326

Kanny, Mary Allison, Linda J. Sax, and Tiffani A. Riggers-Piehl. 2014. "Investigating forty years of stem research: How explanations for the gender gap have evolved over time." *Journal of Women and Minorities in Science and Engineering* 20 (2): 127-148. doi:10.1615/JWomenMinorScienEng.2014007246.

King, Rebecca C. 2000. "Racialization, recognition, and rights: Lumping and splitting multiracial Asian Americans in the 2000 census." *Journal of Asian American Studies* 3 (2): 191-217. doi:10.1353/jaas.2000.0017.

Lee, Minhye, Dajung Diane Shin, and Mimi Bong. 2020. "Boys are affected by their parents more than girls are: Parents' utility value socialization in science." *Journal of youth and adolescence* 49(1): 87-101. doi: 10.1007/s10964-019-01047-6.

Legewie, Joscha, and Thomas A. DiPrete. 2014. "The high school environment and the gender gap in science and engineering." *Sociology of Education* 87 (4): 259-280. doi:10.1177/0038040714547770.

Lowe, Lisa. 1991. "Heterogeneity, hybridity, multiplicity: Making Asian American differences." *Diaspora* 1 (1): 24-44. doi:10.3138/diaspora.1.1.24.

Loyalka, P. K., Maani, M., Qu, Y., and Sean Sylvia (2017). Absolute versus Comparative Advantage: Consequences for Gender Gaps in STEM and College Access. *Available at SSRN 2908533*.

Ma, Yingyi, and Yan Liu. 2017. "Entry and degree attainment in STEM: The intersection of gender and race/ethnicity." *Social Sciences* 6 (3): 89. doi:10.3390/socsci6030089.

Ma, Yingyi. 2011. "Gender differences in the paths leading to a STEM baccalaureate." *Social Science Quarterly* 92 (5): 1169-1190. doi:10.1111/j.1540-6237.2011.00813.x.

MacKinnon, David P., and James H. Dwyer. 1993. "Estimating mediated effects in prevention studies." *Evaluation review* 17 (2): 144-158. doi:10.1177/0193841X9301700202.

Min, Pyong G., and Sou Hyun Jang. 2015. "The concentration of Asian Americans in STEM and health-care occupations: An intergenerational comparison." *Ethnic and Racial Studies* 38 (6): 841-859. doi:10.1080/01419870.2014.941891.

Mukkamala, Shruti, and Karen L. Suyemoto. 2018. "Racialized sexism/sexualized racism: A multimethod study of intersectional experiences of discrimination for Asian American women." *Asian American journal of psychology* 9 (1): 32-46. doi:10.1037/aap0000104.

Museus, Samuel. D. 2014. *Asian American students in higher education*. New York, NY: Routledge.

Ngo, Bic, and Stacey J. Lee. 2007. "Complicating the image of model minority success: A review of Southeast Asian American education." *Review of Educational Research* 77 (4): 415-453. doi:10.3102/0034654307309918.

Omi, Michael, and Howard Winant. 2015. *Racial formation in the United States* (3rd ed.). New York, NY: Routledge.

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): 656-664. doi:10.3102/0013189X10391657.

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): 1048-1073. doi:10.3102/0002831211435229.

Sassler, Sharon, Katherine Michelmore, and Kristin Smith. 2017. "A tale of two majors: Explaining the gender gap in STEM employment among computer science and engineering degree holders." *Social Sciences* 6 (3): 69. doi:10.3390/socsci6030069.

Simpkins, Sandra D., Chara D. Price, and Krystal Garcia. 2015. "Parental support and high school students' motivation in biology, chemistry, and physics: Understanding differences among Latino and Caucasian boys and girls." *Journal of Research in Science Teaching* 52 (10): 1386-1407. doi:10.1002/tea.21246.

Snyder, Thomas D., Cristobal de Brey, and Sally A. Dillow. 2019. *Digest of education statistics 2017*. (NCES 2018-070). Washington, DC: National Center for Education Statistics. Retrieved from https://nces.ed.gov/pubs2018/2018070.pdf

Steele, Claude M. 1997. "A threat in the air: How stereotypes shape intellectual identity and performance." *American psychologist* 52 (6): 613-629. doi:10.1037/0003-066X.52.6.613.

Stout, Jane G., Victoria A. Grunberg, and Tiffany A. Ito. 2016. "Gender roles and stereotypes about science careers help explain women and men's science pursuits." *Sex Roles* 75: 490-499. doi:10.1007/s11199-016-0647-5.

Tao, Yu. 2018. "Earnings of academic scientists and engineers: Intersectionality of gender and race/ethnicity effects." *American Behavioral Scientist* 62 (5): 625–644. doi:10.1177/0002764218768870.

Teranishi, Robert T., Miguel Ceja, Anthony L. Antonio, Walter R. Allen, and Patricia McDonough. 2004. "The college-choice process for Asian Pacific Americans: Ethnicity and socio-economic class in context." *The Review of Higher Education* 27 (4): 527-551. doi:10.1353/rhe.2004.0025.

US President's Council of Advisors on Science and Technology. 2010. *Prepare and inspire: K-12 education in Science, Technology, Engineering, and Math (STEM) for America's future* (Executive report). Washington, D.C.: The President's Council of Advisors on Science and Technology. Retrieved from http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-stemed-report.pdf

Wang, Ming-Te, and Jessica Degol. 2013. "Motivational pathways to STEM career choices: Using expectancy–value perspective to understand individual and gender differences in STEM fields." *Developmental review* 33 (4): 304-340. doi:10.1016/j.dr.2013.08.001.

Wang, Ming-Te, Jessica Degol, and Feifei Ye. 2015. "Math achievement is important, but task values are critical, too: Examining the intellectual and motivational factors leading to gender disparities in STEM careers." *Frontiers in psychology* 6 (Feb): 1-9. doi:10.1037/a0027247.

Wang, Xueli. 2013. "Why students choose STEM majors: Motivation, high school learning, and postsecondary context of support." *American Educational Research Journal* 50 (5): 1081–1121. doi:10.3102/0002831213488622.

Webber, Douglas A. 2014. "The lifetime earnings premia of different majors: Correcting for selection based on cognitive, noncognitive, and unobserved factors." *Labour Economics* 28: 14-23. doi:10.1016/j.labeco.2014.03.009.

Wigfield, A., Jacquelynne S. Eccles, Kwang S. Yoon, Rena D. Harold, Amy J. A. Arbreton, Carol Freedman-Doan, and Phyllis C. Blumenfeld. 1997. "Change in children's competence beliefs and subjective task values across the elementary school years: A 3-year study." *Journal of Educational Psychology* 89 (3): 451-469. doi:10.1037/0022-0663.89.3.451.

Wigfield, Allan, and Jacquelynne S. Eccles. 2002. "The development of competence beliefs, expectancies for success, and achievement values from childhood through adolescence." In *Development of achievement motivation,* edited by Allen Wigfield and Jacquelynne S. Eccles, 91–120. Cambridge, MA: Academic Press.

Wu, Lilian, and Wei Jing. 2011. "Asian women in STEM careers: An invisible minority in a double bind." *Issues in Science and Technology* 28 (1): 82-87. Retrieved from http://www.jstor.org/stable/43315572.

Xie, Yu, and Kimberlee A. Shauman. 2003. *Women in science: Career processes and outcomes.* Cambridge, MA: Harvard University Press.