

Work in Progress - Engineering Students' Disciplinary Choices: Do Race and Gender Matter?

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Abstract - We explore which engineering disciplines are most effective at attracting undergraduates from various race and gender groups at matriculation and graduation. Women and men choose different disciplines within engineering at matriculation, Industrial Engineering is notable for attracting women and men, and the largest disciplines, Electrical and Mechanical, have the largest enrollment gender gap.

Index Terms - Persistence, Retention, Women in Engineering, Engineering Disciplines

OUR STUDY

There have been numerous calls to diversify the engineering profession [1, 2]. In this work in progress, we explore which engineering disciplines are most effective at attracting students from various race and gender groups. Our study addresses the following research questions:

1. How do students of various race/gender groups differ in their choices of engineering major at matriculation?
2. How do students of various race/gender groups differ in their engineering major at graduation?

METHODS

Using the Multiple-Institution Database for Investigating Engineering Longitudinal Development [3, 4], we compare major selection and migration of engineering students by gender and race. The dataset has more than 79,000 students matriculating in engineering at nine southeastern institutions that awarded 1/12 of all U.S. engineering bachelor's degrees from 1987 to 2004. The results should be generalizable to large public institutions. Race is self-reported. We focus on first-time-in-college U.S. citizens or permanent residents matriculating directly in engineering disciplines. We study whole population data, so inference is unnecessary—all reported differences are true. Figure 1 shows the number of females and males at matriculation (Sem 1) and six-year graduation (Sem 12).

INITIAL FINDINGS

Women and men do not choose the same engineering disciplines at matriculation. The top two choices of men of all races are Mechanical (ME) and Electrical (EE) (although

the order varies by race). For women, ME and EE are the second and third choices while Chemical (ChE) is first. Materials (Matl) is much more popular for women, and Computer Engineering (CPE) is notably unpopular for women. There are racial differences in disciplinary choice that will be pursued as this work continues, but the gender differences are more notable, and are the focus of the presentation in Figure 1.

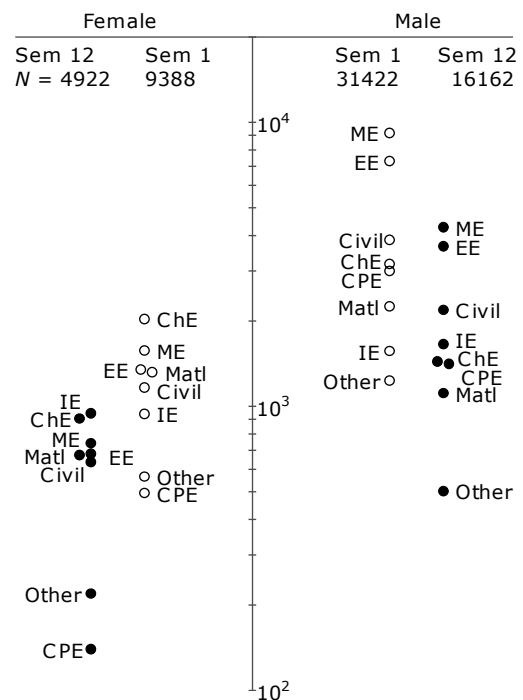


FIGURE 1

NUMBERS OF STUDENTS (\log_{10} SCALE) IN ENGINEERING MAJORS AT SEMESTERS 1 (OPEN CIRCLE) AND 12 (FILLED CIRCLE) ALL RACES, BY SEX.

Industrial engineering is the only discipline that changes rank from Semester 1 to Semester 12. The order of disciplinary preference (and actual enrollment ratio) for females and males changes little from Semester 1 to 12. The preference for Chemical and the similarity of female enrollment in Materials and Electrical at matriculation is repeated at Semester 12. A closer inspection reveals that it is only the rank of Industrial that changes. All other majors hold their rank positions, but Industrial engineering improves its rank by three positions for females and males.

The gender gap in enrollment is particularly notable in a few disciplines and is nearly independent of race. Mechanical, Electrical, and Computer have large gender gaps, with female enrollment an order of magnitude smaller than male enrollment, as shown in Figure 2. Only Blacks have a smaller gender gap, as shown by the proximity of the female and male enrollment at Semesters 1 and 12. This finding agrees with recent reports that show that the smaller engineering disciplines including Materials, Chemical and Industrial engineering attract more women than the larger ones: ME, EE, and Computer [5]. This finding suggests the need for more research on the specific characteristics of these majors that are attractive to women.

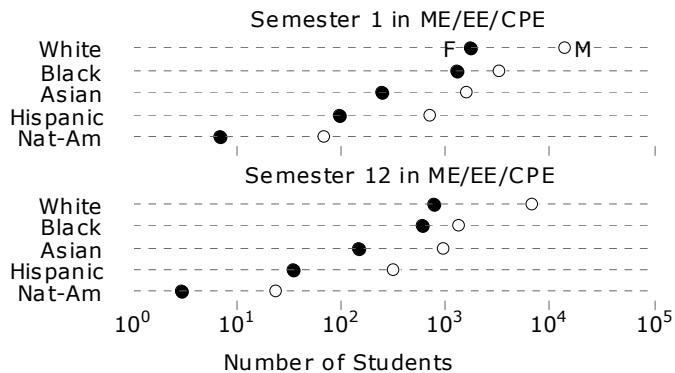


FIGURE 2
THREE MAJORS IN WHICH GENDER MAKES A DIFFERENCE FOR ALL RACES.
MALES (OPEN CIRCLE) AND FEMALES (FILLED CIRCLE).

Industrial Engineering attracts females and males. Noting the uniqueness of Industrial in our earlier finding, we present further data for Industrial in Figure 3. Industrial is also set apart from other engineering disciplines in that it gains students from Semester 1 to 12—replacing students lost through attrition in nearly all races. Industrial actually has more Asian females and males at Semester 12 than at Semester 1. This trend recalls the positive outcomes observed at the University of Oklahoma [6], suggesting a cultural difference of Industrial Engineering.

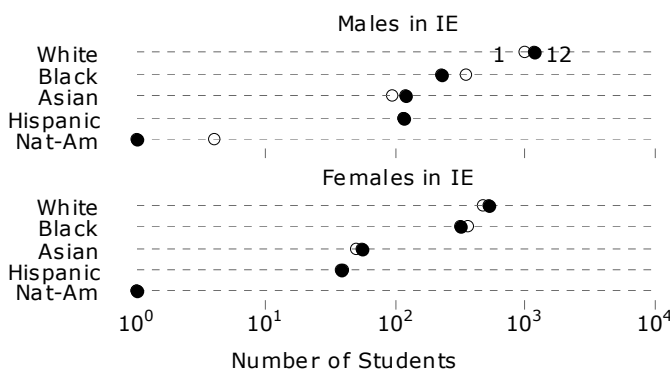


FIGURE 3
SUCCESS IN INDUSTRIAL ENGINEERING FOR ALL RACES, MALE AND FEMALE. SEMESTER 1 (OPEN CIRCLE) AND SEMESTER 12 (FILLED CIRCLE).

FUTURE DIRECTIONS

There is much more to explore in the dynamics of race and gender in major selection and progress. Our future research will look at differences at various points in the educational journey to better understand the migration patterns of engineering students. This ongoing work will provide a framework for other researchers and be useful in identifying strategies for increasing the diversity of the profession.

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