

# **CAREER: Characterizing Undergraduate Engineering Students' Experiences with Mental Health in Engineering Culture**

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Eileen Johnson received her bachelor's and MS in bioengineering from the University of Illinois at Urbana-Champaign. She previously worked in tissue engineering and genetic engineering throughout her education. During her undergraduate career, she worked with Dr. Brendan Harley developing biomaterial implants for craniomaxillofacial defects and injuries. In graduate school, she worked with Dr. Pablo Perez-Pinera working on new genetic engineering tools. There, she became interested in engineering education after helping develop and teach an online only laboratory class. She currently works as a research associate under Dr. Karin Jensen with a focus on engineering student mental health, retention, and development of resources.

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## **Introduction**

Undergraduate engineering student mental health is an urgent concern for the engineering education community. Mental health concerns for students are increasing in prevalence and severity in recent years, and early research shows that the COVID-19 pandemic has exacerbated this crisis [1]. Additionally, some research has indicated that engineering students who experience mental health challenges are less likely to seek help for mental health concerns [2]. Our previous research has described a culture of stress in engineering, where high stress levels and poor mental health are expected or deemed as necessary for success by undergraduate students [3]. The goal of this project is to further understand undergraduate engineering students' experiences with mental health during their undergraduate degree programs in order to develop and improve proactive trainings, policies, and interventions that support undergraduate engineering student mental health. Towards this goal, our project seeks to answer the overarching research question, *How can we dismantle a culture of high stress in engineering and instead foster a culture that promotes wellbeing?* To best understand students' experiences with mental health, we sought to develop new measures that characterize students' experiences with stressors in engineering and perceptions of norms around mental health and self-care. To accomplish this, we created and tested a novel survey that will be used in a longitudinal data collection with undergraduate engineering students. Future work will include combining the novel survey items with existing measures of mental health and intention to remain in engineering over a four-year data collection period. Here we describe our preliminary analysis of a novel survey distributed to undergraduate students.

## **Methods**

### *Data Collection*

Institutional Review Board approval was obtained before data collection began. The survey items were originally developed from statements by students in a qualitative interview study, and items were refined through cognitive interviews [3]. The new survey was administered to undergraduate engineering students at a large, public engineering college in the Midwest. The survey was delivered in Qualtrics and piloted with respondents outside the participant pool prior to distribution. Survey participants were recruited through a college email to all undergraduate students. A reminder email was sent one week after the initial invitation. Student participants were offered a \$10 Amazon gift card code and entry into a raffle for one of sixteen \$50 Amazon gift card codes for participation. Survey completion time for respondents averaged five minutes.

### *Measures*

The survey consisted of 81 new items developed to measure engineering students' experiences with and perceptions of stress and wellness in engineering. For example, survey items included "High stress is expected for engineering students" and "Engineering students commonly stay up all night working". Participants were asked to indicate their agreement to each statement on a 6-point Likert scale (strongly disagree, disagree, somewhat disagree, somewhat agree, agree,

strongly agree). By utilizing a 6-point scale, participants are forced to either slightly agree or slightly disagree even in a neutral decision, potentially reflecting the respondent’s unconscious bias [4]. In order to check for questions that participants were consistently unable to answer, a seventh “No basis for judgement” option was added. The survey also included 14 demographic questions, including those on the following topics: age, length of enrollment, enrollment status, major, gender identity, race, ethnicity, first generation college attendee, and English as a first language. Demographic questions were purposefully placed at the end of the survey to avoid stereotype threat. Respondents were also asked to what extent their answers were affected by the ongoing COVID-19 pandemic. Finally, an open-response question was included at the end, “Is there something else that was not covered on the survey that you would like to share?” The question is intentionally phrased with the pronoun “something” rather than the more often seen “anything” as this alteration has been shown to invite participants to provide additional information instead of ending the conversation [5]. The items were piloted by two undergraduate volunteers and reviewed by two field experts. After this process, questions were reworded to be more consistent and precise.

*Analysis*

Descriptive statistics of quantitative items were conducted in R [6]. Open responses were analyzed by thematic analysis [7].

**Participants**

A total of 624 survey responses were collected (approximately 9% response rate). Fifteen engineering majors were represented in the sample. There was an approximately even distribution of students by year in program. There was an overrepresentation of students identifying as women, with the survey having a 40.5% response rate compared to the college’s 24%. Additionally, there was an underrepresentation of international students, as the survey had a response rate of 12.8% versus the college’s 22%. Participants self-reported their race and ethnicity, and they were allowed to select more than one option. A breakdown of the sample by self-reported race and ethnicity can be seen in Table 1. In our sample, there is an overrepresentation of White and Asian students, as the college has a total of 36% and 32%, respectively.

**Table 1. Representative self-reported race and ethnicity sample for undergraduate engineering students.** Students were allowed to select more than one option.

White	Asian	Indian / Indian subcontinent	Hispanic, Latino, or Spanish Origins	Black or African American	Native Hawaiian / Pacific Islander	Native American	Option not listed / Prefer not to answer
46.63%	41.67%	12.82%	7.85%	1.76%	0.32%	0.48%	4.97%

## Results

### *College Support and Diversity*

Overall, students feel positively about diversity and inclusion in the college. For example, 92% agreed that their engineering professors are welcoming to students of all genders and races. Eighty-five percent of respondents agreed that they do not feel an engineering professor has made them uncomfortable due to race or gender. Further, 89% of students say they disagree with the idea that their engineering college or department wants them to fail. Finally, 89% of students agreed that their engineering classes are respectful towards students from diverse backgrounds.

### *Normalized High Stress*

Undergraduate engineering students indicated they experience high stress levels and feel that it is normal and expected. In our sample, 95% of students agreed that high stress is an expected experience for engineering students. Additionally, 92% agreed that engineering students experience higher levels of stress compared to other majors on campus. The effects of stress are not unnoticed, as 96% of respondents indicated that physical health can be impacted by stress levels experienced by engineering students. While stressors were not a focus in our study, 86% of respondents agreed that they are stressed out by professors who do not teach effectively.

### *Concerns about Competition*

Students feel there is competition between themselves and their peers; 87% of respondents indicated that they compare their performance to peers. Also, 97% of students feel that other engineering students in their program can succeed. However, while 63% agreed that engineering students have to compete against other engineering students for grades, scholarships, and recognition for academic work, 61% disagreed that engineering professors expect competition among students.

### *Poor Working Habits*

Engineering undergraduates demonstrate a lack of self-care, shown by the fact that 70% agreed that students do not prioritize taking care of themselves. Further, 67% of respondents agreed that engineering students commonly skip meals to finish homework. Eighty-nine percent of respondents indicated they felt pressure to stay up late to complete work and 80% agreed that “all-nighters” were common.

### *No Basis for Judgement*

Students were consistently unable to answer questions regarding the mental health of others. For example, 28.2% used the “no basis for judgement” option regarding “Mental health issues are more common for engineering students compared to other majors on campus”. Further, 17.6% of respondents used this option for the item “Engineering professors are stressed”. In our sample, 16.2% of respondents indicated “no basis for judgement” for the item “My engineering college/department is supportive of students experiencing mental health issues”, indicating a need for better communication regarding mental health resources.

### *Themes from Student Open Response*

Of the 624 survey responses, 72 respondents provided additional comments to the final survey question “Is there something else that was not covered on the survey that you would like to share?”.

### Survey Design

A total of 11 students commented on the design of the survey and/or made suggestions for improvements. Two comments suggested possible additions to the survey to ask about disability and whether students work alone or in groups. One respondent expressed appreciation that they were able to choose multiple selections for the question “What is your race? (check all that apply)”. Five students shared that they felt some questions needed clarification or stated that they were “open to interpretation”, with two students specifically indicating that the questions about faculty were hard to answer and resulted in them using the “no basis for judgment” option. One student stated that the question “Engineering students experience a healthy amount of stress” was confusing, sharing:

The question about if I get a healthy amount of stress, I'm really not too sure about what is a healthy amount of stress. I thought stress by definition is unhealthy, however you get stressed in any demanding environment, so learning how to take it is "healthy" in that respect. Just something I was confused about.

Finally, three respondents shared that they felt their responses were specifically impacted by the ongoing COVID-19 pandemic.

### Stressors

The most common response was description of perceived stressors, with 45 students writing about one or more specific stressors they experienced. The most common stressor described was the ongoing COVID-19 pandemic, with 10 students sharing that the pandemic had increased their stress levels. For example, one student shared: “A lot of the stress and mental health issues that have come up are exacerbated by the pandemic.” Many students added that the lack of social interaction was particularly detrimental, for example:

I feel like COVID has caused the social aspects of college to be gone. It's been harder for me to meet friends because of the lack of in person classes and activities.

Other commonly shared stressors were caused by the COVID-19 pandemic, including the cancellation of spring break and challenges related to remote coursework. One student described mandated exam proctoring as “invasive and fails to consider students varying home lives and is an unnecessary stressor.” Additional stressors reported by students included discrimination, poor teaching, transferring majors or into engineering, coursework, “weed out” courses, large class sizes, and lack of support or understanding from faculty and staff.

### Culture

Nine participants shared comments about an expectation of engineering as a discipline being one of high stress and poor self-care. Some students described engineering generally compared to non-engineering disciplines and other students shared that they felt certain engineering disciplines were more stressful compared to other engineering majors. For example, one student

shared: “I believe it [engineering major] is expected to experience more stress and have mental health issues.” Other students described that poor self-care was common amongst their peers and that many students do not feel they have time to prioritize their health. For example, one student explained:

Too many of my peers, including myself, skip meals, do not sleep for a few days and feel as if they don't have time to take care of their mental, emotional and physical health outside of school.

Another student explained that some students have more “free” time for relaxation or to prioritize health but that this time comes at the “expense of their grades.” Other participants reiterated the feeling of lack of time to prioritize mental health:

I often here [sic] my peers discussing their mental health states, but they never actually take the time to plan for how they can improve their mental health. Simply because they "don't have the time to do so." When I see my engineering friends stressing about things or telling me about their schedules, I feel overwhelmed for them. However, my confidence for future success declines because I hear how much everyone else is doing. I feel that I am not doing enough, but I do not wish to put myself through the stress that others are going through.

Students expressed that competition was felt amongst peers and that schedules of engineering students were quickly overloaded. Students described themselves or peers as often being overcommitted to extracurricular activities, with some noting that these packed schedules led to increased stress. One student specifically discussed culture in engineering and offered a description of the root causes of this culture being students, and that it is exacerbated by faculty:

I think that the greatest issue with engineering is the culture in general. It's a result of a concentration of highly motivated and successful students, many of which are male, who are competitive both intentionally (in some cases) and unintentionally (in most cases, since many gifted students compulsively feel that drive)... While a lot of the negative aspects of the engineering community arise naturally from the type of students, it's up to the university to work to actively dismantle that.

Interestingly, this student explained that while many aspects of the negative culture could be attributed to the students, it is the university's role to “dismantle” this culture.

#### *Need for Resources/Support*

Nine participants indicated that they felt additional resources and support were needed to support undergraduate mental health. Multiple students offered suggestions for additional resources including additional counselors, sending more emails, and resources to support time management. One student suggested that additional counselors should be a priority, noting that they felt this was a greater need over “promoting awareness and acceptance”.

#### *Supportive Faculty and Staff*

Five students wrote about the specific support they had received from faculty and staff in the college that supported their success. Two students credited faculty being understanding during the pandemic. For example: “I’ve definitely seen for the most part engineering faculty be very understanding and helpful during the COVID-19 pandemic.” Another student wrote about the support they received from their academic advisor and how they supported them to find the “courage and willpower” to seek help at the counseling center.

### Appreciation

Four respondents expressed their appreciation to the college for conducting a survey related to mental health, with one student sharing “Please loudly share the results of this survey.”

### **Discussion**

The pilot survey offered an opportunity to further refine survey items. In addition to identifying items that many students felt unable to answer (by selecting the “No basis for judgment” option), students also identified some of these questions in the open response question. These analyses will support whether or not to retain items in future iterations of the survey. Students also provided suggestions for additional survey questions, including the extent to which students work in groups. One student shared “Disability has impacted my experience as an engineering student more than race or gender has”, illustrating the need for the survey to better capture stress experienced by students with disabilities. Finally, one respondent indicated that they were confused by the label “healthy” in relation to stress, sharing that they felt stress was always unhealthy. This response highlights the importance of understanding how students think and communicate about stress, particularly given its colloquial use to describe a range of experiences.

The pilot survey also identified student stressors. The stressors for engineering undergraduate students are largely in agreement with our previous work [8] surveying undergraduate students, with the main exception of the stressor of the COVID-19 pandemic, which created and exacerbated stressors described by students. These findings underscore the need for additional research and supports for students during and after the COVID-19 pandemic. The emphasis some students placed on culture indicate the need to foster cultures of wellness [9]; students in our study suggested that events hosted by the college that support student well-being and promote positive culture in engineering could help to create these environments. Creating a culture of wellness in engineering programs could also be achieved through wellness activities being incorporated into the curriculum [10-12] or offering wellness programs tailored to meet the needs of engineering students [13]. Collectively, the survey underscored the need for additional research and resources for undergraduate student mental health, including opportunities to share their experiences, concerns, and recommendations with faculty and college administrations.

### **Future Work**

We are currently using Exploratory Factor Analysis (EFA) to identify latent factors for the survey. Our preliminary analysis identified 9 latent factors, retaining 51 items. In future work, these survey items will be combined with existing measures of mental health (stress, anxiety, and depression) [14], retention [15], and perceptions of inclusion [16] in a longitudinal design. The

planned data collection will include first-year students from across engineering disciplines and invite them to participate in regular surveys (twice per semester) over the course of four years. We will further expand our work to include interviews with engineering students, faculty, and staff. The interviews will provide additional perspectives on supporting mental health in undergraduate engineering programs and contribute to an increased understanding of the engineering student experience with mental health. Overall, the insight gained from this project will be leveraged to develop proactive interventions to support student well-being.

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