# Targeted Recruitment of Biomedical Engineering Graduate Students: The Influence of Recruitment Event Changes

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# Graduate Students: The Influence of Recruitment Event Changes

## Abstract

This paper presents progress on an ongoing study of the effectiveness of the University of Texas at Austin's Biomedical Engineering graduate program's annual post-admission recruitment event in recruiting students of diverse backgrounds, including students of low SES, URMs, and those from Top 20 undergraduate engineering programs. Applicant, admit, visitor, and enrollee data was collected from 2009-2015. Recruitment event improvements have been made annually since 2012 to better cater to the student populations of interest. The initial results will inform future improvements and initiatives to meet our goal of recruiting the above mentioned target student populations.

## Introduction

For decades, the United States has pushed to stay at the forefront of advancements in science, technology, engineering and mathematics (STEM) on a global scale. Biomedical engineering (BME) is an interdisciplinary field aimed at improving healthcare outcomes. Crucial to the achievement of this goal is the education of a new generation of biomedical engineers who will serve as leaders in research, education, medicine, and industry. In order to prepare this new generation of leaders, graduate programs at research-intensive universities must be able to attract and retain the best students in the field.

The context for the current study is the University of Texas at Austin (UT Austin) BME doctoral program. The BME department is home to 85 PhD students, 1 MS student, 21 tenure and tenure-track faculty, and approximately 462 undergraduate students. At this time, the graduate program is predominantly a PhD program.

The program relies mainly on faculty research funds to employ graduate students. Recruiting graduate students to partner with faculty on research is an essential part of developing new leaders in the field and maintaining a high quality BME PhD program. Excellent students not only assist with current faculty projects, but are also producers of their own innovative research, which they carry with them into their careers post-graduation. To this end, the department seeks to recruit a diverse group of students from leading undergraduate engineering institutions each admission cycle.

Historically, the UT Austin BME PhD program has not enrolled as many students as desired from certain student populations. While the program has been successful enrolling a significant percentage of women, who currently comprise 45% of the graduate program, enrollment of students from underrepresented minority (URM) groups in engineering, as well as students from low socioeconomic (SES) backgrounds, remains low. Additionally, the program aims to increase the number of students who graduate from U.S. News & World Report (USNWR) Top 20 undergraduate engineering programs, a list published by USNWR on a yearly basis. To address these deficits, three areas of focus for the program's recruitment efforts have been identified: (1) students from top-ranked undergraduate engineering institutions, (2) students from

underrepresented racial and ethnic groups in engineering (URM students), and (3) students from low SES backgrounds.

In an effort to attract these students, the program engages in pre- and post-admission efforts. The specific focus of this report is on the annual post-admission graduate student recruitment event. Admitted students are invited to the event in spring to meet with faculty and current students, learn about research labs, and explore Austin. Each year the event is improved to address feedback from faculty, staff, current students, and the visiting recruits.

What follows is an initial analysis of the influence of changes to the event made between 2012 and 2015 on the yield of enrollees, with a focus on students from top-ranked undergraduate engineering programs, URMs, and those from low SES backgrounds. Descriptive analysis of data from applications received from 2009 to 2015 is included for context. It is the hope of the authors that similar graduate programs will find the trends identified in this report useful in their own recruitment efforts.

**Brief Review of the Literature**

*Predictors of Graduate Student Quality*

Matriculating top-quality graduate students is an imperative among research-intensive universities, though the predictors of graduate student "quality" can be difficult to quantify. Most universities examine a variety of student factors—such as test scores, undergraduate academic performance, research experience, and personal attributes—to make admissions decisions. No single factor can predict which students will become the best researchers, innovators, and scholars.[1] An attempt to judge based on any given metric would be impractical and reductive. Rather, the observable data available that is known to correlate with student success is examined with an attention to its limitations.[*]

Among common correlates with graduate student success such as GRE scores and GPA, the quality of a student's undergraduate degree program is also an admission consideration. Undergraduate institution reputations are quantified by annual Top 20 undergraduate engineering program rankings by USNWR. Despite the widespread use of USNWR rankings by students and higher education administrators worldwide, scholars and administrators have long debated their validity.[2,3] Undoubtedly, many excellent students graduate from unranked schools, while lower-achieving students may graduate from highly ranked schools. The inherent limitations of a reputation system notwithstanding, USNWR rankings, like GRE scores and GPA, generally correlate positively with graduate school attendance and success in the research.[4] Thus, a degree from USNRW Top 20 ranked program remains an insufficient yet valuable characteristic of incoming graduate students worth consideration.

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[*] The metrics described in this review are for recruitment process evaluation only, and have been adapted for the purposes of this paper. The scores and conversions should not be considered as a reflection on the admission processes or policies of the UT Austin BME department or the graduate school. The program's domestic and international admission committees make final admission decisions on all applications and do not determine admittance based solely upon GRE scores and GAGPA. International admission committees make final admission decisions on all applications and also do not determine admittance based solely upon GRE scores and GAGPA.

Though BME programs nationwide are typically successful at recruiting high numbers of women relative to other engineering programs, enrollment rates of students from URM or low-SES populations in BME remain low.[5] Access to rigorous secondary and postsecondary education in mathematics and science, lab curriculum and equipment, superior instruction, and relevant work experiences are just a few examples of competitive advantages for STEM graduate program applicants that are often less available to URM or low SES students.[6] These advantages continue to be related to socioeconomic and racial or ethnic status tied to the nation's history of pervasive social, economic, and educational inequalities.[7]

Recruiting students from diverse backgrounds presents a complex set of challenges. According to American Society for Engineering Education (ASEE) statistics, in 2014, URM students made up only 15% of all students earning bachelor's degrees in engineering.[8] Furthermore, low SES and URM students are less likely to complete the upper level math and science coursework necessary for most STEM undergraduate majors.[9] Many students who identify as URM are also from low SES backgrounds, which can put these students at a compound disadvantage.[10] These complex academic disadvantages result in a smaller pool of qualified graduate student applicants from low SES and URM backgrounds.[11] Due to these challenges, selecting from top ranked undergraduate engineering programs can narrow the pool even further.[12] Recruiting top candidates from diverse racial/ethnic and socioeconomic backgrounds is therefore an evident challenge for engineering doctoral programs.

**Methods**

Multiple approaches were used to evaluate the UT Austin BME department's annual post-admission graduate recruitment event. The event and strategic changes from spring 2012 through the present are described. Results include: a descriptive quantitative analysis of the program's domestic applicants, admits, visitors, and enrollees based on attributes of applicants selected from 2009 to 2015 admission applications; and quantitative and qualitative observations of the program's domestic applicants, admits, visitors, and enrollees based on post-admission recruitment event attendance from 2011 to 2015. The observations and descriptive analysis give special attention to student groups of interest including URMs, low SES, and Top 20 students. Finally, practical strategies and plans for future improvements are discussed.

Application data from domestic applicants (N=802), admits (N= 230), visitors (N=207), and enrollees (N=111) in the doctoral program from 2009 to 2015 were analyzed. International students were not included in the analysis for two reasons. First, only a small number of international students (i.e., those who reside domestically) attend the recruitment event. Second, domestic applications provide contextual data regarding race and ethnicity relevant to the scope of this paper, while race and ethnicity data are not collected in international applications.

Currently, the program has seven years of applicant data and four years of recruitment event data. Despite the limited data set available, important trends are emerging in both the quantity and quality of students recruited. The department will continue to collect data in future years

with the goal of ongoing evaluation of the effectiveness of recruitment efforts, and identifying areas for continual improvement.

*Measures*

Data collected between 2009 and 2015 measures both the quantity of students with certain characteristics. "Top 20," "URM," and "low SES" are dichotomous categorical variables that describe student qualities aligned with specific recruitment goals of the UT Austin BME graduate program. These variables were created for the purposes of the present analysis exclusively. It is important to note that race, ethnicity, socioeconomic, and educational background are nuanced qualities that are difficult to capture in an application checkbox. The limitations of these variables should be considered when interpreting the results.

*Quantity of Students*

Each November, the faculty members are sent a survey to report how many new graduate students they intend to recruit to their lab in the next admission cycle. Based on these numbers, the program directors determine how many students to admit in order to recruit the desired number of enrollees. Federal grant funding cycles can make predicting student capacity one year in advance a challenge. Thus, the number of admitted students fluctuates moderately each year.

Numbers of students from Top 20 undergraduate engineering programs, low SES backgrounds, and URM groups were assessed based on application information provided by the students. Top 20 undergraduate engineering programs are identified by USNWR each year and published online. Students indicate their undergraduate university, which is coded as Top 20 or Non-Top 20.

Students also have the option to indicate demographic information on the initial application, including their parents' highest education level and the student's race and ethnicity. This information is gathered and coded for low SES and URM status. For the purposes of this paper, low SES students are identified as students who report having one or more parents without a college degree. URM students are defined as those that report their race or ethnicity as one or more of the following: American Indian, Black, Hispanic, and/or Native Hawaiian/Pacific Islander.

Recruitment event attendance is captured by recording those present during the event. This information is coded into the database with the corresponding student ID, their admission status, academic background, and demographic information.

**Procedures**

*Admittance Procedures and Invitation to Post-Admission Graduate Program Recruitment Event*

Each year in January, the program office sends admission offer letters that include an invitation to attend the program recruitment event in March. Based on visitor responses to the invitation by

email, the program makes travel arrangements and schedules faculty meetings according to students' preferences.

Admitted PhD students are guaranteed a minimum stipend (the rate effective fall 2015 was $24,500) plus tuition and insurance coverage, paid through either academic employment as a Graduate Research Assistant (GRA) or Teaching Assistant (TA), or fellowships. All admitted students are nominated for stipend and supplemental fellowships from the Cockrell School of Engineering and the UT Graduate School. The committee that awards fellowships meets throughout the spring semester to review nominees and decide awards. Once these decisions are reported to the program, the Graduate Coordinator communicates the complete funding package to the admitted students. Not all visitors are given their funding packages prior to the annual recruitment event. The number of fellowships offered and the timeliness of fellowship committee decisions varies by year. This is an important factor to keep in mind when considering student enrollment decisions.

*Summary of Changes to the Post-Admission Graduate Program Recruitment Event*

The department focuses a significant portion of its recruitment efforts on a post-admission graduate program recruitment event that takes place in the spring of each year. In the scope of this analysis, from 2009 to 2011 the structure and activities of this event remained largely unchanged. The typical number of visitors attending the event was steadily between 20 and 25 from 2009 to 2011.

The week of the event, an itinerary is sent out to all visitors by email. On Wednesday, visitors arrive on campus and attend an evening welcome dinner with the graduate program faculty advisor. Thursday starts early and consists of continuous activities, including faculty presentations, lab tours, and a graduate student poster session. Thursday evening the program transports visitors by bus to a restaurant outside of the city with a few faculty members. The visitors return to their hotel after dinner. On Friday, one-on-one meetings and core research facility tours are arranged for students by the program according to their research interests. From 2009 to 2011, this included a handful of current graduate students for some tours, but was mostly handled by a few program staff alone. Visitors depart on Friday or Saturday, depending on their requested travel schedule; there is no final event on Friday. Table 1 offers a summary of the changes that began in the spring of 2012 through the spring of 2015.

*Spring 2012 Recruitment Event Changes*

*Table 1. Recruitment Event Changes by Year*

| Spring 2012 | Spring 2013 | Spring 2014 | Spring 2015 | Spring 2016 |
|---|---|---|---|---|
| + gift bags<br><br>+ improved Thursday dinner location<br><br>+ increased graduate student involvement<br><br>+ more personalized scheduling and support | + improved visitor information packets<br><br>+ increased stipend fellowships | + further improved visitor information packets<br><br>+ better organized schedules<br><br>+ graduate student committee directing volunteers<br><br>+ increased # of visitors | + increased # of students on graduate student committee<br><br>+ increased # of visitors<br><br>+ all visitors leave Friday instead of being given option to stay until Saturday | + conference style format<br><br>+ increased stipend fellowships<br><br>+ increased # of students on graduate student committee<br><br>+ relocation of Wednesday dinner off campus<br><br>+ faculty lunch on Friday |

**Results**

*Applicants, Admits, Visitors, and Enrollees*

Between 2009 and 2015, 802 domestic students applied to the program, 230 were admitted, 207 visited the campus for the recruitment event, and 130 enrolled. "Visitors" indicates admitted students who visited campus by attending the recruitment event. Applications without complete information were coded as missing data and excluded from analyses.

*Figure 1.  Domestic Applicants, Admits, Visitors and Enrollees*
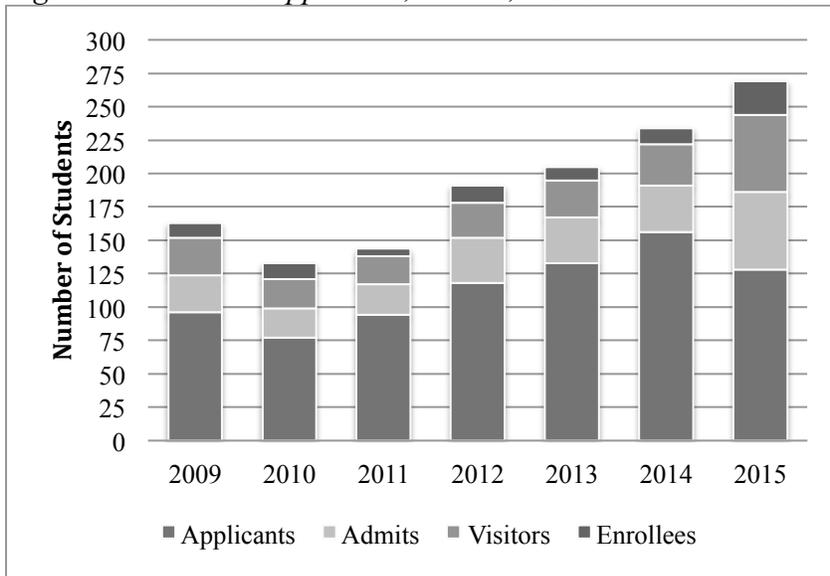


Figures 2 and 3 show the number of low SES and URM applicants, admits, visitors, and enrollees, respectively. Between 2009 and 2015, 197 students identified as low SES applied to the program, 43 were admitted, 38 attended the recruitment event, and 18 enrolled. In the same time period, 108 URM students applied to the program, 21 were admitted, 20 attended the recruitment event, and 9 enrolled. The number of both low SES and URM students admitted and enrolled in the program has been on the rise from 2009 until 2013. Figure 2 shows a significant decline in low SES applicants from 2014 to 2015, when total the number of applicants also declined.

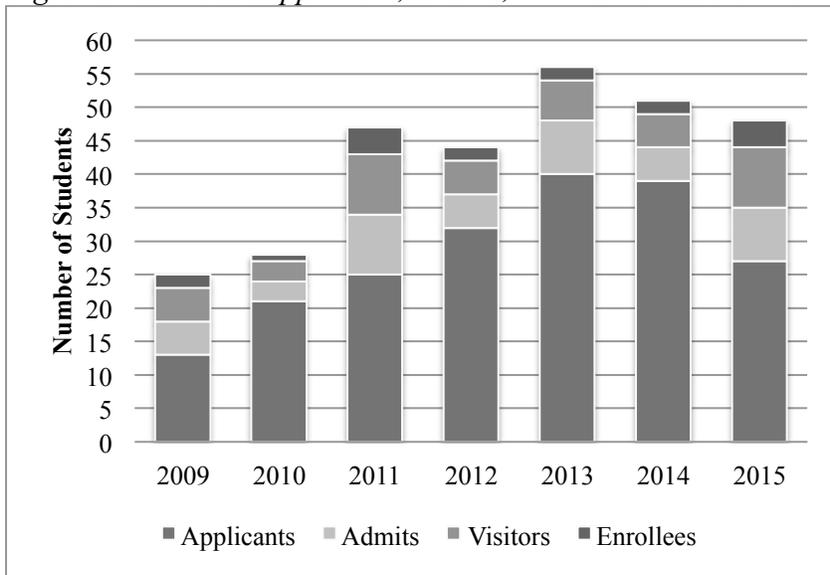*Figure 2.  Low SES Applicants, Admits, Visitors and Enrollees*

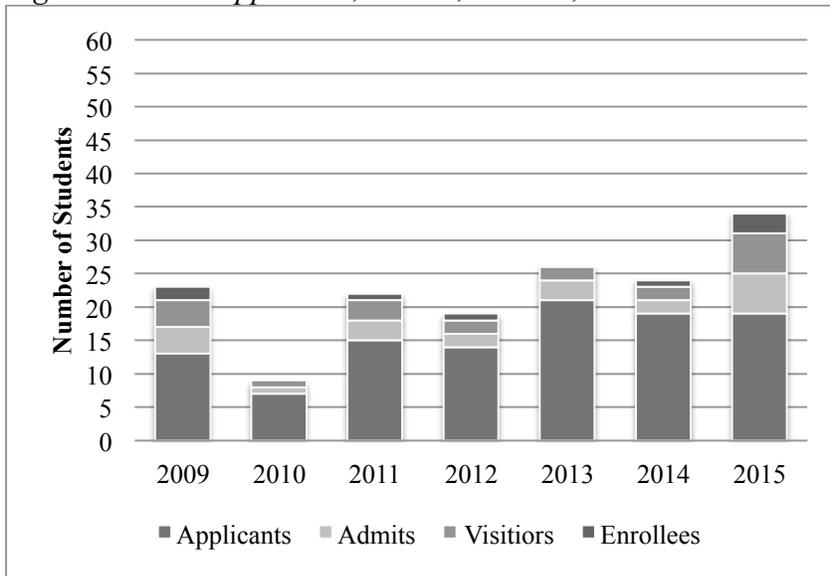*Figure 3. URM Applicants, Admits, Visitors, and Enrollees*



Figure 4 shows the number of applicants, admits, visitors, and enrollees from USNWR Top 20 undergraduate engineering programs since 2009. Between 2009 and 2015, 282 students from USNWR Top 20 programs applied to the program, 111 were admitted, 95 visited campus, and 33 enrolled. From 2010 through 2014 the number of applicants from Top 20 programs increased. A decrease in overall applicants may account for the decrease in Top 20 program applicants in 2015, when the total number of applicants also decreased.

*Figure 4. USNWR Top 20 Applicants, Admits, Visitors, and Enrollees*
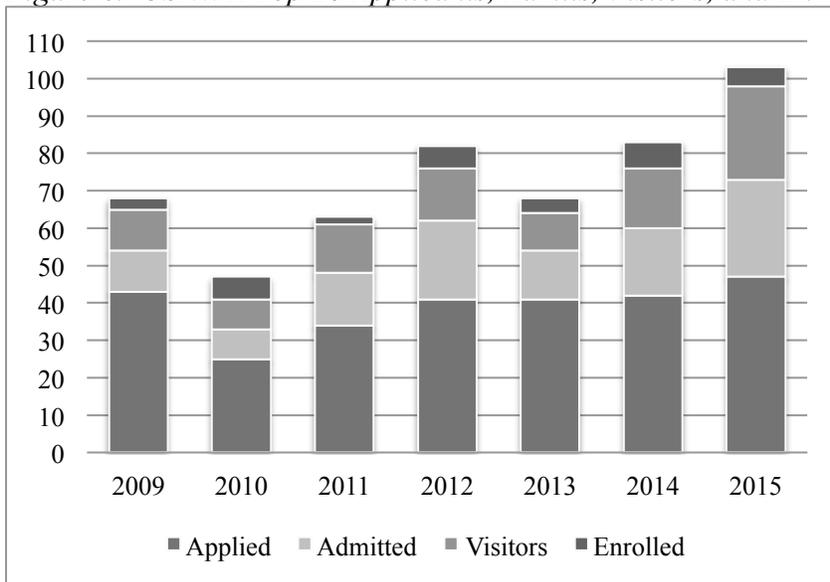
*Intersectionalities*

Of the students who applied to the program, 35 identified as both URM and low SES. Nine of those students were admitted to the program, and five enrolled. Table 2 shows the cross section of these populations.

*Table 2. Applicants who identify as both URM and Low SES*

| Applicants (N) | Not low SES | Low SES | Totals |
|---|---|---|---|
| Not URM | 561 | 161 | 722 |
| URM | 45 | 35 | 80 |
| Total | 606 | 196 | 802 |

A chi-square test of independence identified a significant relationship between URM and low SES status among applicants ($\chi^2$(1, N=802) =17.946, p< .000). This reflects the relationship seen in the general population.

Because of the institutionalized disadvantages URM and low SES students face in accessing higher education, it is not surprising that there are fewer of these students who attend USNWR Top 20 undergraduate engineering programs and apply to the BME graduate program. Tables 3 and 4 show students from URM and low SES groups who attended USNWR Top 20 programs.

*Table 3. URM Applicants from USNWR Top 20 Undergraduate Institutions*

| Applicants (N) | Not URM | URM | Totals |
|---|---|---|---|
| Not Top 20 | 456 | 64 | 520 |
| Top 20 | 266 | 16 | 282 |
| Total | 722 | 80 | 802 |

*Table 4. Low SES Applicants from USNWR Top 20 Undergraduate Institutions*

| Applicants (N) | Not low SES | Low SES | Totals |
|---|---|---|---|
| Not Top 20 | 380 | 140 | 520 |
| Top 20 | 226 | 56 | 282 |
| Total | 606 | 196 | 802 |

A chi-square test of independence revealed a significant relationship between student applicants who endorse either URM or low SES status and graduated from a USNWR Top 20

undergraduate engineering program (URM status $\chi^2$(1, N=802) = 8.961, p < .05; low SES status $\chi^2$(1, N=802) = 4.942, p < .05). A significantly smaller proportion of the URM and low SES students who apply to the program attend Top 20 programs compared with students who endorse neither status.

*Post-Admission Graduate Program Recruitment Event Attendance*

The focus of this ongoing study is the impact of the post-admission graduate program recruitment event. Multiple factors outside of the program's control influence student enrollment decisions. The recruitment event is the program's opportunity to leave a lasting impression on visitors by creating a welcoming environment that fosters a sense of belongingness among the students.

Figure 5 shows recruitment event attendance and percent of admitted applicants who attended the event and the percent of those who attended and enrolled. The event is well attended, reaching over 96% attendance in 2015. Matriculation has remained below 50% since 2015. The expected rate of offer declines are factored into admission decisions each year, so the enrollment rates are not problematic. Rather, the quality of students who ultimately enroll in the program is the more salient consideration. Attendance numbers were analyzed to examine whether the recruitment event influenced admits with desirable student attributes to enroll.

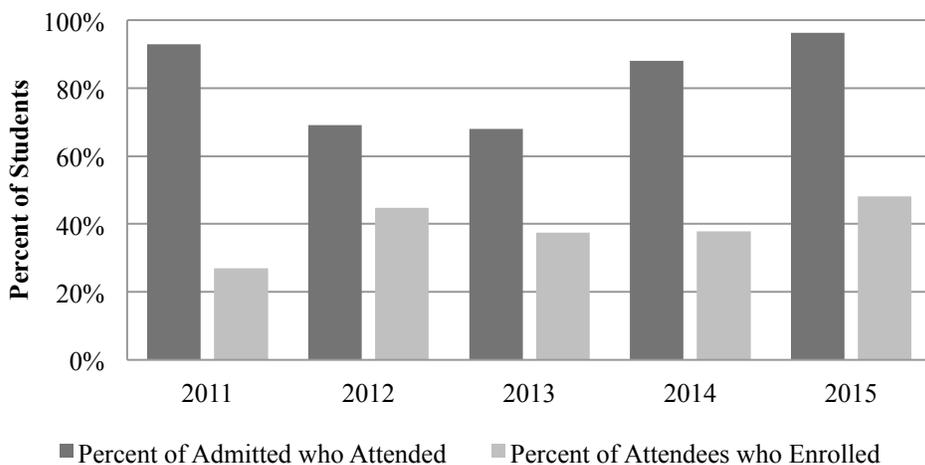*Figure 5.  Recruitment Event Attendance*



Table 5 shows event attendance and enrollment numbers pre- and post- event changes. A chi square test of independence was used to examine the relationship between event attendance and enrollment. For all admitted students between 2009 and 2015, there was a significant relationship between event attendance and enrollment ($\chi^2$(1, N=230) = 4.890, p < .05). Students who attended the event enrolled at a higher rate than those who did not.

*Table 5. Overall Recruitment Event Attendance vs. Enrollment*

| Admitted Students (N) | Pre-Event Changes (2009-2011) | | Post-Event Changes (2012-2015) | | Total |
|---|---|---|---|---|---|
| | Did not attend | Attended | Did not Attend | Attended | |
| Did not enroll | 2 | 42 | 17 | 80 | 141 |
| Enrolled | 0 | 29 | 4 | 56 | 89 |
| Total | 2 | 71 | 21 | 136 | 230 |

The data set was divided into two groups to examine the relationship between attendance and enrollment pre- and post- event changes. Post-event changes (2012 - 2015), the relationship between event attendance approached significance ($\chi^2(1, N=157) = 1.355$, $p = .052$). Considering the two findings together, there is reason to believe students who attend the event will enroll at a higher rate.

Unfortunately, there is not sufficient data prior to the event changes to make significant comparisons at this time. Furthermore, insufficient numbers of applicant groups of interest make analysis of subsamples pre- and post-recruitment event changes impossible. Though a year-by-year analysis would be most informative, in order demonstrate at least initial evidence of the program's progress, a broad analysis of enrollment is necessary. Thus, the following analysis of applicant subgroups examines overall admitted student data from 2009 to 2015.

*Recruitment Event Attendance of USNWR Top 20 Undergraduate Engineering Program Admits*

It is likely that admits who attended high ranking undergraduate engineering programs have more competing offers, which may influence their decision making process considerably. Thus USNWR Top 20 and Non-Top 20 undergraduate engineering program admits were separated into groups for analysis. Tables 6 and 7 summarize total numbers of Top 20 admits who did and did not attend the recruitment event. Two separate Chi-Square tests of independence were performed to examine the relationship between recruitment event attendance and enrollment in the program for admits who attended USNWR Top 20 undergraduate engineering programs and those who did not, respectively.

For overall admits who attended USNWR Top 20 undergraduate engineering programs, the relationship between attending the event and enrolling in the program was not significant ($\chi^2(1, N=109) = .596$, $p > .05$). Conversely, for admits who did *not* attend a USNWR Top 20 undergraduate engineering program, there was a positive relationship between event attendance and enrollment in the program ($\chi^2(1, N=121) = 4.838$, $p < .05$). Admits who do not attend USNWR Top 20 undergraduate engineering programs and attend the recruitment event are more likely to enroll in the program.

*Table 6. USNWR Top 20 Admits and Recruitment Event Attendance*

| Top 20 (N) | Did not attend | Attended | Total |
|---|---|---|---|
| Did not enroll | 11 | 65 | 76 |
| Enrolled | 3 | 30 | 33 |
| Total | 14 | 95 | 109 |

*Table 7. Non-USNWR Top 20 Admits and Recruitment Event Attendance*

| Non-Top 20 (N) | Did not attend | Attended | Total |
|---|---|---|---|
| Did not enroll | 8 | 57 | 65 |
| Enrolled | 1 | 55 | 56 |
| Total | 9 | 102 | 111 |

*Recruitment Event Attendance of URM Admits*

The majority of URM admits attend the event, though many do not enroll. A Chi-Square test of independence was performed to examine the relation between source and event attendance and program enrollment for URM group admits. The relation between these variables was not significant ($\chi^2$(1, N=21) = .79, p >.05). Table 8 shows total URMs who did or did not attend the event.

*Table 8. URM Admits and Recruitment Event Attendance*

| URM Admits (N) | Did not attend | Attended | Total |
|---|---|---|---|
| Did not enroll | 1 | 11 | 12 |
| Enrolled | 0 | 9 | 9 |
| Total | 1 | 20 | 21 |

Since 2009, six URM student applicants have also attended Top 20 undergraduate engineering programs. Each of these students attended the event, but none enrolled in the program.

*Recruitment Event Attendance of Low SES Admits*

Most low SES admits attend the event, but less than half enroll. A Chi-Square test of independence was performed to examine the relation between event attendance and program enrollment for low SES admits. The relation between these variables was not significant ($\chi^2$(1, N=43) = 1.11, p >.05). Table 9 summarizes low SES students who did and did not attend the event.

*Table 9. Low SES Admits and Recruitment Event Attendance*

| Low SES Admits (N) | Did not attend | Attended | Total |
|---|---|---|---|
| Did not enroll | 4 | 21 | 25 |
| Enrolled | 1 | 17 | 18 |
| Total | 5 | 38 | 43 |

Event attendance among low SES students who attended Top 20 undergraduate engineering programs was also examined. A significant relationship was not found between event attendance and enrollment for this group ($\chi^2$(1, N=21) = .175, p >.05). Furthermore, the two students identified as both low SES and URM who attended the event did not enroll. Table 10 shows low SES Top 20 admits who did and did not attend the event.

*Table 10. Low SES and Top 20 Admits and Recruitment Event Attendance*

| Low SES and Top 20 Admits (N) | Did not attend | Attended | Total |
|---|---|---|---|
| Did not enroll | 2 | 14 | 16 |
| Enrolled | 1 | 4 | 5 |
| Total | 3 | 18 | 21 |

*Recruitment Event Attendee Feedback Surveys*

In 2015 the program began to send follow-up surveys to students who attended the recruitment event to solicit feedback on the program's efforts. A total of 19 out of 44 attendees responded to the survey, 12 who declined the admission offer and seven who accepted. Respondents were asked to rate the various activities in which they participated throughout the recruitment event on a four-point Likert scale from "Terrible" (1) to "Great" (4). The overall average rating of the event was a 3.45. Mean scores of activities relevant to event changes focused on faculty interaction are included in Table 11.

*Table 11. Student Ratings of Recruitment Event Activities*

| Activity | Mean Rating Score | Total Responses |
|---|---|---|
| Faculty Presentations | 3.42 | 19 |
| Laboratory Tours | 3.47 | 19 |
| Poster Session | 3.47 | 19 |
| Faculty Meetings | 3.44 | 18 |

Respondents were also asked to provide suggestions for improvement of the event activities. Feedback suggested categorized faculty presentations, more activities outside the building, and better attention to time constraints on visitors. Some representative comments include:

> *"Although some students would like a breadth of background on research, most if not all have a major field (imaging, cellular engineering) that they would like to work in; so different, separate groups for each field would allow each presenter to have more time to discuss their work and more time for students to ask questions."*

> *"Another recruitment weekend had more activities in the city and campus, while I felt that we were in the BME building most of the time. They relied more on social events with faculty/students than faculty presentations for us to get acquainted with everybody. This weekend was also longer, which makes a difference."*

> *"I had a great experience with the faculty meetings, but did not have time to explore all the labs I wanted to; a more flexible schedule would be a great benefit for future students."*

Students who accepted were asked to respond to the question, "What most impacted your decision to attend UT Austin?" Respondents generally reported positive interactions with current students and faculty. Some representative comments include:

> *"I felt the most comfortable at the UT Austin recruitment event with the faculty and current students."*

> *"The UT Austin BME facilities, faculty interviews and the attitude of the current grad students. Overall, the BME dept's 'culture.'"*

> *"The entire BME department made me feel really welcome and made UT Austin seem like a great place to get my graduate degree."*

Students who declined were asked to respond to the question, "What most impacted your decision not to attend UT Austin?" Respondents generally reported matching better with the faculty and research of another institution. Some representative comments include:

> *"I loved my time at UT Austin, and it was a difficult decision to ultimately choose another institution. I appreciated all the energy and effort the faculty and students put into the recruitment weekend. Ultimately, I decided on [other university] because of the relationship I developed with my future mentor during my interviews and during follow up. Also, the financial aid package was higher - although this was not the most important factor."*

> *"UT Austin was one of my top choices and my major reason was the fact that my potential advisor could not guarantee he was even hiring next year. I had 2 top choice advisors and it would be great to do rotations with both of them, but the uncertainty pushed me towards another school that I already had a good match in."*

> *"The research fit and the number of professors working in my area of interest."*

*Recruitment Event Summary*

Over the past four years, the UT Austin BME graduate student recruitment event has been well attended and positively related to enrollment for students who attend undergraduate institutions not ranked in the USNWR Top 20 undergraduate engineering programs. However, event attendance does not necessarily influence target student groups of interest to enroll, that is, students who identify as URM, low SES, and students who attended a USNWR Top 20 undergraduate engineering programs.

Based on survey feedback, most students who attend the event have a positive experience. Strengths include the community of current graduate students, faculty research presentations, and recruitment event social activities. The most common reason for offer declines was lack of 'fit' with faculty research.

**Limitations**

A major limitation of this study is the narrow subset of data available. The program only has seven years of applicant data, and only four years of documented changes to the program's recruitment event. Comparisons could not be made between pre- and post event changes, so the success of the event cannot be inferred. Instead, the data provides a contextual overview of the applicant, admit, visitor, and enrollee populations and recruitment challenges the program faces.

Furthermore, even with a substantial amount of data, the methods of this study do not imply causality. There are many reasons students choose to attend or not attend a given program, or why they may choose to attend a recruitment event or not. There are innumerable confounders that are unable to be measured. The number and quality of offers a student has from other institutions, research interests, faculty referrals, family considerations, and location are just a few examples. Many students may attend the event with their enrollment decisions already made. Likewise, students may not attend the event and still choose to enroll in the program. Because of these limitations, the results should be interpreted with caution.

This report is not intended to reflect a causal research study. Rather, it provides a detailed case example of efforts made to improve student recruiting among multifaceted variables, and seeks to offer insight on the impact of the graduate student recruitment event. The results presented provide a context for reflection on the program's challenges in recruiting high-quality graduate students from diverse backgrounds.

**Discussion**

Analysis of the UT Austin BME graduate program's domestic applicants, admits, visitors, and enrollees from 2009 to 2015 and recorded recruitment event improvements from 2012 to 2015 revealed valuable insights that will drive the program's recruitment efforts in the future. Post-admission graduate recruitment event attendance is positively associated with enrollment overall and for admits who do not attend USNWR Top 20 undergraduate engineering programs. However, this analysis does not provide sufficient evidence to suggest that attendance was related to enrollment for URM, low SES, or USNWR Top 20 students.

The finding that students from USNWR Top 20 undergraduate engineering programs enroll at a lower rate than their counterparts corresponds with anecdotal evidence. Admits from higher ranking institutions may receive many invitations to interview with graduate programs, and tend to have more offers to choose from. Admits from lower ranking institutions are more likely to attend the event with less offers, and thus more carefully consider enrolling in the program. A number of uncontrollable variables—such as locale preference, family proximity, faculty referrals, etc.— limit ways to test for these factors.

UT Austin BME faces a major deficit in regards to enrolling students from low SES and URM backgrounds. The number of applicants from both groups is low, with low SES students representing about 25% of the domestic applicant pool and URM students representing just 10%. These numbers are consistent with a persistent national-level disparity in educational achievement of students from historically underrepresented populations in STEM.[13] However, enrollment issues within the program cannot fully be attributed to lack of diversity in the STEM pipeline, since qualified students from URM and low SES backgrounds frequently declined the program's enrollment offers. Targeted efforts must be implemented to understand the decision-making process of admitted students from these groups.

Though feedback from the recruitment event does not contain identifying information about undergraduate institution or racial, ethnic or socioeconomic background, a relatively high response rate of 43% in 2015 suggests survey responses serve as a rough estimate of the student experience. Overall, the most common themes that emerged regarding student decision-making were related to 'fit' with their research interests. This finding corresponds with decades of research on the importance of feelings of congruence or belongingness for students entering engineering and other fields, especially among students from underrepresented groups.[14] The presence of students and faculty from underrepresented backgrounds is crucial to recruiting similar students, but presents a paradoxical challenge. Increased representation from minority groups will foster a sense of fit and belongingness among student visitors from those groups. The program must make enhanced efforts to consider the needs of underrepresented populations in order to reach a critical mass for fostering diversity within the student body.

**Future Plans**

These findings will serve as a foundation for an ongoing evaluation of UT Austin BME graduate program recruitment efforts, and the impetus for several initiatives that will be put in place for the program's next recruitment cycle. These initiatives include:

(1) Spring 2016 recruitment event changes
(2) Outreach to URM and low SES populations
(3) Creation of a Sustainable system of data collection and maintenance

*(1) Proposed Spring 2016 Event Changes*

*New Conference Style Format*
The most significant change for the 2016 event is the implementation of a new conference style format. Instead of one full day of faculty presentations on Thursday, there will be six faculty presentation sessions by research topic. Three sessions will occur on Thursday and three on Friday. The purpose of the sessions is to break up the presentations into two days and allow faculty to better showcase aspects of their current research projects within the various session topics. To this end, faculty can choose to present at more than one session.

*More Opportunity to Interact with Faculty*
In response to feedback indicating the need for more faculty interaction, there will be additional opportunity for informal interaction with faculty during the 2016 event. The sessions and the new informal lunch with faculty aim to facilitate this interaction and foster opportunities to find the right 'fit.' Additionally, every effort will be made to keep faculty meetings at the 1:1 ratio. The recruitment RSVP survey previously allowed visitors to report up to 10 faculty members with whom they desired to meet. In spring 2016, the survey allows up to five. The purpose of limiting the selection is to encourage visitors to more closely investigate the faculty with whom they may be seriously interested in working. Visitors may request additional faculty meetings after hearing the research presentations of faculty members during sessions at the event.

*Informal Wednesday Welcome Dinner*
In the interest of easing the recruits into the event, the welcome dinner will remain an informal opportunity for visitors to meet the Department Chair, Graduate Advisor, Graduate Coordinator, and current graduate students. In response to feedback requesting to have more activities outside of the BME building, instead of hosting the dinner in the department's building as has been the case in the past, the dinner will take place within walking distance of campus at a popular local restaurant featuring regional cuisine. The goal is to give the visitors an opportunity to socialize on their first day at a relaxed dinner before launching into the more formal activities of the next two days of the event. Social events help foster a sense of fit or belongingness with the students of the program.

*Collection of Meaningful Feedback*
Post-event feedback surveys sent separately to attendees who enroll and attendees who decline will be evaluated and improved to better solicit meaningful feedback on the event.

*(2) Outreach to URM and Low SES Populations*

This analysis revealed a shortage of URM and low SES applicants. In an effort to increase the program's URM and low SES applicant pool, the program will enact the following recruitment efforts.

*Targeted Graduate Coordinator Conference Attendance*
Historically, pre-admissions recruitment efforts have focused on the Annual Biomedical Engineering Society (BMES) Conference. In the future, the program will minimize its presence at BMES to allow it to expand its pre-admissions recruitment efforts at other conferences that

may attract URM and low SES students. These events include but are not limited to: the Annual Society for Women Engineer's (SWE) Conference, the Annual National Society of Black Engineers (NSBE) Conference, and the Annual Society of Hispanic Professional Engineers (SHPE) Conference.

*Targeted Email Outreach to URM and Low SES Students*
Each year the program receives a list of McNair Scholars from the Graduate School and identifies students with relevant degree program backgrounds to target with an informational email. The McNair Scholars Program targets students from underrepresented populations such as low SES and URM students. In the future, the program will seek to obtain additional lists of scholars to reach such as those participating in the Meyerhoff Scholars Program, which seeks to increase the representation of minorities in science and engineering. These efforts will be tracked to evaluate the effectiveness of the email outreach campaigns on producing more McNair and Meyerhoff Scholars applicants, and thus more low SES and URM applicants.

*Targeted Email Outreach to Faculty*
In the past, the program has sent out an email to the previous year's reference letter-writers to request that they share information about the program with their current students who are interested in graduate school. In the future, this effort will be expanded beyond letter-writers to target faculty at universities that have a larger representation of URM and low SES students, such as The University of Maryland Baltimore County, Xavier University, and Howard University.

*(3) Creation of a Sustainable System of Data Collection and Maintenance*

Prior to 2008, the department did not have a sustainable system of data collection and maintenance in place for the program's recruitment efforts. In 2011, the program added changes to data collection efforts, including tracking recruitment event attendance. One weakness of this review is the limited data set. With only seven years of substantive applicant, admit, and enrollee data and only four years of recorded recruitment event improvements, analysis is limited. Thus, these findings are considered a foundation for an ongoing evaluation of and continuous improvement to the UT Austin BME graduate recruitment efforts.

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