

Asian-American Women Engineering Faculty: A Literature Review Using an Intersectional Framework of Race, Class, and Gender

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Abstract — This literature review describes the current landscape for research around Asian-American female engineering faculty using an intersectionality framework of race, class, and gender. Analysis of the American Society for Engineering Education (ASEE) database on engineering programs is coupled with a systematic search for scholarly articles in several literature databases using a combination of the key terms "Asian," "Asian-American," "faculty," and "engineering." Findings reveal that while racial stereotypes like 'model minority' may apply to multiple Asian-American ethnicities, more research on issues pertaining to socioeconomic class and gender should be investigated within each ethnicity. Findings contribute to furthering the research on Asian-Americans in engineering, as well as provide important information to stakeholders to develop potential interventions to increase retention of Asian Americans in engineering faculty positions.

Keywords—Asian-American, engineering faculty, women of color; intersectionality

I. INTRODUCTION

A. Asian-Americans in Engineering: "Overrepresented" but Understudied

The proportion of Asian-Americans in engineering has been historically higher than other ethnic minority groups such as Native Americans, Latinos/as, and African-Americans. Therefore, their inclusion as a minority group in research studies has been questioned by some scholars due to their "overrepresentation" in science and engineering [1], [2] when compared to the general population proportions. According to the 2014 estimates of the U.S. Census Bureau, Asian-Americans comprised 6.2% of the total U.S. population [3].

	Prop. of U.S. Pop. in 2014	Prop. of Total Eng. Bachelor Degrees in 2014	Prop. of Total Eng. Masters Degrees in 2014	Prop. of Total Eng. Doctoral Degrees in 2014
Women	3.2%	3.6%	2.7%	3.2%
Men	3.0%	12.0%	7.0%	6.7%
Total	6.2%	15.6%	9.7%	9.9%

Table 1. A comparison of the population proportion of Asian-American men and women and the engineering degrees earned in the United States in 2014. Source: National Center for Science and Engineering Statistics and American Society for Engineering Education Database.

However, within engineering, Asian-Americans represented 15.6% of all engineering bachelor degrees, 9.7% of masters degrees, and 9.9% of doctoral degrees [4].

These numbers support the idea that Asian-Americans consist of a large demographic within engineering. However, the presence of Asian-Americans in engineering shows a significant disparity across genders. While Asian-American women consisted of a little more than half of the Asian-American population in 2014 (3.2% of the total U.S. population) [3], they obtained around 10% of the engineering degrees at all levels. As seen in Table 1, Asian-American women obtained only 3.6%, 2.7%, and 3.2% of engineering bachelors, masters, and doctoral degrees respectively, compared to the 12% of bachelors, 7% of masters, and 6.7% of doctoral engineering degrees for Asian-American men [4].

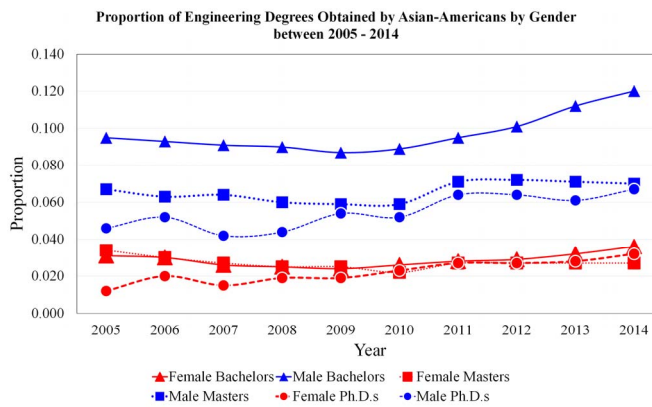


Figure 1. Proportion of Asian-American engineering degrees obtained by gender between 2005 – 2014. Source: American Society for Engineering Education database

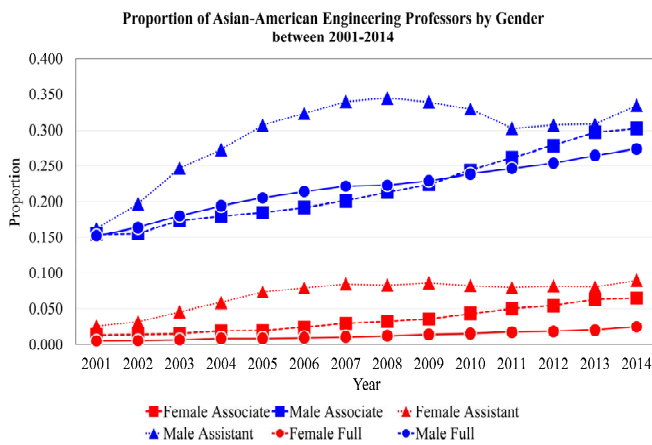


Figure 2. Proportion of Asian-American engineering professors by gender between 2001 – 2014. Source: American Society for Engineering Education database

Figure 1 illustrates the disparity in engineering degrees obtained between Asian-American men and women. While the proportion of Asian-American men obtaining engineering degrees has increased in the last decade, the proportion of Asian-American women obtaining engineering degrees at all levels has remained stagnant.

This disparity between Asian-American men and women persists into the professoriate, with Asian-American women consistently underrepresented at all levels. Figure 2 presents the proportion of total engineering faculty that are Asian-American. Across all levels of the professoriate there have been considerably smaller gains in the proportion of Asian-American female professors over the last thirteen years. Although a more complete description of these numbers would require tracking faculty trajectories from assistant to associate to full professor, to the best of our knowledge, data about these changes is non-existent. Because of this, total proportions are used as a closer estimate to begin to explore the underrepresentation of Asian-American women faculty. The total proportion data for Asian-American professors

shows that Asian-American women have yet to achieve professorship in accordance with their population.

Given the low representation of Asian-American women in the engineering professoriate, it is worthwhile to include Asian-American women as a minority group and investigate specific issues they may face that may potentially hinder their advancement through academia. Investigating this group would help identify strategies that could contribute to the advancement of diversity in engineering education [2].

Three additional issues with data and current literature provide additional motivation for research on Asian-Americans, and particularly Asian-American women, in engineering. First, as expanded upon in the next section, issues in defining “Asian-American” can lead to the inflation of the reported numbers of Asian-Americans. There is no distinction between natural born Asian-American and naturalized Asian-American immigrants in these figures, a difference which has different implications for the struggles and experiences of Asian-Americans as a whole.

Second, literature pertaining to Asian-Americans has frequently considered Asian-Americans as a monolithic group, aggregating a total 48 countries to which Asian-Americans can trace their ancestry. The vastly different cultural norms and expectations of each of these countries can affect individuals’ lived experiences. However, when the demographic aggregate statistics treat Asian-Americans as a single unit, they may hide or overlook the different experiences individuals may have due to specific cultural backgrounds.

Finally, because Asian-Americans have been considered an “overrepresented minority” in engineering, the majority of literature on faculty of color has focused on underrepresented African-American, Latinos, and Native American faculty. As a result, little is known about the issues Asian-Americans, and specifically Asian-American women, face as faculty members. Even less is known about the experiences of Asian-American women faculty in engineering disciplines. The objective of this literature review is to understand the status of research on understanding how issues of class, gender, and race affect the promotion and retention of Asian-American female engineering faculty.

B. Issues in Defining Asian-American

To recognize what the numbers of Asian-Americans represent, it is important to understand the definition used to define “Asian-American.” The U.S. government and American Society of Engineering Education use the following definition to collect and present data relevant to Asian-Americans [5, p. 1], [6]:

“**Asian.** A person having origins in any of the original peoples of Far East, Southeast Asia, or the Indian subcontinent including, for example, Cambodia, China, Indian, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam.”

This definition is separate from ‘Native Hawaiian or Other Pacific Islander,’ though some studies may combine the groups as ‘Asian Pacific Americans (APA).’

The definition of “Asian-American” is important to interpret the findings of previous research on Asian-Americans (i.e. does the literature pertain to immigrants, n-generation Asian-Americans, or both?). In the definition from ASEE and the U.S. government, “Asian” refers both to “Asian” and “Asian-American” with no indication of immigrant status. This is problematic for investigating issues of underrepresentation and marginalization: How recently Asian-Americans and their families immigrated directly relates to issues of class and the strength of cultural ties that may impact their career trajectories, as uncovered in the next sections.

Clarification in the definition of Asian-American reveals potential inflations in the interpretation of reported numbers. For example, in 2013, 57% of engineering doctoral degrees and 43% of engineering masters degrees were earned by international students [7]; the top three countries of origin for these students were China, India, and South Korea [8]. Should the definition of “Asian-American” be limited to n-generation U.S. citizens, the reported numbers of Asian-Americans earning engineering degrees and persisting through the engineering professoriate would significantly drop.

For the purposes of this paper, the term “Asian-American” is used to refer to people of Asian descent who reside or work in the United states; when relevant, immigrant status will be specified for literature specific to immigrants.

II. METHODS

A. Intersectionality

This literature review employed the lens of Intersectionality Theory, which is defined as “the critical insight that race, class, gender, sexuality, ethnicity, nation, ability, and age operate not as unitary, mutually exclusive entities, but as reciprocally constructing phenomena that in turn shape complex social inequalities.” [9, p. 2] Intersectionality was originally introduced by Crenshaw [10], and has been used in fields like sociology and intercultural studies to explore the identity and experiences of Asian-Americans in the labor market and education [11]–[13]. For coherency, literature in this paper is organized into the specific issues of race, class, and gender, with slight overlap amongst the groups.

B. Literature Search

Searches for literature were conducted in the ASEE PEER, ERIC, Compendex Index, Education Full Text, and Google Scholar databases with an initial combination of the terms “Asian,” “Asian-American,” “women,” “engineering,” “faculty,” and “professor.” Once specific issues were identified as common within literature, the terms “model minority” and “yellow peril” were added, along with the ethnicities of “Chinese,” “Indian,” “South Korean,” “Japanese,” “South Asian,” “Southeast Asian,” and “East Asian.” A total of 118 papers were recovered, from which 84 papers with specific reference to Asian-Americans (as

opposed to generic references to ‘underrepresented minorities’) were relevant to the literature review objective. Of these 78 papers, only one was specific to Asian-American female faculty in Canada, and was included due to Canada having a similar educational environment to the United States. From here, the final inclusion criteria expanded to include literature around Asian-American experiences as students in science, technology, engineering, and math (STEM) fields, and experiences as workers in STEM fields. Finally, relevant papers on Asian-American issues spanning the fields of education, health, sociology, and Asian-American studies were included.

This literature review was restricted by the prohibitively limited amount of research pertaining specifically to Asian-Americans and Asian-American faculty, and specifically Asian-American women faculty in the field of engineering. Through this paper, we aim to expand the discourse on the role of Asian-Americans in the engineering professoriate using Intersectionality Theory to critique the related body of literature, ultimately informing future areas for research.

III. THEMES FROM LITERATURE

A. *Issues of Class: Understanding How Asian-American Women Enter the Professoriate*

Models like the status attainment model describe the role family socioeconomic status (SES) plays in educational attainment; while it successfully predicts outcomes for many groups, it fails in predicting the educational outcomes of the children of Asian immigrants, who achieve higher levels of education than predicted [14]. When considered as a homogenous group, the high educational attainment of Asian-Americans contributes to the stereotype of Asian-Americans as a commonly successful minority group [15]. However, a deeper disaggregation of the experiences of different Asian ethnic groups reveals that the success of a few groups masks the struggles of many others.

Social class contributes to the differences in educational attainment achieved across Asian-American groups. As might be expected, Asian ethnicities that experience high rates of poverty experience lower rates of educational attainment [16]. Terenishi and colleagues’ survey [15] of approximately 18,000 Chinese-American, Filipino-American, Japanese-American, Korean-American, Southeast Asian-American, and Other Asian-American college freshmen to understand how their socioeconomic background influenced their choice of college. Southeast Asians and Filipinos indicated they had more major financial concerns about college than Chinese, Japanese, and Korean Americans. Additionally, Asian-American groups with lower socioeconomic status were less likely to attend more selective colleges – Filipinos, Japanese, and Southeast Asian students were almost twice as likely to apply to only one institution than Korean and Chinese Americans. This may be due to financial costs of submitting costly applications to colleges. While not always the case, a prestigious academic lineage can provide the reputation, preparation, and experiences required to obtain undergraduate research experiences, earn graduate funding, and enter prestigious graduate schools, thereby affecting potential career avenues for Asian-American faculty.

Socioeconomic class not only affects how different Asian-American groups select colleges, but also how they persist through college. Paulsen and St. John [17] used a financial nexus model to investigate how income disparities relate to persistence of undergraduates, and found that poor Asian-Americans were less likely than other-race students to persist. This pattern is particularly characteristic for Southeast Asians [16], [17] and especially for newer immigrants [17], [18].

Financial burdens for Asian-Americans potentially continue even after securing a job in the professoriate. Like their Latino/a counterparts, Asian-Americans culturally place high importance on lifelong familial duty and obligations [19-21]. As a result, many Asian-Americans financially support family members, even students on meager graduate student salaries. These factors and the ways in which ethnic groups experience economic class privileges differently suggests that immigrant status and ethnic group should be taken into account when trying to understand socioeconomic barriers that Asian-Americans may face. For faculty in engineering, these issues may manifest in different ways, as the profession of engineering and obtainment of engineering degrees carries various social class status in different countries' cultural values systems, which may impact persistence through academia despite the specific challenges faced by faculty of various Asian-American ethnic groups.

B. Issues of Race

Racial issues in education in the United States are typically viewed through a "Black-and-White" lens, or "Latino-and-White" lens in the United States [22-24]. As a result, less attention has been given to Asian-Americans' experience of racism [25]. This section first focuses on two major Asian-American stereotypes that emerged through the reviewed literature: the "yellow peril" and "model minority" stereotypes. Although these stereotypes seem to contradict each other by painting Asian-Americans as either a scary, exotic threat or an acquiescent, successful group that other minority groups should aspire to, both stereotypes continue to perpetuate the attribute of foreignness to Asian-Americans [26]. Also relevant to the discussion of raced expectations for Asian-Americans are culturally-appropriate styles seen as appropriate for Asian-American leaders.

1). The Yellow Peril Stereotype

The "yellow peril" stereotype predates the "model minority" stereotype with origins tracing as far back as the medieval fear of Mongolian invasion of Europe [22, 27]. Yellow peril describes the fear of Asian races threatening the domination of the White race culturally, economically, politically, and militarily [22]. In the United States, yellow peril was most prominent in the early 20th century, when U.S. laws excluded Asian immigrants during the colonization of Pacific Islands and the Philippines. Heightened anxiety during WWII led to the internment of Japanese-Americans, and fear of communism led to Chinese Americans being targeted as primary suspects of treason and espionage [22].

Today, yellow peril is manifested in the threat of increased competition from Asians and Asian-Americans for jobs and education; this is propagated through political discourses

against outsourcing and the hiring of Asian immigrants, and using Asian-Americans as a "mascot" for dismantling affirmative action [24, 28]. Even at the grade-school level, Asian-Americans are publically attacked for being competitive and aggressive: In 2005, a Wall Street Journal article titled "The New White Flight" described how White Americans are fleeing schools with high Asian-American populations, citing aggressive academic competition from Asian-Americans as the driving factor [29].

2. The Model Minority Stereotype

In contrast, the model minority stereotype idealizes Asian-Americans as an ethnic minority that achieves success and quietly overcomes discrimination and hardship through hard work, despite their racial background [22, 30, 31]. While this stereotype is perceived as a positive attribute for Asian-Americans, in reality it is a double-edged sword. While the model minority stereotype can sometimes serve as a self-fulfilling prophecy by enhancing Asian-American academic performance [32, 33], the stress of high expectations can negatively affect Asian-American students.

The model minority image of Asian-Americans is a shared reality – "knowledge that is assumed to be known and shared by others," independent of facts [30, p. 20]. Trytten et. al [34] found that Asian-American engineering students experienced facets of the model minority stereotype, though they didn't identify the stereotype explicitly. In the study, 159 Asian-American participants across 227 interviews described the following facets of Asian-American stereotypes: that they are (1) extremely intelligent, especially in math and science, (2) hardworking, (3) seeking educational prestige (4) seeking economic attainment, and (5) are uncomplaining [34]. In order to compensate for pressure and negative effects of these stereotypes, some participants denied the experience and their feelings, justifying their actions within these facets, which indicates that in fact, the participants still conformed to the model minority stereotype [35].

Model minority pressures affect both high- and low-achieving Asian-American students. The pressure to perform due to racial expectations can have detrimental effects in classes; Cheryan and Bodenhausen [36] found emphasizing the model minority stereotype prior to performance on math exams led to a diminished ability of students to concentrate, which produced lower math performance. Students can experience anxiety in living up to such expectations, and those who don't achieve academically can feel depressed and embarrassed. This embarrassment can subsequently prevent Asian Americans from seeking necessary academic assistance [37, 38]. Trytten et al. [34] suggest that current generations of Asian-American students are leaving engineering more frequently than earlier generations. One reason may be due to increased anxiety due to cultural expectations.

3. Asian-American Leadership

Engineering faculty are expected to be leaders both within their engineering field and on their campus [39]. However, Asian-American leadership styles are influenced by their cultural background and cultural values [40] and may be perceived differently within U.S. standards of leadership. While U.S. leadership style is based on assertiveness and

decisiveness, Asian-American values like humility, promotion of harmony, deference to authority, and placing group needs over individual needs are valued and seen as qualities of strong leaders [40]. As a result, Asian-Americans are less likely to demonstrate lower levels of assertiveness and higher levels of collective success than White Americans [41, 42].

C. Issues of Gender

In addition to issues of class and race, Asian-American women face an additional dimension of gender that impacts their persistence in the engineering academe. This section describes issues specific to Asian-American women that may impeded their progression in the professoriate.

1.) Cultural Expectations of Asian-American Women

Asian-American women face differences in gender attitudes in what they perceive their role to be (maintaining culture, performing household chores, and given less freedom than men) vs. that of White American women (having more equality, power, and independence) [43]. Different ethnic groups within the “Asian” definition have different expectations for women and their roles. For example, South Asian women in the United States, even those that are U.S.-born, face tremendous pressure to adhere to traditional gender roles, family obligations, and cultural values [44]. To attain goals, they selectively adapt to U.S. sociocultural norms and balance with strictly ingrained cultural values.

Asian-American women may also often feel pressure to portray characteristics of Asian femininity [43]. Specifically, Asian-American women experience the “Lotus Blossom Baby” stereotype, in which Asian-American women are sexualized, demure, and submissive as “property” for white males [45]. Attempts to combat this perception by portraying masculine traits may backfire, with Asian-American women then being perceived as cold “dragon ladies [45]”

In order to handle such stereotypes, Asian-American women must implement biculturalism – balancing and navigating between the different cultures that guide their perceptions and mindsets [46]. Their ability to maintain relations within the two groups – their Asian culture and dominant American culture – is known as bicultural efficacy [47]. Exploring the role of bicultural efficacy among Asian-American women would help understanding the factors motivating or deterring this group to join the engineering professoriate.

2.) Asian-American Women in STEM

Special attention must be given to Asian-American women in science and engineering disciplines. Mohr and Purdue-Vaughn’s [48] conducted interviews with minority women in STEM workplaces and found concerns fell into three categories: 1) pressure to prove competency greater than that which was required of male peers, 2) perceiving the need to align masculine or feminine attributes with gender expectations and 3) dealing with stereotypes about the priorities of working mothers. These concerns were also found in the experiences of Asian-Canadian female faculty, who

specifically struggled with (1) appearance and behavior and (2) authority and competency [49].

Although no literature was found regarding issues specific to Asian-American female engineering faculty, experiences of Asian-Canadian female faculty can be translated to a U.S. context due to similarities in academic culture. Negative experiences Asian-Canadian female faculty have encountered relate to perceived foreignness in two main ways: (1) appearance and behavior and (2) authority and competency. First, Asian-Canadian female faculty have directly experienced the effects of yellow peril from white students who have perceived them as foreigners, and the effects of the model minority stereotype when students express displeasure if they are “opinionated” or “critical” [49]. This directly feeds into perceptions of being less authoritative than their peers if they do act in stereotypical submissive manners. Second, if Asian female faculty speak with an accent, students perceive them to be less competent than their peers [50]. If a faculty member additionally looks younger than she may be, students may ‘infantilize’ the instructor and diminish her authority.

Literature around minority women faculty in engineering has frequently mentioned the success of mentoring in creating a community to navigate academic pathways that may not have previously been easily accessible due to issues of race and gender [51]; however, no literature focuses on the role of mentors specific to Asian-American female faculty in engineering. Are specific ethnicities within the Asian diaspora more likely to seek out mentors similar to them, or volunteer as mentors? Outside of academia, Monica Adya [52] found South Asian women in the IT field had a preference for male mentors and viewed the benefits of mentoring to be assistance in career advancement and integrating into the culture. Adya suggested this preference for male mentors may stem from either a lack of South Asian women mentors and/or might be a reflection of the patriarchal nature of South Asian societies. Similar research on the relationship between male and female engineering faculty mentors and Asian-American female engineering faculty may provide insights into the mentorship behaviors that Asian-American female faculty view as beneficial.

IV. CRITIQUE OF THE LITERATURE THROUGH INTERSECTIONALITY THEORY

Intersectionality Theory can motivate a variety of issues that have yet to be studied within the context of Asian-American female faculty in engineering. While the literature provided in this paper has alluded to the race, class, and gender issues Asian-American women may face as they traverse the engineering academe, few of the works disaggregated the ethnic groups to better understand the experiences of Asian-American women. This disaggregation is essential, as each group has its own cultural expectations for women, which may affect how working faculty members carry pressure from outside expectations or sources. For example, certain groups, specifically Indian-American women, have not been studied in terms of dealing with family pressure to marry, have children, and quit a career. Similar

cultural pressures in other ethnicities can be comparatively explored to gain a richer understanding of external, and potentially internal, pressures Asian-American female engineering faculty may face.

The overlapping experiences from Asian-American women of a variety of ethnicities, a variety of immigrant statuses, and socioeconomic statuses should be considered in an engineering context to further understand potential barriers and issues in the development of skills necessary for faculty. For example, little is known about Asian-American leadership skill development in academia at the student level and faculty level. Do different Asian-American ethnicities attain engineering faculty leadership roles at different proportions? How do the “yellow peril” and “model minority” stereotypes continue to evolve in this context when considering gender (e.g., are we less wary of women leaders, since we discount the impact women can have in engineering and leadership?)?

Additionally, comparative studies between Asian-American faculty and African-American faculty may reveal potential interventions for the recruitment and retention of women Asian-American engineering faculty. This research would be helpful in identifying and affirming existing methods, which could then be built upon to increase the recruitment and retention of Asian-American female faculty in engineering.

V. CONCLUSION AND FUTURE WORK

This paper described issues of class, race, and gender that may impact Asian-American women as they progress through the engineering professoriate. Socioeconomic class plays a role in how they select and persist through college; however, this varies across the different ethnic subgroups. With additional cultural considerations for family obligations, finances for Asian-American women may be additionally used for supporting family. Additional research should be done to understand the role socioeconomic status plays for specific Asian ethnicities throughout the engineering academic pipeline, and to what extent financially supporting family impacts socioeconomic status for each ethnicity.

The yellow peril and model minority stereotypes were identified as cultural stereotypes that can negatively impact how Asian-Americans are perceived, and cultural influences on leadership styles explained how Asian-American female engineering faculty may be disadvantaged as faculty leaders. Research on how model minority stereotypes affects engineering students should be extended into the graduate and faculty careers of Asian-American engineering students. Furthermore, examining individual leadership styles of engineering faculty by ethnicity may reveal nuances in how each is perceived as leaders.

Finally, Asian-American women were found to face stricter cultural expectations for gender roles that may conflict with how they manage impressions at work. Additional research should be done within engineering to understand if similar conflicts exist for female Asian-American engineering faculty.

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