# Measuring Underrepresented Student Perceptions of Inclusion within Engineering Departments and Universities\*

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Despite efforts made by the engineering community, the struggle to increase racial and ethnic diversity continues. As women and ethnic minorities make up a larger percentage of the United States labor force, academic departments need to support the development of students from these talent pools. To improve the retention of these students, engineering departments need to be inclusive, allowing students to feel welcomed, valued, respected, and supported. The overall purpose of this study was to develop and pilot a survey instrument, grounded in Tinto's Model of Institutional Departure, to provide engineering educators and administrators with a tool that can be used to investigate how underrepresented engineering students rate the level of inclusion within engineering departments, paying close attention to gender and race/ ethnicity. Herein we specifically report on the instrument development and the initial findings through data collected from two public, predominately White research institutions with high undergraduate engineering student enrollment. Our results demonstrate that the Engineering Department Inclusion Level (EDIL) survey can yield valid and reliable scores with the population of interest. Before embarking on further data collection to continue developing the survey, we wanted to determine what value the survey might have. Results indicate no differences between men and women from underrepresented populations but that African-Americans rated the same environments less inclusive than other racial/ ethnic groups across all of the scales. Finally, PhD students scored University Pride lower than participants at other academic levels. Moreover, based on initial data results, we suggest further research on feelings of inclusion as an important aspect to creating a diverse environment.

Keywords: retention; diversity; engineering departments; inclusion level

# 1. Introduction

# 1.1 Problem statement

Despite the United States passing of the Civil Rights Act of 1964 and the Higher Education Act of 1965, many universities have continued to struggle to increase racial and ethnic student population diversity across higher education fields [1–4]. Even with intentional efforts to close the diversity gap, White males typically still demographically dominate science, technology, engineering, & mathematics (STEM) disciplines in particular, even though women and ethnic minorities make up a large percentage of today's United States labor force [5]. As women and ethnic minorities continue to account for a larger percentage of the population, an increasing number of United States engineering students will need to come from these talent pools; this is one of the reasons the engineering community needs to make a conscious effort to increase student diversity [6]. A more learner-centered argument for increasing student diversity is that diverse educational settings are more effective for all students (based on self-reported learning gains) than less diverse ones [1, 7]. Finally, diversity also benefits engineering as a whole because engineering designs

need to reflect the cultures of the different customers; without diversity, some needs may be inadequately represented in design solutions [8]. For all of these reasons, diversity is important and it is necessary to continue seeking ways to promote diversity in STEM fields.

To facilitate promoting diversity, our research focuses on feelings of inclusion within engineering departments and at the university in general. By inclusion we mean feeling welcomed, respected, valued, and supported [9] within a department or university climate. A particular problem with being underrepresented in a given community is that it can lead to feeling unwelcome. Research has demonstrated this for women and ethnic minorities in the engineering community. For example, a study surveying 100 female STEM students across the United States concluded that female students often feel isolated in the engineering culture due to the lack of female role models, caring faculty members, and support from their peers; this resulted in a negative view of the department in which they were enrolled [10]. Similarly, a study of African-American women found negative perceptions of gender and race barriers in science classrooms [11]. More specifically, another study describes in great detail, through an ethnographic examination, how one female ethnic-minority student felt as if she did not belong in the engineering culture [12]. In particular, she thought that her advisor did not believe she should be an engineer, and she noted that she did not have any friends and was afraid to get involved in extracurricular activities. If engineering departments aim to increase diversity, we must eliminate experiences like these and make engineering more inviting to underrepresented students in particular. Since workable solutions to eliminate such experiences and fully support underrepresented students are not widespread, lack of diversity remains an important issue that simply must be addressed [6, 13–16].

It is common belief that a lack of diversity is primarily a recruitment issue. However, simply enrolling more students from underrepresented groups and thereby creating demographic diversity is not a panacea for closing the diversity gap in engineering. In addition to demographic diversity, the cultural environment, or campus climate, must be inclusive, allowing students from various backgrounds to feel welcome and comfortable such that they want to stay enrolled. As described in our literature review, there are minimal, if any, survey instruments that measure feelings of inclusion in engineering at the department level and feelings of inclusion at the university level. Our research fills this void by providing researchers and educators alike with a survey tool that can be used to measure feelings of inclusion among underrepresented students in engineering. In this manuscript, we describe the development of the Engineering Department Inclusion Level (EDIL) survey instrument by answering the following research questions:

- 1. What aspects of department and college inclusion should be included in the Engineering Department Inclusion Level (EDIL) survey?
- 2. What are the validity and reliability of the scores for the instrument?

By analyzing data from the initial implementation, we also provide evidence for the utility of the EDIL survey in addressing such research questions as:

- 1. How do underrepresented students rate the level of inclusion in engineering departments?
- 2. How do gender, race/ethnicity, and academic level impact the way students view the level of inclusion?

Answering these questions paves a pathway for the discovery of strategies that more broadly promote inclusiveness in engineering. Our survey instrument is grounded in Tinto's Model of Institutional Departure [17] as this model offers a way to examine campus climate by highlighting factors that prior

research has demonstrated to be particularly important to underrepresented students.

#### 1.2 Framework and situation in the literature

According to Tinto's Model of Institutional Departure [17], the ability to integrate into an institution academically and socially—has a profound effect on a student's decision to remain enrolled in or to withdraw from a university. Each student's institutional experience entails a combination of formal and informal interactions, activities, and performances. Integration is impacted by these experiences and those unable to integrate are more likely to withdraw. Campus climate in Tinto's model [17] may be particularly salient to underrepresented students, who may find it difficult to integrate into the dominant culture. Therefore we focused on campus climate in developing our instrument.

When a university creates an inclusive campus climate, each student can feel comfortable and it will be easier for diverse students to integrate academically and socially. When inclusion is achieved, (1) students feel as if they belong at the institution, (2) are respected by the institution, (3) are valued by the institution, (4) and have the support and commitment necessary to do their best work [9]. The impact of students having a positive perception of campus climate is seen in measures of retention, graduation rates, GPA, and time to degree [18]. For example, African-American undergraduate engineering students tend to have a more positive view of their college experience when attending a Historically Black College or University: these students also tended to have higher GPAs [19]. Conversely, campus climate has been identified as a contributing factor to why African-Americans are sometimes unsuccessful at predominately White institutions [20]. Specifically in engineering, lower perceptions of racism and discrimination have resulted in greater institutional commitment and higher graduation rates [19]. Campus climate has also been found to have a significant effect on retention with regards to first-year students, becoming less important as they matriculate [21].

These examples demonstrate the importance of campus climate to multiple groupings of students. However, not unexpectedly, different groups can view the same campus climate differently [22]. For example, if White students have a positive experience, African-American students may have a negative perception of racial, academic, and general campus climate [23], resulting in completely different experiences in the same environment. These possible differences in perceptions make it important to study campus climate to a finer grain and from more diverse student perspectives.

Creating a more inclusive environment will ben-

Make the United States the most attractive setting in which to study and perform research so that we can develop, recruit, and retain the best and brightest students, scientists, and engineers from within the United States and throughout the world [24].

This broad change can be instigated at the local level. Due to the proximity of social climate (i.e., campus climate) to students' choices about engaging in college, changes made at the department level can be impactful. For example, the university itself does not have to be changed for an engineering department to improve student perception of the department's social climate [25]. This focus on perception is important because it is not the reality of the campus climate that matters in a student's choice to engage in and stay at a university as much as the student's perceptions of the climate. In fact, research shows that student perceptions affect the ways students behave and ultimately the level of integration achieved [25].

# *1.3 Important factors in perceptions of campus climate for this study*

According to Baird [25], several dimensions of the institutional experience are frequently found important to the social climate as perceived by students, including: (1) how friendly the student culture is; (2) the quality of faculty-student interaction; (3) an emphasis on creativity and personal expression; (4) and a sense of shared identity or mission. These aspects were given attention in developing our survey because they involved social interactions that could logically be believed to differ by gender and ethnicity. For example, a Black female may rate the quality of faculty-student interaction differently than an Asian male. Other dimensions were mentioned that did not seem applicable because they were either not directly related to inclusiveness or an engineering department/college could not directly control them. For example, it is presumed that the severity of academic standards is applied to each student equally, regardless of race or gender, and that a specific department cannot easily control how important sports and having fun are to the university overall [25].

Ideally, each student would have a positive perception of the four previously mentioned dimensions within his or her department and university. However, research shows that underrepresented students often feel excluded by the dominant culture. A female student summarized this by saying, "I think for any engineer, it's about how accepted you feel and whether you feel confident and comfortable with your surroundings...If there's not someone that's going to worry about you if you drop out, then what's to keep you from dropping out" [26]. If a majority of underrepresented students feel this way, the diversity and life experiences applied to engineering problems will be severely limited [8]. Complicating our understanding of how minority students experience campus climate in engineering is that the majority is often unaware of the bias and discrimination felt by minority students [22].

#### 1.4 Purpose of this study

Research shows the benefits of diversity and how student perception of campus climate can diverge across demographic groups. These findings suggest that more attention needs to be paid to underrepresented groups to ensure that they are able to integrate socially and academically into the institutions they attend. Ensuring that universities and individual departments are inclusive from the student perspective is important and will increase the chance of students successfully integrating and becoming committed to the institution. Although numerous studies have discussed how populations can perceive the same campus climate differently and the effect it has on retention, these studies have focused on universities as a whole. Researchers have not looked at how underrepresented students within specific disciplines experience the level of inclusion in their department or how their view of the general campus climate might also relate to this perception. Our study directly fills this gap.

Moreover, there is no survey instrument designed specifically to measure feelings of inclusion for underrepresented students at both the department level and university level. However, there is related work suggesting that this type of research is needed. For example, in an attempt to measure feelings of inclusion for first-year minority student in engineering, Jordan and Sorby [27] asked students how much they agreed with four questions: (1) I can relate to the people around me in my class; (2) I have a lot in common with other students in my class; (3) The other students in my class share my personal interest; and (4) I can relate to the people around me in my extra-curricular activities. Using these measures, the study focused on how friendly the student culture is and how much the participant has in common with others at the class level and within extra-curricular activities. This perception of fit is only one aspect of inclusion. In particular, the questions do not cover interaction with faculty, a sense of shared identity or mission, or feelings of belonging, all of which the literature suggests are important aspects of inclusion. In comparison, Freeman and colleagues [28] measured

a sense of class-level and university-level belonging by surveying 238 freshmen in non-major sections of biology, psychology, and English at a southern university with an enrollment of about 16,000 students. To measure belonging (a component of inclusion), the researchers used an adapted version of the Psychological Sense of School Membership (PSSM) [29], which was developed using children in middle-school to asses the extent to which students felt accepted, respected, and valued at both the classroom and school level; the researchers adapted the survey to assess belonging in a specific class and at the more general university level. However, they did not look at department level belonging, which might be considered an important intermediary group, particularly at the college level, since curricular are often department specific. Smith and colleagues [30] specifically looked at different layers of groups by measuring a sense of belonging in 900 science and engineering students across 5 diverse institutions. They examined belonging to class, belonging to major, belonging to the university as an institution, and belonging to the university as a community. Though the study examined different groups to which students could belong, ranging from class through university, they used a somewhat limited measure. At each group layer, they asked four questions that addressed feeling accepted, comfortable, supported and like he or she is part of the group. Finally, Wilson and colleagues [31] examined belonging at an even more localized level by investigating whether different settings (classroom, conferences, retreats, etc.) exhibit significant differences in participant belonging. Collectively, these measures span different layers of groups to which students could feel included and use multifaceted measures of inclusion. However, the gap is that no studies look at the department and university levels using multifaceted measures that encompass the constructs the literature suggests are an important aspect of inclusion.

The purpose of our research is to fill this void by providing researchers and educators alike with a survey tool that can be used to measure feelings of inclusion among underrepresented students in engineering at the department level. Therefore, we describe the development of the EDIL and provide evidence for its utility in addressing research questions regarding feelings of inclusion. We believe our survey paves a pathway for the discovery of strategies that more broadly promote inclusiveness in engineering. Through our data analysis, we describe relationships between gender, race/ethnicity, academic level, and the perceived level of university and departmental inclusion (i.e., social or campus climate).

# 2. Methodology

In developing our survey instrument, we followed best practices for survey methods [32]. The primary outcomes are a survey instrument, *Engineering Department Inclusion Level* (EDIL) survey, in addition to descriptive statistics that demonstrate the usefulness of the survey and offer insights into underrepresented students' feelings of inclusion in engineering departments and the university as a whole by university, race, gender, and academic level.

# 2.1 Instrument

The development of the EDIL survey instrument was carried out in seven steps following best practices as defined by Gall et al. [33]:

- 1. Clearly define the construct of interest, which contributes to enable measures of content validity. In this study, the level of inclusion was divided into four-categories, following the example of Miller and Kat [9], students should feel as if they (1) belong, (2) are respected, (3) are valued (4) and have support.
- 2. *Define the target population*. As already described, our research targets underrepresented engineering students.
- 3. Review related tests to generate ideas regarding test format and validity. The general climate factors from the Charles F. Kettering (CFK), Ltd. School Climate Profile [34] were most influential to our project. Questions from this profile as well as the critiques of this instrument were reviewed [35-37] to see what types of questions could and should be used to measure university climate.
- 4. Develop the prototype of the survey instrument. As well as focusing on student perception of the inclusion level and how they were treated, questions were asked regarding perceptions of the treatment of all students. For example, we asked students to rate agreement with the response "All students feel welcome in this department." Each question was asked with regard to the university as well as the department to allow examination of perceptions of the university as a whole and the department. The prototype included 22 discrete items with the entire survey consisting of 44 items (each item doubled to ask about department and university) in addition to demographic information. Each item was a statement about the engineering department (or university respectively) and respondents were asked to indicate the extent of agreement or disagreement. A critique of the CFK survey [36], which used a four-point Likert-like scale, suggested that a six-point

scale be used to increase the discriminative power and test validity, ranging from strongly disagree (1) to strongly agree (6); this suggestion was taken into consideration and a six-point scale was employed.

- 5. *Evaluate the prototype.* As a check of face validity [33] and to ensure clarity, comprehension, acceptability of the questions, and survey length, two faculty researchers and five doctoral students reviewed the instrument. The reviewers were provided with the definition of the construct being measured. They were then asked if the questions were adequate and made sense and if they had any suggestions regarding the survey overall.
- 6. *Revise test based on suggestions.* The survey was revised based on suggestions from the reviewers. Specific changes included changing "I am treated like a person in this department" to "I am treated like a person (not a number) in this department" and "Faculty in the department respect me" was added as a question. The final survey is included as Appendix A.
- 7. *Collect data to determine test validity and reliability.* A variety of tests were conducted to evaluate validity and reliability. The outcomes are discussed in the following section.

In summary, the EDIL survey was developed following recommended best practices. The initial survey deployment, described later, yields valuable information about the survey instrument itself and the potential usefulness of the survey to those who wish to evaluate inclusion in engineering.

#### 2.2 Research sites

To build and test our instrument, engineering students from underrepresented demographics were surveyed. The populations of interest were females and underrepresented minorities (URMs), i.e., African-American, Hispanics, and Native Americans/Alaska Natives. For context, consider that despite accounting for a third of the school-age population, all URM students combined represent approximately 11% of the working STEM population as opposed to Whites (77%) and Asians (about 12%). Additionally, women account for approximately half of the school-age population while only making up about a fourth of the STEM workforce [5]. Our sample includes students at two predominately White universities and varied in academic levels, engineering disciplines, ethnic backgrounds, and university attended. The participating universities were very similar based on classification categories provided by the Carnegie Foundation (http:// www.carnegiefoundation.org/), a commonly used classification system in the United States. Both

universities are large, public, predominately White research institutions with high undergraduate enrollment located in the United States. Additionally, each school is primarily residential and has a STEM dominant graduate program. Similar universities were selected to control for variables that may reasonably affect the campus climate, such as student demographics and location. The student populations of University 1 and University 2 are approximately 20,000 and 30,000 respectively, and the engineering college at both consisted of approximately 80% male students and 70% White students. The goal for our population selection was to choose engineering departments at universities with White being the majority race and male being the majority gender because, according to the Engineering Workforce Commission [38], this represents the engineering demographic generally.

#### 2.3 Data collection

Potential participants were contacted via email using the contact lists from support programs for underrepresented groups at each university. Note that this does not mean that our sample represents only students who self-select into such programs. Instead, the listservs include undergraduate students who are assigned to the listserv based on the demographic information provided in their application to the university. Essentially, our sampling approach stratified the overall engineering populations by gender and ethnicity so that our sampling process would isolate the demographics of interest. Our intention was to also sample graduate students. To that end, we invited the graduate students that are also on the support program listservs to participate. A limitation of this approach is that graduate students are less likely to be targeted by support programs than undergraduates so our graduate student population is more highly self-selected, first as program participants then as study participants.

The survey was web-based, using a secure online survey tool. To increase response rate, a follow up email was sent at each university within a week of the initial invitation. Benefits of the online survey and email contact approach included: a reduction in researcher-induced bias by ensuring anonymity such that participants did not know the race, ethnicity, or gender of the researchers conducting the study; the respondents could complete the survey at their convenience; data could be collected rapidly; and the specified population could be reached, utilizing mailing list that contain only these students [32].

#### 2.4 Participants

A total of 242 students completed the survey, with 94 students from University 1 (39%) and 148 stu-

dents from University 2 (61%). Respondents included 223 females (92%) and 19 males (8%), with 186 White, 26 African-American, 14 Hispanic and 16 Asian. Each male respondent was African-American or Hispanic. The total response for males is noticeably lower than that for females; this is because White women are considered underrepresented in engineering and, therefore, there was a larger sample of possible participants at the start than other underrepresented groups. Respondents were primarily undergraduate students, with 52 freshman, 59 sophomore, 59 juniors, and 48 seniors. Twenty-four graduate students completed the survey. Each engineering discipline was represented, with civil (42 students), chemical (33 students), industrial (30 students), and mechanical engineering (28 students) most heavily represented. Since multiple support programs sent the invitations and some participants may be on multiple listservs, we do not know how many survey invitations were issued.

#### 2.5 Instrument validity and reliability

As a first step in data analysis, we undertook exploratory factor analysis (EFA) to determine which factors emerged from the instrument. EFA is a method that is used to examine underlying variables that may exist in a collection of items used in a survey [39]; it is used in cases where there are no preconceived assumptions about how items may relate to one another, or any pre-existing constructs. In our first EFA, we considered all items together and used principal axis factoring with direct oblemin (oblique) rotation [39, 40]. Principal axis factoring was chosen because our data were shown to be non-normal thus excluding the use of probabilistic factoring such as Maximum Likelihood Estimation which require normality. The non-orthogonal (oblique) direct oblemin rotation was chosen because we anticipated that factors would be correlated. Orthogonal rotation methods force factors to be uncorrelated whereas oblique rotation can be thought of as a less-restrictive type of rotation where factors can be correlated or uncorrelated. This analysis resulted in 6 factors total and 5 of the 6 factors having a departmental or university focus. A grouping of items (18, 21, 42, 45, and 46) relative to diversity was not context specific.

Given the strong breakdown to department and university specific contexts, we then conducted a similar EFA but separating the items to groups based on if the question was asking about the university or department level. A total of six factors emerged from this second analysis with identical factors at the university and departmental levels. These factors include Caring, Diversity and Pride. Caring measures how respected, welcome, cared about, and valued a student feels. Diversity measures perceptions of fair treatment and institutional commitment to diversity. Pride measures institutional pride and the desire a student has to remain.

Tables 1 and 2 show the pattern matrices for the items relative to these factors at the university and

	Table 1.	University	Level Pattern	Matrix
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		Factor		
Item	Question	Caring	Diversity	Pride
1	I feel respected at this university	0.744		
2	I am treated like a person (not a number) at this university	0.825		
3	I am respected by other students at this university	0.584		
4	All students are respected at this university	0.544		
5	I feel welcome at this university	0.543		
6	I belong at this university			0.812
7	I take pride in the fact that I attend this university			0.861
8	All students feel welcome at this university			
9	I am comfortable voicing my concerns at this university	0.553		
10	People at this university care about me as a person	0.756		
11	There is someone at this university that I can count on	0.514		
12	This university really cares about the students	0.817		
13	I feel wanted at this university	0.868		
14	I feel needed at this university	0.857		
15	I am valued by the university	0.974		
16	This university really values the student	0.829		
17	This university is very inclusive	0.514		
18	This university is very diverse		0.673	
19	Females are treated fairly at this university		0.637	
20	Ethnic minorities are treated fairly at this university		0.823	
21	This university is committed to promoting diversity		0.867	
22	This university is committed to promoting inclusion		0.595	
23	I like attending this university			0.858
24	I would rather attend this university than transfer to another			0.835

Table 2.	. Department	Level	Pattern	Matrix
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		Factor		
Item	Question	Caring	Diversity	Pride
25	Faculty in the department respect me	0.836		
26	I am treated like a person (not a number) in this department	0.908		
27	I am respected by other students in this department	0.732		
28	Faculty in this department respect all students	0.824		
29	I feel welcome at this department	0.815		
30	I belong in this department			0.867
31	I take pride in the fact that I am a student in this department			0.800
32	All students feel welcome at this department	0.769		
33	I am comfortable voicing my concerns within this department			
34	Faculty members in this department care about me as a person	0.859		
35	There is a faculty member in this department that I can count on	0.608		
36	This department really cares about the students	0.929		
37	I feel wanted at this department	0.810		
38	I feel needed at this department	0.737		
39	I am valued by the department	0.818		
40	This department really values the student	0.805		
41	This department is very inclusive	0.594		
42	This department is very diverse		0.713	
43	Females are treated fairly at this department			
44	Ethnic minorities are treated fairly at this department		0.552	
45	This department is committed to promoting diversity		0.960	
46	This department is committed to promoting inclusion		0.953	
47	I like being an engineering student in this department			0.771
48	I would rather remain in this department than transfer to another			0.876

department level (see Tables 1 and 2 respectively). These matrices show how each item loads onto a specific factor, with a higher coefficient meaning greater prediction of that factor. Blank boxes represent weak factor loadings, or those of less than 0.5. We did not consider such weak loadings in order to keep the item loading sparse by reducing the number of items that loaded onto multiple factors [39]. Although items can load on multiple factors, use of this convention resulted in no items that loaded onto multiple factors.

Item 8 from the university scale and items 33 and 43 from the department scale did not meet the factor loading cutoff of 0.5 to be considered part of one of the three factors. However, we were able to match these items to factors using their corresponding items about department or university, which were assigned to a factor. This was done because of the extreme similarity in items, which we believe warranted keeping them in the survey for future evaluation. Using the structure matrix, items 8 and 33 aligned best with Caring and item factor 43 aligned best with Diversity. Note that the factor alignment for each of these items matches the alignment for the parallel question on the other scale (e.g., item 32 is the department version of question 8 and it aligned with Caring, item 9 is the university version of item 33 and it aligned with Caring, and item 19 is the university version of item 43 and it aligned with Diversity). The inclusion of these items did not affect the reliability of each factor. However, if future implementations of this survey show that these items continue to not load in confirmatory factor analysis results, they may be discarded.

Following the EFA, we conducted an internal consistency check as a measure of reliability. Cronbach's  $\alpha$  measurement for internal consistency is a measure of relatedness between items in a factor; higher scores mean items are more related, and thus a more reliable measurement of that factor. The items corresponding to each factor had internal consistency scores above 0.85 (Table 3), which is acceptable for educational research [41].

#### 3. Data analysis and results

Using SPSS, we used a series of analysis of variance tests (ANOVA) to look for differences by gender,

Factor Name	Items	Cronbach's $\alpha$ Internal Consistency
University Caring	1, 2, 3, 4, 5, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17	0.95
University Diversity	18, 19, 20, 21, 22	0.88
University Pride	6, 7, 23, 24	0.92
Department Caring	25, 26, 27, 28, 29, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41	0.97
Department Diversity	42, 43, 44, 45, 46	0.92
Department Pride	30, 31, 47, 48	0.92

race/ethnicity, academic year, and university. Due to the limited number of participants from the various engineering departments, we were unable to look at departmental differences. We followed the ANOVA with Tukey's honestly significant difference (HSD) test to determine if differences were significant.

In Table 4, we report mean EDIL scores by Gender and by factor though we found no differences by Gender on any of the factors at a significance level of p < 0.05. Note that this may be a reflection of all participants being from groups that are underrepresented in engineering, i.e., we had no Caucasian or Asian men. Across both genders, we found that mean scores were highest for Department and University Pride.

As shown in Table 5, we did find differences based on race/ethnicity. Only groups with statistically significant (p < 0.05) differences are shown. Groups in bold score significantly lower than the other groups listed in the table for the same factor. However, all groups are shown in Figure 1 as a visual representation of all group scores (significantly different or not).

Significant differences were found across all factors. For University Caring, African-Americans scored significantly lower than Whites and Asians/ Pacific Islanders. On University Diversity, African-Americans scored significantly lower than Whites, Asians/Pacific Islanders, and Hispanics. On University Pride, African-Americans scored significantly lower than Whites. On Departmental Caring, African-Americans scored significantly lower than Asian/Pacific Islanders. On Departmental Diversity, African-Americans scored significantly lower than Whites, Asians/Pacific Islanders, and Hispanics. On Departmental Pride, African-Americans scored significantly lower than Asians/ Pacific Islanders. Note that we did not compare men and women based on race/ethnicity because our sample of men is too small, and we have no White or Asian men in our sample so all men are members of an underrepresented group. We also did not compare students who indicated they were Mixed

Table 4. Mean EDIL Scale Score by Gender

Indicate your sex:		Ν	Mean	Standard Deviation
University Caring	Male	19	4.59	0.93
	Female	223	4.73	0.79
University Diversity	Male	19	4.67	1.18
	Female	223	4.73	0.85
University Pride	Male	19	5.28	0.97
	Female	223	5.39	0.75
Department Caring	Male	19	4.60	0.94
	Female	223	4.75	0.90
Department Diversity	Male	19	4.54	1.20
	Female	223	4.67	0.96
Department Pride	Male	19	5.22	0.85
	Female	223	5.20	0.92

Factor Name	Ethnic Group	Ν	Mean	Standard Deviation
University Caring	White	185	4.76	0.74
	Asian/Pacific Islander	15	5.10	0.62
	<b>African American</b>	<b>25</b>	<b>4.23</b>	<b>0.97</b>
University Diversity	White	185	4.79	0.73
	Asian/Pacific Islander	15	5.12	1.15
	Hispanic	13	4.89	0.87
	<b>African American</b>	<b>25</b>	<b>3.95</b>	<b>1.29</b>
University Pride	White	185	5.42	0.74
	African American	25	<b>4.90</b>	<b>0.95</b>
Department Caring	Asian/Pacific Islander	15	5.28	0.65
	African American	25	<b>4.29</b>	1.18
	Mixed Race	4	<b>3.67</b>	0.89
Department Diversity	White	185	4.72	0.85
	Asian/Pacific Islander	15	5.12	1.09
	Hispanic	13	4.89	0.92
	<b>African American</b>	<b>25</b>	<b>3.98</b>	<b>1.39</b>
Department Pride	Asian/Pacific Islander	15	5.62	0.48
	African American	<b>25</b>	<b>4.73</b>	<b>1.10</b>



Fig. 1. Mean Factors Score by Race.

Table 6. Mean EDIL Score vs. Academic Y
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Academic Year	Ν	Mean	Standard Deviation
Freshman	52	5.62	0.67
Sophomore	59	5.46	0.56
Junior	59	5.32	0.60
Senior	48	5.31	0.94
Masters	11	5.23	0.75
PhD	13	4.65	1.42
	Academic Year Freshman Sophomore Junior Senior Masters PhD	Academic YearNFreshman52Sophomore59Junior59Senior48Masters11PhD13	Academic Year      N      Mean        Freshman      52      5.62        Sophomore      59      5.46        Junior      59      5.32        Senior      48      5.31        Masters      11      5.23        PhD      13      4.65

Race due to the small sample size. In summary, African-American students consistently scored the lowest on all factors.

Similarly, we compared participants across academic level as shown in Figure 2. The only significant difference was that PhD students scored lower on University Pride than all other academic levels. This is shown in Table 6.

Finally, we found differences across universities with significant differences in University Caring and Department Caring as University2 scored higher than University1 (see Table 7).

#### 4. Discussion

In this manuscript, we set out to describe the development of the *Engineering Department Inclusion Level* (EDIL) survey instrument by answering the following research questions:

1. What aspects of department and college inclusion should be included in the Engineering Department Inclusion Level (EDIL) survey? 2. What are the validity and reliability of the scores for the instrument?

We then analyzed data from the initial implementation to determine potential utility of the EDIL in addressing such research questions as:

- 1. How do underrepresented students rate the level of inclusion in engineering departments?
- 2. How do gender, race, and academic level impact the way students view the level of inclusion?

We have organized our discussion of the results around these questions with the last two combined into a single sub-section.

# 4.1 Important aspects of university and departmental inclusion

Recall that we designed our survey drawing on Baird's [25] suggestion that there are multiple dimensions of the institutional experience that tend to be important to the social climate as perceived by students. Factoring of our responses



Fig. 2. Mean Factor Scores by Class

94

<b>Fable 7.</b> Mean EDIL Scale Score by University				
University		Ν	Mean	Standard Deviation
University Caring	<b>University 1</b>	<b>148</b>	<b>4.62</b>	<b>0.84</b>
	University 2	94	4.87	0.70
University Diversity	University 1	148	4.71	0.92
	University 2	94	4.75	0.82
University Belonging	University 1	148	5.42	0.76
	University 2	94	5.31	0.79
Departmental Caring	<b>University 1</b>	<b>148</b>	<b>4.60</b>	<b>0.93</b>
	University 2	94	4.97	0.80
Departmental Diversity	University 1	148	4.59	0.99
	University 2	94	4.78	0.95
Departmental Pride	University 1	148	5.19	0.92

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yielded 3 important dimensions: (1) Caring, (2) Diversity, and (3) Pride. We also found that these 3 areas are distinct factors at the university and departmental level.

University 2

The Caring scale encompasses items addressing feeling respected, welcome, cared about, and valued. This might be considered a longer version of the belonging scale by Smith et al. [30] that examined feeling comfortable, accepted, supported, and part of a particular classification (i.e., class, major, university as an institution, university as a community) or this might be considered similar to the belonging scale by Freeman and colleagues [28] that examined feeling accepted, respected, and valued. However, we called our scale Caring because the direct question about belonging

loaded on the Pride scale rather than the Caring scale. We suspect that the statement, "I belong here" was interpreted as meaning "I deserve to be here" based on conversations during the initial instrument development. Similarly, we did not call this scale the Inclusivity scale even though the direct question about inclusivity loaded on the Caring scale. We believe our measure of Caring has more dimensions of inclusivity than this one direct statement and even the four statements used in the scale by Jordan et al. [27] that focus on relating to and having shared interests and things in common with others.

0.90

5.24

In addition to Caring, the EDIL survey includes scales for Diversity and Pride. The Diversity scale includes items about perceptions of fair treatment

and department or university commitment to diversity. The Pride scale includes items about belonging, pride, and a desire to stay in the department or at the university. These two scales are quite different than the previously referenced measures of belonging and inclusivity. However, we believe they are an important measure of inclusion level broadly because they add a dimension of university climate, providing a more complete picture regarding inclusion. That is to say, the Diversity scale measures how committed students believe the department/ university is to promoting an inclusive environment, and the Pride scale measures the intention to remain and commitment to the department/university. Supported by Tinto's Model of Institutional Departure [17], intentions and institutional commitments are influenced by the levels of integration a student achieves and impacts his or her departure decision. According the model, the more positive the institutional experiences, the more academic and social integration, the more positive intentions and commitments, and the less likely students are to depart. Therefore, we believe that both Diversity and Pride are important measures when considering how inclusive a department or university is from the student perspective.

#### 4.2 Validity and reliability of scores

Our results also demonstrate that the EDIL survey can yield valid and reliable scores with the population of interest. We checked face validity through reviewing pilot questions with experts. Also, factor analysis demonstrates that survey items load onto meaningful, interpretable factors related to caring, diversity, and pride on department and university levels. Each factor was tested for reliability using Cronbach's  $\alpha$  internal consistency score, which demonstrated that each factor could be measured reliably. As discussed in the *Conclusions and Future Work* section, additional development and testing, such as through confirmatory factory analysis, is needed.

# 4.3 General feelings of inclusiveness and differences by gender, race, and academic level

Before embarking on further data collection to continue developing the survey, we wanted to determine what value the survey might have. Therefore, we examined the data from our initial deployment to determine potential utility of the survey in addressing our research questions about feelings of inclusion, particularly with regard to gender, race, and academic level. We recognize limitations in this deployment of the survey (discussed in the following section), but believe our data are sufficient to demonstrate that this survey could be a useful tool for researchers and administrators and is therefore worthy of further development. It is particularly important to remember that our sample is small, but it is representative of populations in which our instrument is likely to be deployed. For example, few engineering departments have enough black males to expect a statistically significant sampling.

Overall, students in this study agreed with most of the statements and found their engineering department to be somewhat inclusive. However, results show that student perceptions of the level of inclusion are impacted by ethnicity. In this way, our results are consistent with prior studies showing that different groups can view the same campus climate differently [22]. African-Americans consistently rated the level of inclusion lower than the other racial/ethnicity groups. If engineering departments wish to attract and retain students from this demographic, this type of discrepancy is not desirable. Although White students were the majority at each university, students who identified themselves as Asian-Pacific Islander rate the level of inclusion very similarly to Whites; this indicates that being a minority in and of itself is not problematic and something else impacts the way African-American and Hispanic students rate the level of inclusion within engineering departments. This suggests that if universities want every student to have a positive institutional experience and integrate academically and socially [17], an earnest effort must be made to ensure inclusion is achieved and students from different ethnicities all feel welcomed, respected, valued, and supported [9].

Our results are inconsistent with prior literature in the fact that we saw no differences by gender across any of the factors at the department or university level. This may be due to the bias of the sample where all of our participants were from underrepresented groups in engineering (i.e., no White or Asian men were surveyed), and the number of women in our sample was much larger than the number of men. For this first deployment, this sampling was an intentional choice because the population of interest is underrepresented groups. However, this choice coupled with our low number of responses means that we have insufficient data to examine race/gender intersections to look more closely at differences by gender. Consequently, we do not believe our small quantitative sample is sufficient to refute existing literature [e.g., 10, 12, 42] that shows women tend to find engineering climate less welcoming than men. As part of our continued survey development, we believe that this is worthy of further study with a larger, more gender-balanced sample.

Similarly, with regard to differences by academic level, our findings are inconsistent with prior literature though we acknowledge our limited data set. Smith et al. [30] suggest that belonging at the major level increased with academic level across the undergraduate years at a research university; we did not find this to be the case in our sample as we found no differences across undergraduates with regard to inclusion (which encompasses similar measures of belonging). We did find that the 13 PhD students scored lower on University Pride. Given the small sample size, we hesitate to offer a possible explanation and instead think further testing is warranted.

In short, our results were consistent with prior research in that different racial/ethnicity groups can perceive the same environment differently with regards to inclusiveness and inconsistent with prior research in that no differences by academic level were found across the two research universities included in our study.

#### 4.4 Limitations

The findings of this study should be interpreted within the context. First, each respondent attended a large, public, predominately White research institution with high undergraduate enrollment located in the United States. While such schools are highly representative of schools offering engineering departments, the school context is a limitation. Second, students were contacted via support program mailing list, and students heavily involved in these programs may have been more inclined to reply to the invitation to participate in the study. It is possible that students who have negative institutional experiences and feel excluded are not as responsive to emails sent from these programs. Third, the number of male, ethnic-minority respondents was also too small for significant conclusions to be drawn from the observed differences. Lastly, as previously described, the sample size was skewed and males were significantly underrepresented. Considering these limitations, future work is needed, but we believe we have still make a signification contribution to the literature.

### 5. Conclusions and future work

Initial deployment of our survey to the target population of interests suggests that feeling of inclusion can be measured in underrepresented students in engineering at predominantly White institutions in a valid and reliable way. Moreover, the initial analysis shows differences among ethnic groups with regard to feelings of inclusion. In its current state, the EDIL survey could provide engineering departments and colleges with a way to gage the inclusiveness students are experiencing and monitor the impact diversity initiatives are having. If administered regularly, the inclusion scores could provide an indicator for the progress departments and colleges are able to make from year to year. Such a tool is particularly important since the success of current diversity-related initiatives at the college/department level is often based on student satisfactions or recruitment and retention numbers [43–46]. This survey would facilitate a way to better understand how and why such programs work and monitor the impact diversityrelated initiatives have on student perception with regards to inclusiveness at both the college and university level.

Based on our initial findings, we believe the EDIL is worthy of further development, including a confirmatory factor analysis to confirm the factors identified herein. The EDIL survey should be administered to a larger population of students at a variety of institutions to determine which institutional and departmental factors influence-both positively and negatively-the level of inclusion within engineering departments across the country. White men's perceptions also need to be compared to these minority populations and the perception of more minority males is also needed. The inclusion scores across engineering disciplines should be examined to determine if certain disciplines are doing a better job than others at creating an inclusive environment. Lastly, future research should examine how the interaction between the engineering department and university changes as students advance academically.

The engineering community should be able to create inclusive environments that increase the chances of students having a positive institutional experience, making the decision to depart less likely. As engineering education seeks to improve retention rates, researchers and practitioners need to examine ways in which departments can make the institutional experience more positive for all students, increasing the odds of integration occurring. The findings from this study support the idea that students of different ethnic groups may experience inclusiveness differently. Therefore, continued work is needed to assess inclusion levels and make a conscious effort to ensure students feel as if they are welcome, valued, respected, and supported in engineering departments.

#### References

- P. T. Terenzini, A. F. Cabrera, C. L. Colbeck, S. A. Bjorklund and J. M. Parente, Racial and ethnic diversity in the classroom: Does it promote student learning?, *The Journal of Higher Education*, **72**(5), 2001, pp. 509–531.
- J. B. Berger and J. M. Braxton, Revising Tinto's interactionalist theory of student departure through theory elaboration: Examining the role of organizational attributes in the persistence process, *Research in Higher Education*, 39(2), 1998, pp. 103–119.
- 3. S. D. O'Connor and S. Schwab, Affirmative action in higher

education over the next twenty-five years: A need for study and action, *Cornell Law Faculty Publications*, 2010.

- 4. Y. M. Kim, Minorities in higher education, *American Council on Education*, 2011.
- D. E. Chubin, G. S. May and E. L. Babco, Diversifying the engineering workforce, *Journal of Engineering Education*, 94(1), 2005, pp. 73–86.
- J. Turns, A. Linse, T. VanDeGrift, M. Eliot, J. Jones and S. Lappenbusch. Using diversity statements to promote engagement with diversity and teaching, ASEE Annual Conference & Exposition, Chicago, Illinois, June 18–21, 2006.
- C. C. Morphew, Conceptualizing change in the institutional diversity of U.S. colleges and universities, *Journal of Higher Education*, 80(3), 2009, pp. 243–269.
- 8. W. W. Wulf, Diversity in engineering, *Leadership and Management in Engineering*, 1(4), 2001, pp. 31–35.
- F. A. Miller and J. H. Kat, *The Inclusion Breakthrough:* Unleashing the Real Power of Diversity, Berrett-Koehler Publishers, San Francisco, CA, 2002.
- J. Gallaher and F. Pearson, Women's perceptions of the climate in engineering technology programs, *Journal of Engineering Education*, 89(3), 2000, pp. 309–314.
- S. L. Hanson, Insights from vignettes: African American Women's perceptions of discrimination in the science classroom, *Journal of Women and Minorities in Science and Engineering*, 12(1), 2006, pp. 11–34.
- C. E. Foor, S. E. Walden and D. A. Trytten, I wish that I belonged more in this whole engineering group: Achieving individual diversity, *Journal of Engineering Education*, 96(2), 2007, pp. 103–115.
- D. Chubin, Educating generation net—Can US engineering woo and win the competition for talent?, *Journal of Engineering Education*, 97(3), 2008, pp. 245.
- K. Watson and J. Froyd, Diversifying the US engineering workforce: A new model, *Journal of Engineering Engineering*, 96(1), 2007, pp. 19–32.
- S. M. Malcom, The human face of engineering, *Journal of Engineering Education*, 97(3), 2008, pp. 237–238.
  C.-S. G. Davis and C. J. Finelli, Diversity and retention in
- C.-S. G. Davis and C. J. Finelli, Diversity and retention in engineering, *New Directions for Teaching and Learning*, 2007(111), 2007, pp. 63–71.
- V. Tinto, Leaving College: Rethinking the Causes and Cures of Student Attrition, 2nd ed, University of Chicago Press, Chicago, 1994.
- P. Edgert, Assessing campus climate: Implications for diversity, *New Directions for Institutional Research*, 1994(81), 1994, pp. 51–62.
- A. R. Brown, C. Morning and C. Watkins, Influence of African American engineering student perceptions of campus climate on graduation rates, *Journal of Engineering Education*, 94(2), 2005, pp. 263–271.
- D. Love, A. Trammell, and J. Cartner, Transformational leadership, campus climate, and its impact on student retention, *Journal of Organizational Culture, Communications & Conflict*, 14(2), 2010, pp. 75–81.
- J. P. Lorenzetti, Student satisfaction and retention: Understanding the year-by-year relationship, *Recruitment & Retention in Higher Education*, 23(12), 2009, pp. 5–8.
- J. R. Ancis, W. E. Sedlacek and J. J. Mohr, Student perceptions of campus cultural climate by race, *Journal of Counseling & Development*, 78(2), 2000, pp. 180–185.
- L. D. Reid and P. Radhakrishnan, Race matters: The relation between race and general campus climate, *Cultural Diversity & Ethnic Minority Psychology*, 9(3), 2003, pp. 263– 275.
- N. R. Augustine, Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future, National Academies Press, Washington, DC, 2007.
- L. L. Baird, College climate and the Tinto model, in J.M. Braxton (ed), *Reworking the Student Departure Puzzle*, Vanderbilt University Press, Nashville, TN, 2000, pp. 62–80.

- S. E. Walden and C. Foor, What's to keep you from dropping out? Student immigration into and within engineering, *Journal of Engineering Education*, 97(2), 2008, pp. 191–205.
- K. L. Jordan and S. A. Sorby, Pilot intervention to improve a "sense of belonging" of minorities in engineering, ASEE Annual Conference and Exposition, San Antonio, June 10–13, 2012.
- T. M. Freeman, L. H. Anderman and J. M. Jensen, Sense of belonging in college freshmen at the classroom and campus levels, *The Journal of Experimental Education*, **75**(3), 2007, pp. 203–220.
   C. Goodenow and K. E. Grady, The relationship of school
- C. Goodenow and K. E. Grady, The relationship of school belonging and friends' values to academic motivation among urban adolescent students, *The Journal of Experimental Education*, 62(1), 1993, pp. 60–71.
- T. F. Smith, D. Wilson, D. C. Jones, M. Plett, R. A. Bates and N. M. Veilleux. Investigation of belonging for engineering and science undergraduates by year in school, *ASEE Annual Conference and Exposition*, San Antonio, June 10–13, 2012.
- D. M. Wilson, P. Bell, D. Jones and L. Hansen, A crosssectional study of belonging in engineering communities, *International Journal of Engineering Education*, 26(3), 2010, pp. 687–698.
- L. M. Rea and R. A. Parker, *Designing & Conducting Survey Research: A Comprehensive Guide*, 3rd ed, Jossey-Bass, San Francisco, 2005.
- 33. M. D. Gall, J. P. Gall and W. R. Borg, Collecting research data with tests and self-report measures, *Educational Research: An Introduction*, Pearson, Boston, 2007.
- 34. E. R. Howard, B. Howell and E. Brainard, *Handbook for Conducting School Climate Improvement Projects*, Phi Delta Kappa Education Foundation, Bloomington, IN, 1987.
- W. L. Johnson and P. N. Dixon, A Statistical Analysis of the Charles F. Kettering Climate Scale, 1990.
- W. L. Johnson and A. M. Johnson, A psychometric analysis of the Charles F. Kettering Scale for a junior high school population, 1993.
- 37. W. L. Johnson, A. M. Johnson, R. Gott and K. Zimmerman, Assessing the validity of scores on the Charles F. Kettering Scale for the junior high school, *Educational and psychological measurement*, **57**(5), 1997, pp. 858–869.
- National Center for Science and Engineering Statistics, Women, Minorities, and Persons with Disabilities in Science and Engineering, http://www.nsf.gov/statistics/wmpd/2013/ tables.cfm, Accessed 25 August 2013.
- B. Thompson, Exploratory and Confirmatory Factor Analysis: Understanding Concepts and Applications, American Psychological Association, Washington, D.C., 2004.
- A. B. Costello and J. W. Osborne, Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis, *Practical assessment, research & evaluation*, **10**(7), 2005.
- J. Pallant, SPSS survival manual: A step by step guide to data analysis using SPSS, Open University Press, Buckingham, 2010.
- S. L. Hanson, Insights from vignettes: African American women's perceptions of discrimination in the science classroom, *Journal of Women and Minorities in Science and Engineering*, 12(1), 2006, pp. 11–34.
- S. G. Brainard and L. Carlin, A six-year longitudinal study of undergraduate women in engineering and science, *Journal of Engineering Education*, 87(4), 1998, pp. 369–375.
- D. Hermond, Measuring the retention strategies of a minority engineering program: A service quality perspective, *Journal of Engineering Education*, 84(4), 1995, pp. 395–400.
- M. W. Ohland and G. Zhang, A study of the impact of minority engineering programs at the FAMU-FSU college of engineering, *Journal of Engineering Education*, **91**(4), 2002, pp. 435–440.
- P. C. Lam, D. Doverspike and P. Mawasha, Predicting success in a minority engineering program, *Journal of Engineering Education*, 88(3), 1999, pp. 265–267.

# APPENDIX A

"Engineering Department Inclusion Level" Survey

### **Rating Scale:**

- 1. Strongly disagree
- 2. Disagree
- 3. Somewhat disagree
- 4. Somewhat agree
- 5. Agree
- 6. Strongly agree

Please rate the extent to which you agree or disagree with the following statements about the university you currently attend:

### I. Questions about university

- 1. I feel respected at this university
- 2. I am treated like a person (not a number) at this university
- 3. I am respected by other students at this university
- 4. All students are respected at this university
- 5. I feel welcome at this university
- 6. I belong at this university
- 7. I take pride in the fact that I attend this university
- 8. All students feel welcome at this university
- 9. I am comfortable voicing my concerns at this university
- 10. People at this university care about me as a person
- 11. There is someone at this university that I can count on
- 12. This university really cares about the students
- 13. I feel wanted at this university
- 14. I feel needed at this university
- 15. I am valued by the university
- 16. This university really values the student
- 17. This university is very inclusive
- 18. This university is very diverse
- 19. Females are treated fairly at this university
- 20. Ethnic minorities are treated fairly at this university
- 21. I like attending this university
- 22. I would rather attend this university than transfer to another

#### **Rating Scale:**

- 1. Strongly disagree
- 2. Disagree
- 3. Somewhat disagree
- 4. Somewhat agree
- 5. Agree
- 6. Strongly agree

Please rate the extent to which you agree or disagree with the following statements about the engineering department you are currently a student in:

#### II. Questions about engineering department

- 1. Faculty in the department respect me
- 2. I am treated like a person (not a number) in this department
- 3. I am respected by other students in this department
- 4. Faculty in this department respect all students
- 5. I feel welcome in this department
- 6. I belong in this department

- 7. I take pride in the fact that I am a student in this department
- 8. All students feel welcome in this department
- 9. I am comfortable voicing my concerns within this department
- 10. Faculty members in this department care about me as a person
- 11. There is a faculty member in this department that I can count on
- 12. This department really cares about its student
- 13. I feel wanted in this department
- 14. I feel needed in this department
- 15. I am valued by this department
- 16. This department really values the student
- 17. This department is very inclusive
- 18. This department is very diverse
- 19. Females are treated fairly in this department
- 20. Ethnic minorities are treated fairly in this department
- 21. I like being an engineering student in this department
- 22. I would rather remain in this department than transfer to another

#### **III. Demographics**

- a. Indicate your sex:
  - 1. Male
  - 2. Female
- b. Indicate your race/ethnicity:
  - 1. White
  - 2. African-American
  - 3. Hispanic, Latino or Spanish origin
  - 4. Asian-Pacific Islander
  - 5. American Indian or Alaska Native
  - 6. Other: \_
- c. Indicate your current academic level:
  - 1. Freshman
  - 2. Sophomore
  - 3. Junior
  - 4. Senior
  - 5. Masters
  - 6. Doctorate
- d. Are you currently enrolled in school? (Yes, No)
- e. If so, which university are you currently attending? (Open-ended)
- f. Which engineering department are you currently in? (Choose the one you identify with the most if more than one)
  - 1. Aerospace and Ocean Engineering
  - 2. Automotive Engineering
  - 3. Bioengineering
  - 4. Biological Systems Engineering (Biosystems)
  - 5. Chemical Engineering
  - 6. Civil and Environmental Engineering (Civil or Environmental)
  - 7. Electrical and Computer Engineering
  - 8. Engineering Education (Engineering & Science)
  - 9. Engineering Science & Mechanics
  - 10. General Engineering
  - 11. Industrial Systems Engineering (Industrial)
  - 12. Material Science & Engineering
  - 13. Mechanical Engineering
  - 14. Mining and Materials Engineering
  - 15. Other: \_\_\_\_\_

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