

How Granular Is the Problem?

A Discipline-Specific Focus Group Study of Factors Affecting Underrepresentation in Engineering Undergraduate Programs

Tia Barnes¹, Amy Trauth^{1,2}, Rachel Davidson², **Jenni Buckley**^{2,1}

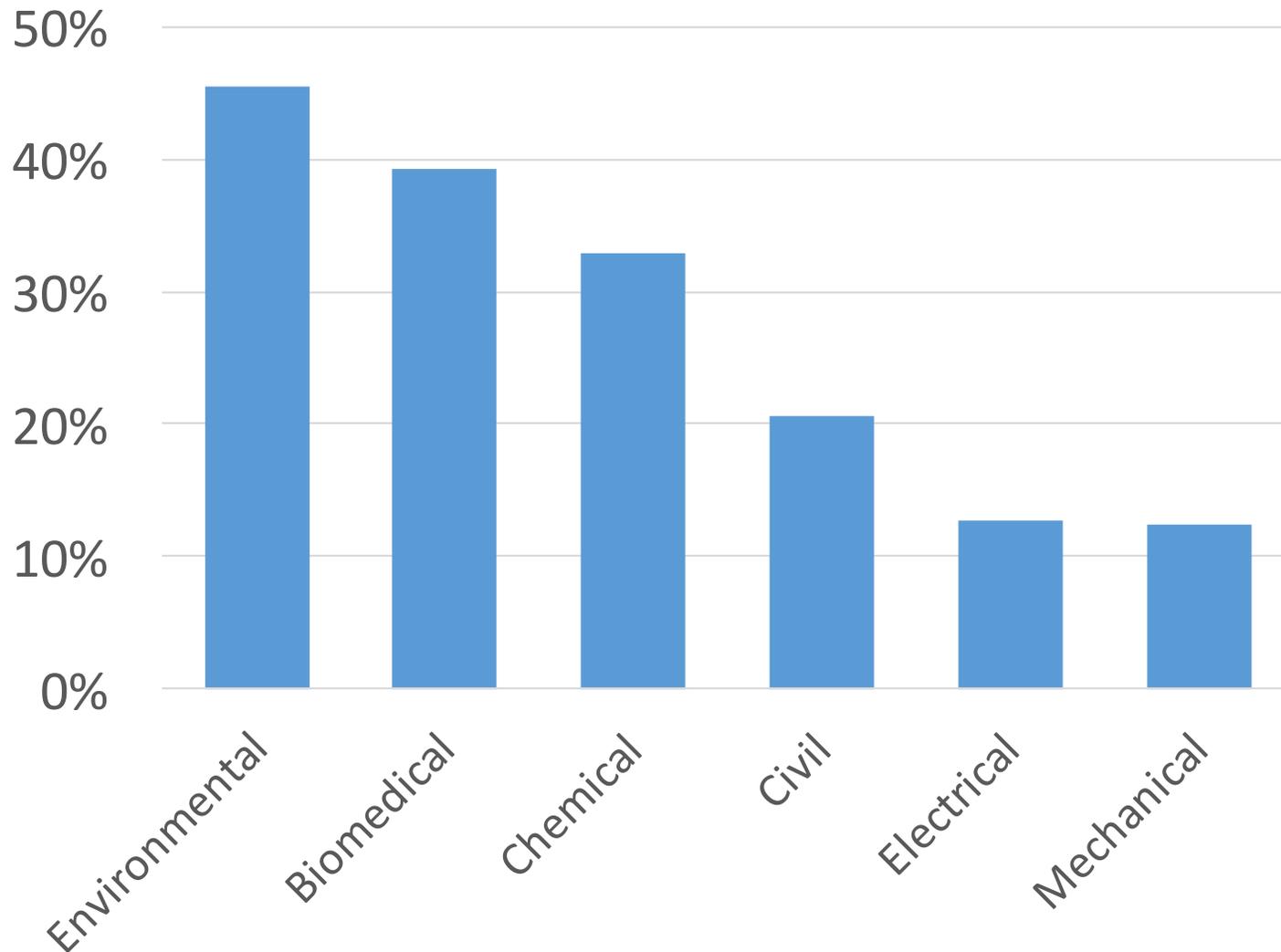
UD College of Education & Human Development
UD Department of Mechanical Engineering

CSD Brown Bag Lunch
April 2018

There is **systematic** and **persistent** lack of diversity in the engineering.

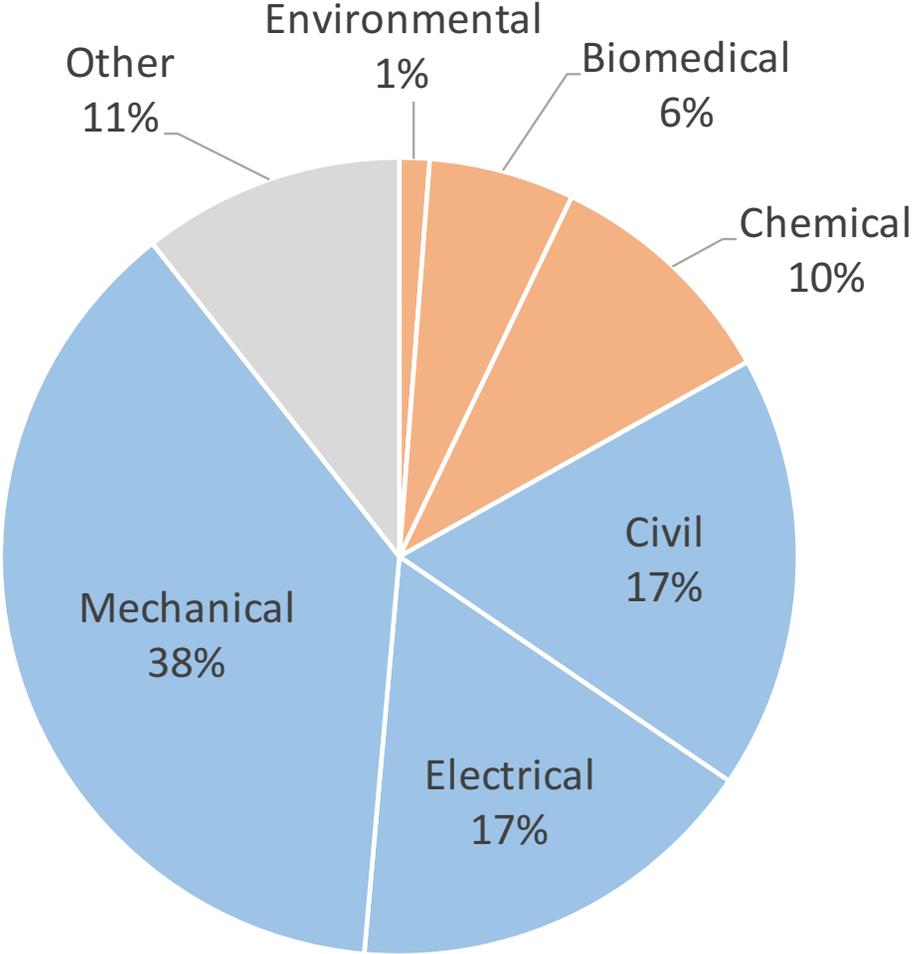
- Sub-critical mass of women (~20%) in engineering
- Non-uniform distribution of women across majors
- Uniformly low representation of students of color (10-12%)
- Disparities in graduation rates for students of color vs. majority (20%-points)

Percentage Bachelor's Degrees Awarded to Women

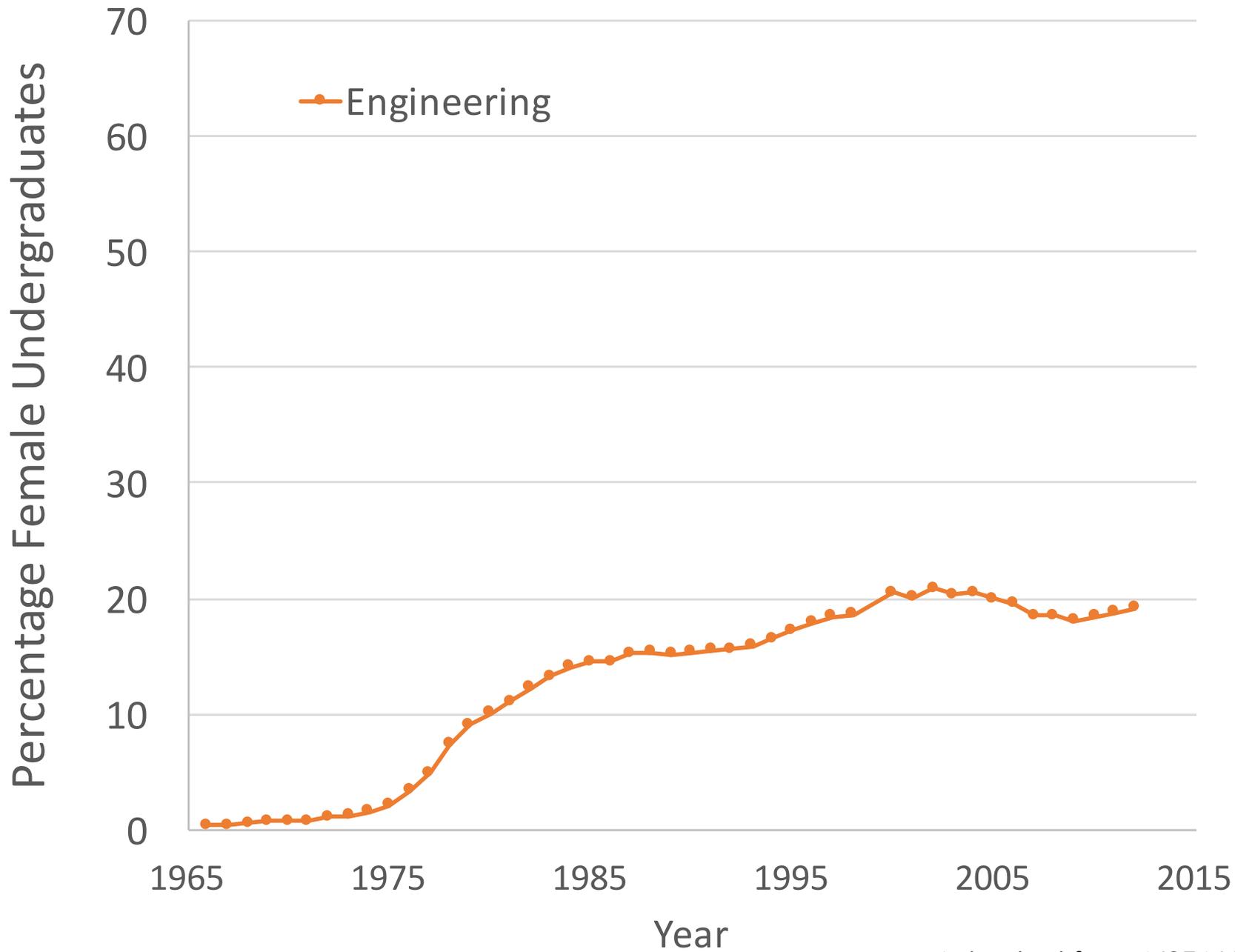


Adapted from ASEE Engineering by the Numbers, 2016

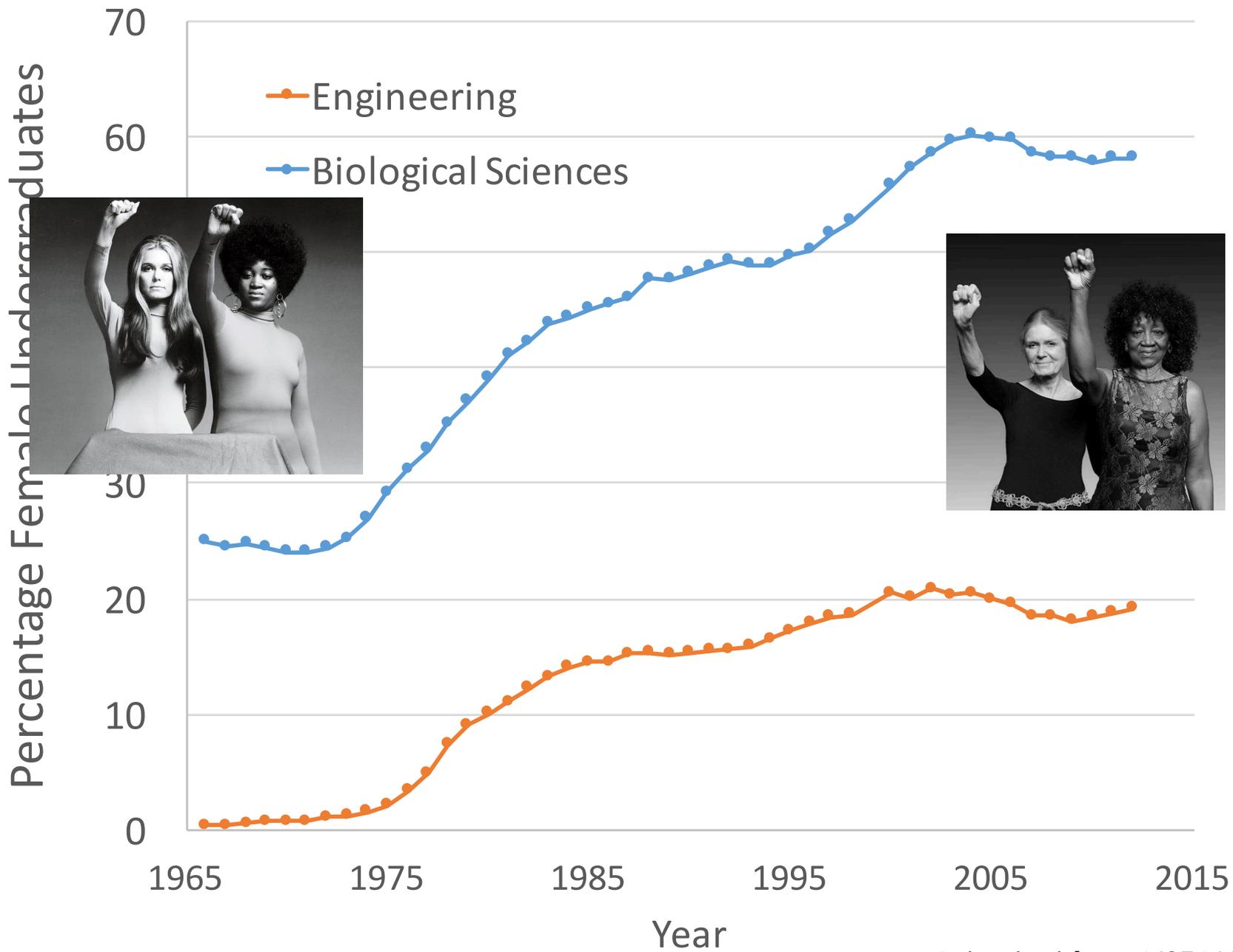
Total Bachelor's Degrees Awarded



Adapted from ASEE Engineering by the Numbers, 2016

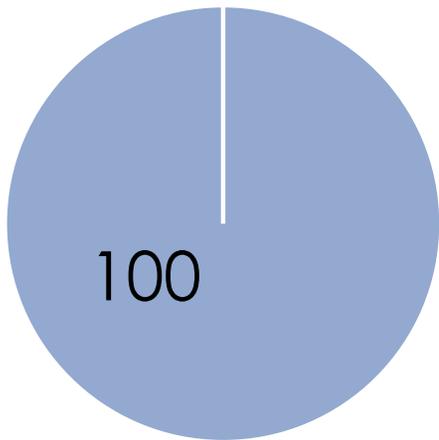


Adapted from NSF NCSES 2012

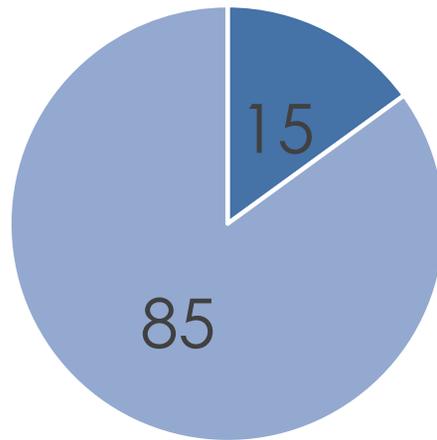


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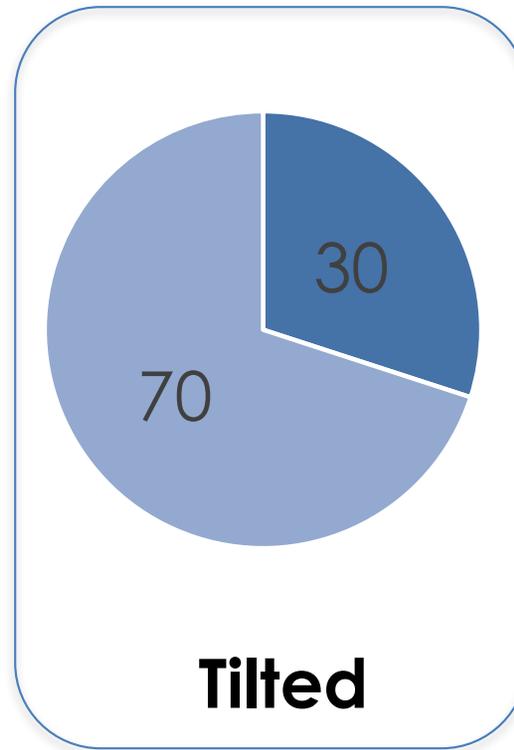
The goal is a **critical mass** of under-represented students in each discipline.



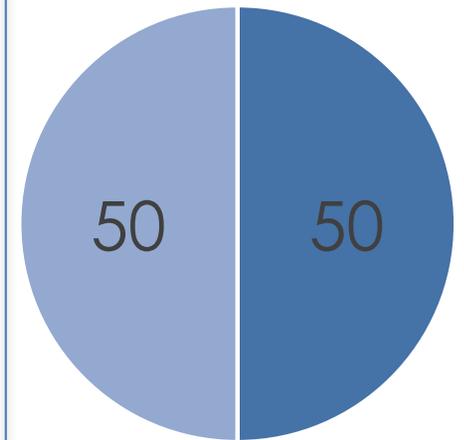
Uniform



Skewed



Tilted



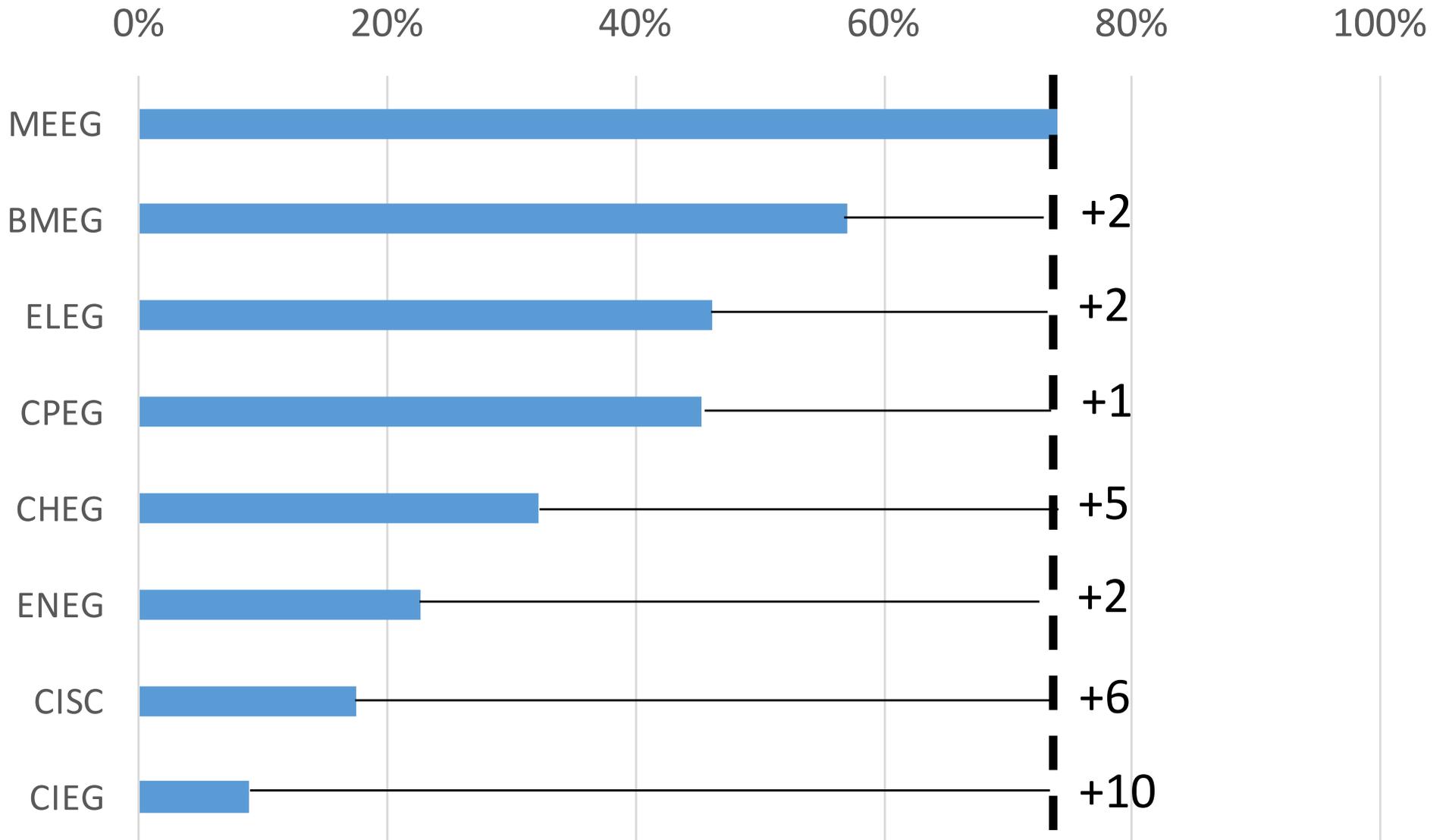
Balanced

30% = Critical Mass

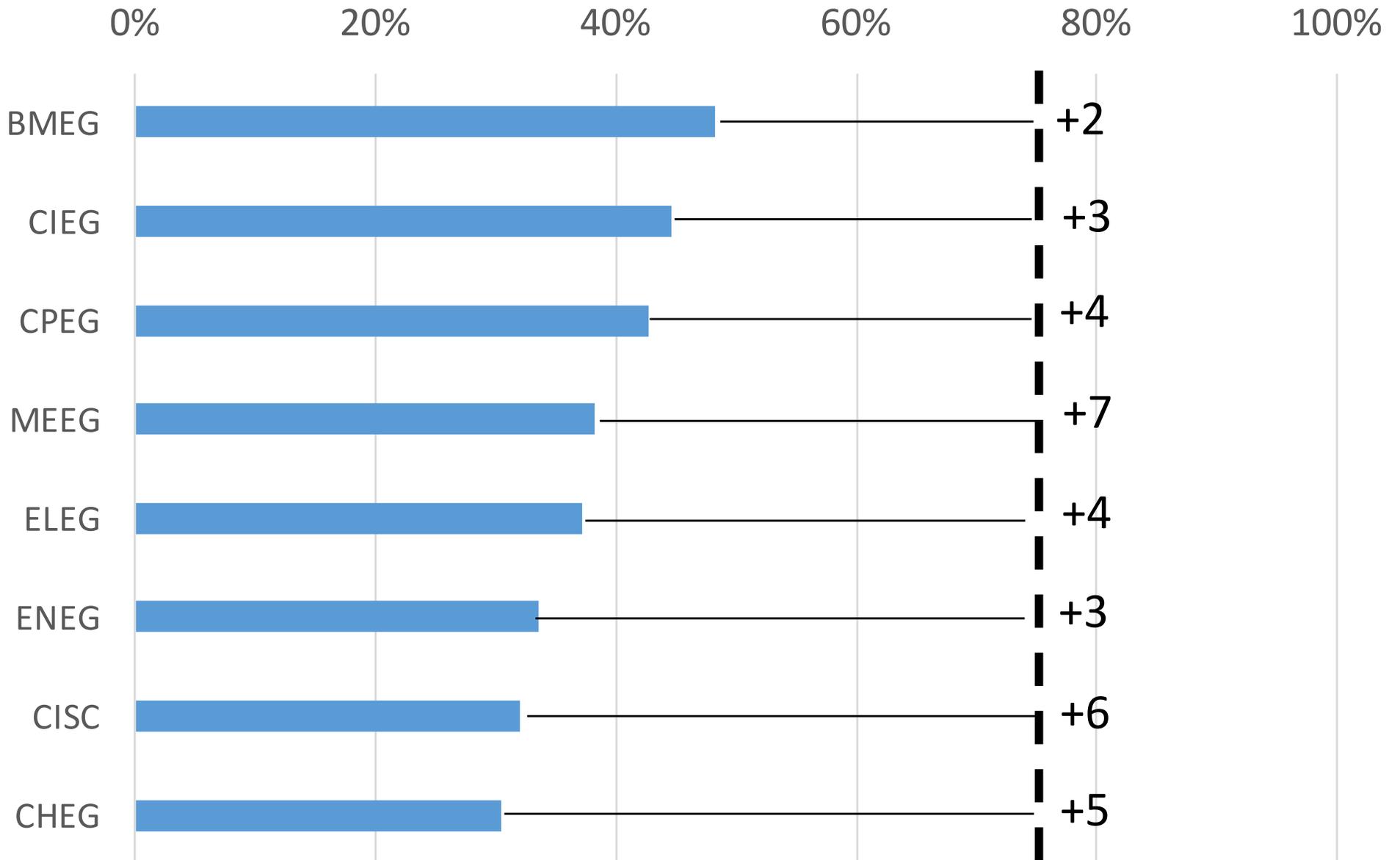
We have taken a hard look at diversity here at UD College of Engineering.

- Grade for Gender Diversity = C
 - At national average for % women graduates
 - At national average for retention of women (60% 6-year grad)
- Grade for Racial Diversity = C- or D
 - 10-15% points below national average for %URG graduates
 - 20%-point disparity between majority & URG retention

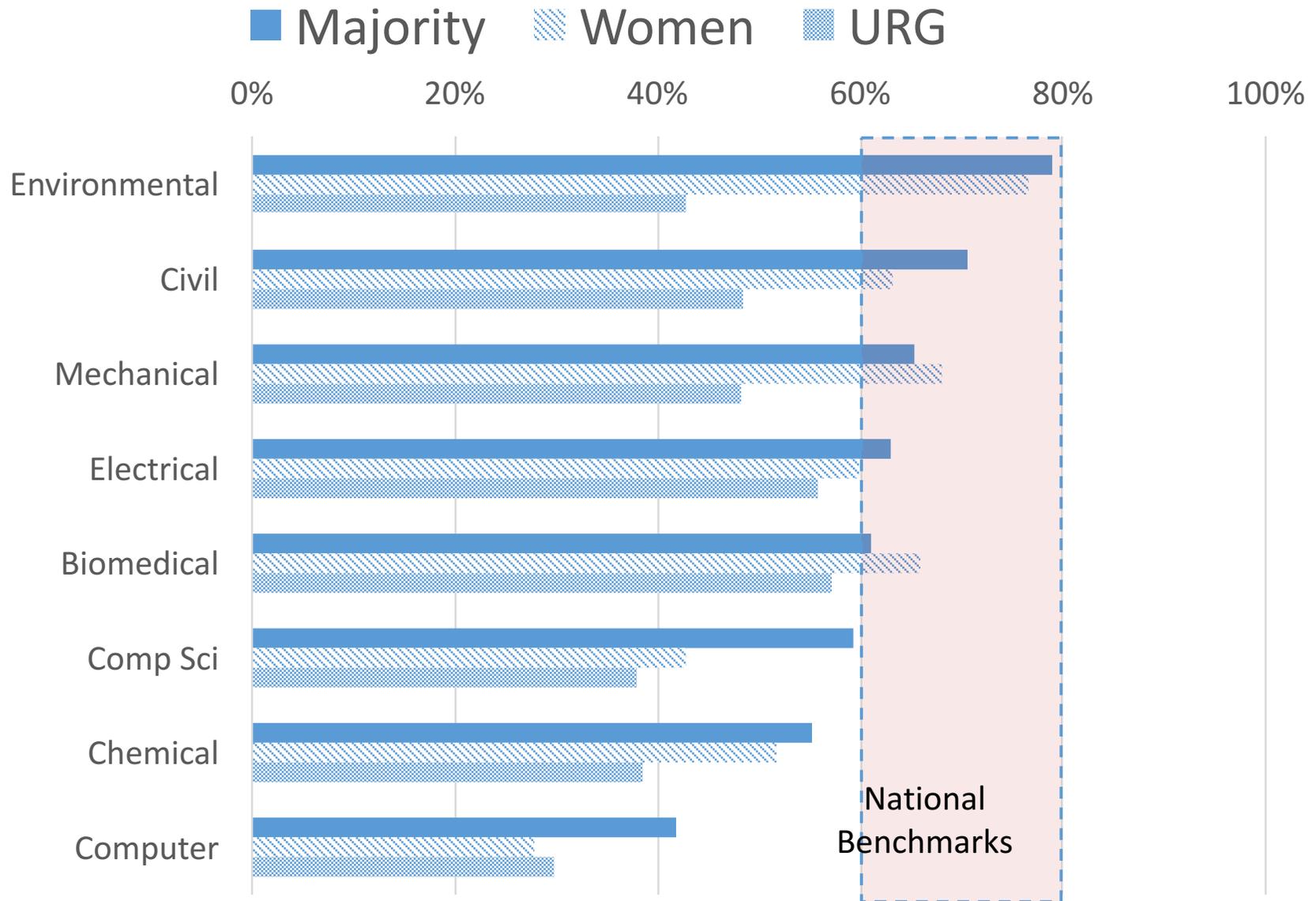
Percentile Nationally for % Female Graduates



Percentile Nationally for %URG Graduates



6-Year Graduation Rates



But the numbers don't tell the most important part of the story, which is **the student experience.**

We conducted a **comprehensive focus group study** of the undergraduate experience within the UD College of Engineering.

- 12 focus groups of 2-8 students (avg. 4 per group)
- Randomly selected, no incentive for participation
- Disaggregated by gender and race
- Clustered by engineering discipline

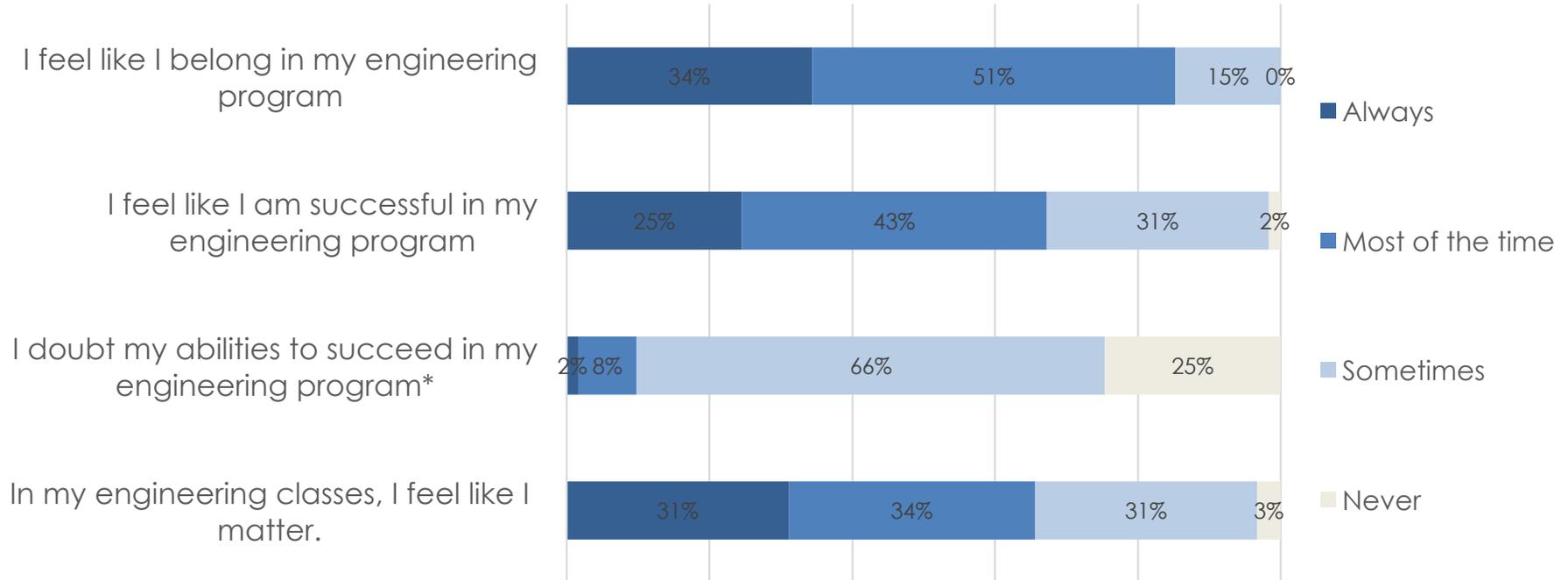
1. Women in CHEM-E
2. Women in MECH-E & CIV-E
3. Women in ELEG & CIS
4. Women in BMEG & ENEG
5. Majority Students in CHEG
6. Majority Students in MECH-E & CIV-E
7. Majority Students in ELEG & CIS
8. Majority Students in BMEG & ENEG
9. URGs in CHEG, ENEG, & BMEG
10. URGs in MECH-E, CIV-E, ELEG, & CIS
11. National Society for Black Engineers
12. Society for Hispanic Professional Eng.

Topics for discussion in the focus groups were based on the engineering education literature.

- Pre-interview survey
 - Engineering discipline & year in program
 - Self-reported GPA
 - Self-efficacy & belonging in program
- Moderator prompts focused on:
 - High school preparation
 - Peer interactions
 - Faculty/staff interactions
 - Professional identity
 - Program supports
 - Family supports
- Analysis:
 - Survey data analyzed quantitatively (SPSS v 24)
 - Focus group interviews were transcribed
 - NVivo qualitative analysis software (97.9% agreement, $\kappa = 0.75$)

Pre-interview survey results suggest a decidedly "average" aggregate experience.

How often do you agree with these statements?
(n=61)



* Indicates that this item is reverse worded.

For two themes, majority & minority students had similar experiences.

Theme	Student Experiences & Perceptions	Differential Experiences	Level
High School Preparation	<ul style="list-style-type: none"> - Insufficient prior exposure in basic math & science courses - Differential access to STEM-focused extracurricular activities 		Institutional & College Level
Family Supports	<ul style="list-style-type: none"> - Family seen as a source of emotional support to persist in engineering - Financial stressors related to tuition, completing degree on time, and keeping merit-based scholarships 		Institutional

Direct quotes related to **High School Preparation**

“I went to a fairly large high school that had a lot of AP programs as well as some engineering ones. So, my senior year of high school, I took Intro to Engineering, in which we learned AutoCAD; we did a couple different drawing projects and little engineering projects....which I think prepared me a lot. That's part of the reason why I chose engineering, was those courses.”

“My high school was the exact opposite. I don't feel like I was prepared for Engineering courses. A lot of the courses... it was the sense of they're spoon-feeding you information and then you got to take it all in and then give it all back to them on the test and I wasn't ready for problem solving, and thinking outside the box to solve things, and just being given information and then working with it instead of get to a common goal. I was so used just getting it and then giving it back that I don't think I was prepared barely....”

For all other themes, we found a lot of differences in experiences for minority vs. majority students.

Theme	Student Experiences & Perceptions	Differential Experiences	Level
Peer Interactions	<ul style="list-style-type: none"> - “Weed out” culture within certain departments negatively affects peer-to-peer interactions - Chilly climate within informal learning environments, e.g., study work groups & project teams - Formal & informal peer networks seen as highly beneficial 	<ul style="list-style-type: none"> - Micro-aggressions against women & students of color - Black students, but not Latinx, report lack of cultural awareness & isolation - Peer networks seen as more important for women & students of color 	Departmental

Direct quotes related to **Peer Interactions**

"I think it's more subconscious than anyone actually thinking oh, women in this field don't belong. But it's the kind of situation where you're working in a group and someone comes up and is like, 'Can you help me with No. 4?' And I go, 'I've got No. 4; I can help you.' And they ignore you."

- White Female Student

"... a lot of our peers haven't been exposed to black people throughout their entire lives. So, when they see you, they make a lot of assumptions, or they're very inquisitive about things, but not in a manner that is the right way of being inquisitive"

- Black Student

Theme	Student Experiences & Perceptions	Differential Experiences	Level
Faculty/Staff Interactions	<ul style="list-style-type: none"> - Mixed reviews on instructional & mentoring experiences, with some faculty seen as highly supportive of student success and others not - Some faculty promote “weed-out” culture & chilly climate - Lack of racial diversity amongst faculty 	<ul style="list-style-type: none"> - Micro-aggressions by faculty against women & students of color - Students of color more conscious of lack of diversity amongst faculty 	Departmental

Direct quotes related to **Faculty/Staff Interactions**

“One of my professors made a joke about this in one of my ...classes. We were talking about separation by boiling things off and he’s like, it’s kind of like what we’re doing with you guys. Boiling off the weak ones.” – [Student]

“Early on in my academic career, I had an experience with a professor where he would mention, ‘Hey, man, stay out of trouble,’ and this, that, and the third. I’m like, ‘What trouble am I going to get into?’ ...I’ve never heard him say that to any other student when they were in office hours, and then, he would even mention – he would even highlight the fact that I was black, and also make comments on that while we were in office hours...” – Black Male Student

“For me, the main things that I would like to see happen in the college – my ideal situation if I came through: I would like to see a professor that looked like me”. – Black Student

Theme	Student Experiences & Perceptions	Differential Experiences	Level
Professional Identity	<ul style="list-style-type: none"> - Design projects & internships help students see themselves as engineers - Biomedical & Chemical engineers have more difficult time with professional identity formation 	<ul style="list-style-type: none"> - Mixed perceptions (positive, negative, neutral) of how being a woman and/or student of color impacts engineering identity 	College Level & Departmental

Direct quotes related to **Professional Identity**

“I feel like the one thing about myself that would make people question whether I would be an engineer, are probably me being a woman. But, I never thought about that really until college when I started my internships, and I went into the workplace and saw that I was the only one...”- Female Student

“I always hear this from everyone else that like being a woman in the engineering field will be beneficial for us later on, when we’re finding a job. So, I think that aspect is definitely gonna help us.” – Female Student

Theme	Student Experiences & Perceptions	Differential Experiences	Level
Program Supports	<ul style="list-style-type: none"> - Need for improved articulation with career services, particularly for newer majors (bioengineering) - Importance of affinity groups, like SWE, NSBE, SHPE, in student recruitment & retention - Relatively higher GPA requirement in engineering to maintain merit scholarships 	<ul style="list-style-type: none"> - Women and students of color stress the importance of affinity groups but feel that they are under-funded - Students of color highlighted relatively higher GPA requirement for merit scholarships & feel it leads to students prematurely leaving the program 	College Level & Department

Direct quotes related to **Program Supports**

"... as far as NSBE and things like that, the college – the department – will be like, 'Oh, we spent \$600,000.00 renovating a room.' Great. NSBE asks for a money to go to a conference, and they're like, 'Oh, you're capped at \$1000.00.' So, priorities – okay, where exactly do you see me fitting into your picture of, 'Oh, we want to paint diversity.'" " – Black Student

"Because I know the scholarship cutoff, you get cutoff at 3.0. If you have a 2.9, that's still a good GPA for an engineer, but you lose your scholarship.."- Student

"Because I was in [Each One Reach One; EORO] and my mentor was electrical engineering and so he saved me... I used to turn to him or his peers that he introduced me to that were also in the major. Like, "What classes should I take? What kinda professor's this?" Those things really make a difference in how your college experience goes about. So if I didn't do EORO, I don't know what my life would be right now as a third year student to be honest with you."

These results suggest we have some serious issues related to climate.

What are we going to do about this?

Action items from our **College's Strategic Plan.**

Department Level	College Level	Institution Level
<ul style="list-style-type: none">- Cultural awareness & sensitivity training for faculty- Ensure equal leadership opportunities for women & students of color within departments, e.g., TAs, RAs	<ul style="list-style-type: none">- Create summer bridge program for women and students of color- Increase college-level funding to students with short-term financial aid needs- Increase funding for affinity groups, such as SWE, NSBE, & SHPE,	<ul style="list-style-type: none">- Revise GPA requirement for merit-based scholarships to be uniform across colleges- Continued focus on recruitment of faculty of color in STEM- Work closely with local K12 feeder schools to improve rigor of math & science preparation

We have been **fully transparent** about our findings from this study.

From: [REDACTED]
Date: Saturday, February 17, 2018 at 2:09 PM
To: Jenni Buckley <jbuckley@udel.edu>
Subject: RISE Presentation - College of Engineering Diversity Initiative

Hello Professor Buckley,

[REDACTED]
I'm a sophomore Chemical Engineering major. I am also a member of the RISE program so I was at your presentation this morning! I was hoping to talk to you afterwards but didn't get a chance to, unfortunately. I am very interested in the work you are doing as the chair of the CoE's new Diversity Initiative and I wanted to share a thought, or observation, if you will, about some of the things you mentioned today:

I've noticed a sort of correlation between students who seemed to have "lesser developed" engineering backgrounds coming into the program and those whose opinions seem to be dismissed or underappreciated later on. I think the engineering basis with which our students enter the College of Engineering and their respective majors really has an impact on how they are viewed by their peers over the next four years.

Obviously, I understand that students will inevitably enter their programs with different backgrounds and experiences as their peers - which has its own wonderful benefits - but I think it's important that we, as a College, understand how these different starting points can affect students' experiences so that, if nothing else, we can provide the support necessary for everyone to have an opportunity to have their opinions and ideas respected equally.

Issues of diversity are something that I am very passionate about; so much so that I recently became a Diversity Enrichment Leader (DEL) through the Office of Admissions. The DEL program is relatively new to the university, however we have already contributed to a more diverse student body--and have hopes of further improvement in the coming years. Being a DEL gives me the opportunity to interact with potential students and sell UD as a welcoming, diverse environment. In an effort to do this job to the best of my ability, I am always looking for ways to be more involved and understand more deeply the environment of diversity and inclusion on campus--I am a Latina woman so I do see some aspects of student life and diversity, however I know there is much more to it than what I've personally experienced.

This being said, I wanted to reach out to see if there was any way in which I could contribute to your work in the CoE. I would love the opportunity to be more involved in helping our campus reach it's full potential with respect to becoming a welcoming, safe place for students of all backgrounds.

Thank you for speaking at our RISE workshop this morning and I hope to hear from you soon,

[REDACTED]

This is how we're helping our faculty
get with the program.



- Regular reporting at faculty meetings
- Applying for CTAL Instructional Improvement Grant for Inclusive Classroom Workshop development
- Coordination amongst department-specific staff advisors
- Rapid dissemination about new services, e.g., UD Success Grants

New Funding Mechanism for **Diversity-Focused RSOs**



- \$1,500 per semester available
- Time saved by running fewer fundraising events should be spent on events that promote program goals

Our program goals

- A. Recruit a diverse population of students
- B. Foster an inclusive climate
- C. Promote interactions and dialogue between people with different backgrounds, identities, and experiences

The process



coe-diversityfunds@udel.edu

We've been continuously refining our recruitment practices, in partnership with Admissions.

Mechanical Engineering

Measure	% URG
2017 Enrollment	23.0%
Dept. Historical	12.6%



This is an ongoing project, and we are notably struggling in some areas.

Electrical Engineering

Measure	% Women
2017 Enrollment	0%
Dept. Historical	10.8%

Update!
2 women transferred
into Electrical!

Our focus group study has provided baseline data for **continuous evaluation** of our college's diversity efforts.

- Custom-designed survey instrument
 - Thematic elements from our focus groups
 - Validated measures from the literature
- Baseline data collected Spring 2018
 - 488 responses (19.5% response rate)
 - Data analysis scheduled for Summer 2018
- Survey will provide data about how our interventions affect the student experience.

Excerpts from our new survey instrument

	Strongly agree	Agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Disagree	Strongly disagree
I feel comfortable asking questions in my engineering and/or computer science class	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel comfortable contributing to class discussions in my engineering and/or computer science class	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The professors in my engineering and/or computer science classes respect me	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
I can relate to the people around me in my class	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have a lot in common with other students in my class.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Acknowledgements

UD Center for Diversity Studies Research Grant Program

We're in it
for the
long haul!



Prof. Rachel Davidson (Assoc Dean)

Prof. Jenni Buckley (UG Diversity Chair)

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Ms. Terrie Kalesse, Prof. Lori Pollock

Prof. Terry Harvey, Prof. Andy Novocin

Prof. Ismat Shah, Ms. Allie Andrews

(Ad Hoc) Mr. Muizz Hassanali, Mr. Tam Nguyen