Empirical Study of Growth Mindset of Chemical Engineering students across gender, year of study, and social, academic, and identity factors

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Introduction

This full paper describes an empirical study of growth mindset among undergraduate chemical engineering students. We specifically looked at how students differ in their growth mindset across gender and year of study (year) and how growth mindset correlates with social, academic, and identity factors. Growth mindset differentiates people who believe that intelligence is fixed and nonmalleable (fixed mindset) vs. people who believe that intelligence can be changed and developed and can therefore improve over time and effort (growth mindset) [1]. This mindset can change the way students respond to challenges (like a hard engineering test). Students with a fixed mindset will fail a test and think "I am dumb" while students who have a growth mindset with think "I need to study harder".

There have been many studies looking at growth mindset and student success. In 2019, a large study of 15,000 students and 150 STEM faculty showed that the racial achievement gap was larger in classes where the faculty had a fixed mindset [2]. A review study in 2021 found mixed results in incorporating growth mindset interventions [3], while another study found that these interventions are most beneficial for students from lower socioeconomic backgrounds and for minority students [4]. Specifically, one growth mindset intervention study found that a growth mindset for students of lower-income families significantly mitigated the effects of poverty on achievement [5]. Similarly, prior research on a small group of chemical engineering students found that a growth mindset intervention narrowed the existing gender gap for the control group, in which women had lower growth mindset than men [6]. These findings suggest that growth mindset can also have non-academic impacts.

With the goal of increasing growth mindset among our students, we first wanted to assess the students that we do have and what factors correlated with growth mindset. This work is a continuation of our previous work where we looked at engineering identity, collective self-esteem, belonging, peer inclusion, and hegemonic masculinity and found significant differences in all scales for men vs. women [7].

In exploratory analysis for this work, we found a significant correlation between growth mindset and social scales such as hegemonic masculinity and peer inclusion. At that point, we decided to look more closely at some of the subscales in the instruments we used and shifted our focus to examining the connection between growth mindset to various social, academic, and identity factors. We were particularly concerned with the following research questions:

1. How do chemical engineering undergraduate students differ in their growth mindset across gender and year?
2. How does a growth mindset correlate with social, academic, and identity factors for chemical engineering undergraduate students?

Methods

We surveyed a total of 340 students in the chemical engineering department in three separate required courses that are typically taken during the 2nd, 3rd, and 4th year. Each course is a pre-requisite for the following course. By surveying all three courses, we are sampling a large sector of our student population across years of study. A Qualtrics survey approved by the Institutional Review Board was given to students in these three classes at the end of the Spring 2024 and Fall

2024 semesters. Students received extra credit for their participation in the survey, agreed to by all instructors of the courses, and an alternative assignment was offered to grant extra credit if they did not want to complete the survey. Some students may have taken the survey twice (if they repeated the course or if they moved on to the next course in the sequence). We did not remove those who repeated the survey response in different courses because we wanted to capture the experience of each student in each class. This study took place at The Pennsylvania State University, which is a large R1 university that graduates 125-200 students a year.

After reading a consent statement (see Appendix A), students completed established measures of Engineering Identity (ENG ID) [8], Collective Self-Esteem (CSE) [9], Belonging and Sense of Social and Academic Fit (SSAF) [10], and Peer Inclusion (PEER) [11], Hegemonic Masculinity (HM) [12], and Growth Mindset (GROWTH) [2] as shown and referenced in Table 1 (see Appendix B for the full measures used). The table also shows the different subscales for some of these instruments. The collective self-esteem instrument was adapted from [9] to read "chemical engineer" as the group. Each measure used a seven-point Likert scale from (1) strongly agree to (7) strongly disagree. For the growth mindset questions, we decided to use the two questions used in the work of Cannings *et al.* [2] as these were the questions we asked our faculty previously [13].

1. *You have a certain amount of intelligence, and you really can't do much to change it.*
2. *Your intelligence is something about you that you can't change very much.*

Table 1: Instruments and subscales used in survey and analysis

Instrument Name and subscales (if any)	**# of Items**	**Reference**	Cronbach Alpha
Engineering Identity (ENG ID) - Recognition - Interest - Performance/competence	13	Godwin 2016 [8]	**0.87**
Collective Self-Esteem (CSE) - Membership - Private - Public - Identity	16	Luhtanen & Crocker 1992 [9]	**0.81**
Belonging: Sense of Social and Academic Fit (SSAF) - Academic fit - Social fit	10	Walton et al. 2023 [10]	**0.86**
Peer Inclusivity: Connection to Peer Relations and Engineering Identity (PEER)	10	Davis et al. 2023 [11]	**0.76**
Hegemonic Masculinity (HM) (e.g., masculine role norms) - Masculine power & status - Anti-femininity - ~~Toughness~~ (Not used)	18	Vescio & Schermerhorn, 2021 [12]	**0.90**
Growth Mindset (GROWTH)	2	Canning et al. 2019 [2]	**0.80**

Our exploratory analysis indicated a strong, significant correlation between growth mindset, hegemonic masculinity, and peer inclusion. We considered hegemonic masculinity and peer inclusion to be scaled relating to social beliefs, and this finding motivated us to explore the

different connections of growth mindset with social, academic, and identity factors. Most of the scales we included in our survey had subscales established by the authors, as seen in Table 1. We determined the internal validity of each scale through the Cronbach Alpha, but we did not change the scales or subscales in our classification of each as social, academic, or identity. We defined social factors as relating to social beliefs, academic factors as relating to beliefs about performance, and identity factors as relating to beliefs about who you are or how others see you/your group. The classification and validation of each scale can be found in Table 2 below.

Table 2. Classification of scales and subscales within Identity (how you see yourself or others see you), Academic (beliefs about your performance), and Social (social beliefs). The Cronbach alpha shows the validation of each subscale using our data. Note that peer inclusion does not have any subscales.

Instrument	Subscale	Summary statement representing scale or subscale	Classification	Cronbach Alpha
ENG ID	Recognition	"People see me as an engineer."	Identity	.76
	Interest	"I am interested in engineering."	Identity	.85
	Performance/Competence	"I believe I am good at engineering."	Academic	.85
CSE	Membership	"I am a good ChE group member."	Academic	.73
	Private	"I think ChE is good."	Identity	.79
	Public	"Others think ChE is good."	Identity	.68
	Identity	"I identify as a ChE."	Identity	.81
SSAF	Academic Fit	"I am like others who do well in ChE."	Academic	.67
	Social Fit	"I fit in with others in ChE."	Social	.84
Peer Inclusion	-	"I feel respected, included, and valued by my peers."	Social	.76
HM	Power & Status	"I agree that men should be high in power and status"	Social	.89
	Anti-Femininity	"I agree that men should not be feminine."	Social	.82

Students were also asked to give their demographic information in addition to their survey answers, such as race, gender, sexual orientation, socio-economic status, whether they were an international student, and whether they started at a satellite campus. They also self-reported their GPA. Table 3 shows the breakdown of students in this analysis based on year and gender identity. Note that there were 5 genderqueer/gender non-confirming students who completed the survey and were not included in this analysis. There was also one student who did not select a year or a gender identity.

While this paper will focus on gender differences among the scales, gender is more complex than the binarized system that is often required for statistical significance. We hope this research primarily functions as a foundation for understanding the role of hegemonic masculinity in engineering rather than a limiting view and understanding of gender. The distribution of students across gender and year can be found in Table 3 below.

Table 3. Distribution of students by year and gender identity. Parentheses indicate the typical year students take this course.

Year	# of Men	# of Women	Total
Material Balances (2nd year)	75	50	125
Fluid Mechanics (3rd year)	69	40	109
Chemical Kinetics (4th year)	67	33	100
Total	211	123	334

Positionality

The first author is a white lesbian who believes in the expansiveness of self, gender, and sexuality. Her motivation to research the experiences of belonging and identity for LGBTQ+ undergraduate engineering students comes from her own experiences and observations of her peers. Her academic background is in chemical engineering, sexuality and gender studies, and engineering education. Moreover, as a chemical engineering student at the Pennsylvania State University, the participants are her peers. This "insider" position impacted her understanding of the participants and her ability to connect with the participants who were also queer women in the chemical engineering program.

The second author is a white cis-gender woman who recognizes that her experience and perspective are shaped by her identity and privilege and that her interpretation and analyses are informed by these experiences. She has spent years creating equitable opportunities for students.

Results

To address the first research question, we submitted an analysis of variance (ANOVA) between participants for growth mindset based on gender (man, woman) and by year (2nd, 3rd, 4th). A significant gender difference for growth mindset did not emerge, $F(1, 334) = 2.8$, $p = .098$, $\eta_p^2 = .01$. A significant difference by year also did not emerge, $F(1, 334) = 0.7$, $p = .507$, $\eta_p^2 = .00$. The gender by year interaction on growth mindset was also not significant, $F(1, 334) = 1.7$, $p = .182$, $\eta_p^2 = .01$. Moreover, there was no significant gender difference across between students of the same gender across different years, but a significant different between men ($M = 4.49$) and women ($M = 5.14$) in the third-year fluid mechanics class did emerge ($p = .026$). These findings are visualized in Figure 1.

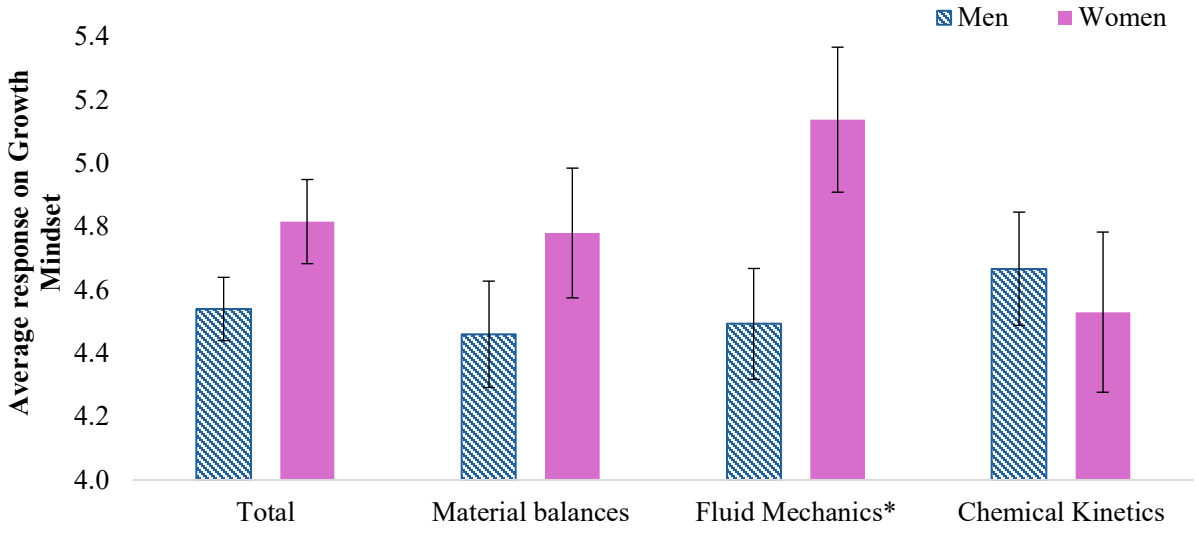

*Figure 1. Average responses for men and women on a 7-point Likert scale for growth mindset questions split by gender and year.). Note: * indicates $p < 0.05$, ** indicates $p < 0.01$.*

We then conducted a bi-variate correlation of engineering identity, collective self-esteem, sense of social and academic fit, peer inclusion, hegemonic masculinity (power & status and anti-femininity), growth mindset, and GPA. These results are seen in Table 4, and the table is split by gender to examine the different manifestations of growth mindset for students of different genders.

Table 4. Correlations between measures and GPA split by gender identity. (Note: Men are shown on the bottom, left triangle of the table; women are shown on the top, right triangle of the table.)

	GROWTH	GPA	PEER	HM PS	HM AF	ENG ID	CSE	SSAF
GROWTH	1	-.279**	.294**	-.246**	-.376**	.095	.241**	.112
GPA	.043	1	.160*	-.100	-.043	.274**	.241**	.296**
PEER	.302**	.023	1	-.135	-.192*	.512**	.526**	.668**
HM PS	-.288**	.071	-.123	1	.340**	.058	.063	.054
HM AF	-.222*	.036	-.216**	.469	1	.085	-.043	.053
ENG ID	.284**	.142	.567**	-.044	-.156	1	.583**	.738**
CSE	.154	-.021	.437**	-.005	-.060	.639**	1	.502**
SSAF	.217*	.275**	.673**	-.045	-.072	.756**	.655**	1

* Indicates $p < 0.05$, ** indicates $p < 0.01$

Like our last paper, we found a significant correlation between engineering identity (ENG ID), collective self-esteem (CSE), sense of social and academic fit (SSAF), and peer inclusion (PEER) for both men and women, but we saw a correlation between endorsement of hegemonic masculinity and only the anti-feminine subscale of hegemonic masculinity (HM AF) [7].

Based on previous research, we were curious about the correlation between growth mindset and GPA – especially as it relates to gender. We found a correlation between growth mindset and GPA for women but not for men. The correlation for women was significant but negative, which indicates that women with a lower GPA have more of a growth mindset. This is encouraging at some level because it means that lower-performing women believe that they can improve with effort.

Table 4 shows a significant correlation between growth mindset and peer inclusion (PEER) and both subscales of hegemonic masculinity (HM). Men and women both had a significant, positive correlation between growth mindset and peer inclusion, indicating that students who have a growth mindset were more likely to feel included by their peers. However, both men and women also had a significant negative correlation between growth mindset and hegemonic masculinity for both power & status and anti-femininity; students with a growth mindset were less likely to endorse hegemonic masculinity.

We considered these to be social factors, and this then led us to explore other factors in the data such as academic and identity factors. We separated the remaining instruments (engineering identity, collective self-esteem, and sense of social and academic fit) by their subscales into social, academic, and identity classifications for further analysis (see Table 2). The goal of this separation was to explore how growth mindsets correlate to factors within each classification. For this analysis, we compared the variable correlations as well as submitting each variable to a one-way analysis of variance (ANOVA) to determine significant gender differences (see Appendix D).

Social Factors

We considered social factors to be any subscale relating to social beliefs, particularly social fit among peers or the endorsement of social and cultural ideologies. Table 5 shows the correlations between growth mindset and each social subscale as split by women and men.

Table 5. Correlations between Social Factors and Growth Mindset Separated by Men and Women.

GROWTH	SSAF: Social Fit	Peer Inclusion	HM: Power & Status	HM: Anti-Femininity
Women	.244**	.302**	-.250**	-.222*
Men	.189**	.294**	-.246**	-.376**

* Indicates $p < 0.05$, ** indicates $p < 0.01$

The correlation between growth mindset and each social factor (social fit, peer inclusion, power & status, and anti-femininity) was significant for both men and women. The correlations for the subscales of hegemonic masculinity were negative, and the correlations for social fit and peer inclusion were positive. However, significant gender differences emerged only for power & status, $F(1, 334) = 23.4$, $p = <.001$, $\eta_p^2 = .08$, and anti-femininity, $F(1, 334) = 31.7$, $p = <.001$, $\eta_p^2 = .09$. The gender difference for social fit was marginally significant, $F(1, 334) = 3.24$, $p = .073$, $\eta_p^2 = .01$.

Academic Factors

We considered academic factors to be any subscale relating to performance (as an engineer or as a member) or outcome in an academic setting. Table 6 shows the correlations between growth mindset and each academic subscale as split by women and men.

Table 6. Correlations between Academic Factors and Growth Mindset Separated by Men and Women.

GROWTH	ENG ID: Performance/ Competence	CSE: Membership	SSAF: Academic Fit	GPA
Women	.243**	.243**	.127	-.279**
Men	.064	.167*	-.040	.043

* Indicates $p < 0.05$, ** indicates $p < 0.01$

As mentioned, the correlation between GPA and growth mindset was significant and negative for women yet absent for men. This trend of significance continued as performance/competence in engineering identity (ENG ID) and Membership in collective self-esteem (CSE) were both positively and significantly correlated for women. Performance/competence describes the participant's sense of their performance in engineering, and membership refers to how good of a group member the participant believes they are. The only significant correlation for men was between membership and growth mindset, and the correlation value was weak. The correlation between academic fit and growth mindset was not significant for either women or men. Moreover, significant gender differences emerged only for performance/competence, $F(1, 334) = 14.7$, $p = <.001$, $\eta_p^2 = .04$, and Membership, $F(1, 334) = 12.5$, $p = <.001$, $\eta_p^2 = .04$.

Identity Factors

We considered identity factors to be subscales relating to beliefs about who students are or how others see students/their groups. Table 7 shows the correlations between growth mindset and each identity subscale as split by women and men.

Table 7. Correlations between Identity Factors and Growth Mindset Separated by Men and Women.

GROWTH	CSE: Private	CSE: Public	CSE: Identity	ENG ID: Recognition	ENG ID: Interest
Women	.159	.056	-.029	.217*	.230
Men	.220**	.183*	.104	.064	.121

* Indicates $p < 0.05$, ** indicates $p < 0.01$

The correlations between growth mindset and the identity factors were limited. For men, growth mindset was significantly correlated with the public and private subscales of collective self-esteem (CSE), which were concerned with the participant's sense of other's views of chemical engineers and their views of other chemical engineers, respectively. For women, growth mindset was significantly correlated only with recognition of engineering identity (ENG ID), which describes the participant's sense of whether others see them as an engineer. Moreover, significant gender differences emerged only for the Identity subscale of collective self-esteem, $F(1, 334) = 6.11$, $p = .014$, $\eta_p^2 = .02$.

Discussion

We expected to find a difference in the measured growth mindset across participants of different genders and years. However, we found that a student's growth mindset does not vary significantly with their gender or year. We found a significant gender difference among students in Fluid Mechanics (typically taken in 3rd year) but not students in either Material Balances (typically taken in 2nd year) or Chemical Kinetics (typically taken in 4th year). However, the differences in instructors of the classes, particularly their gender and inclusion of material that may encourage growth mindset, inhibit any conclusion about this finding. Prior research has found a gender gap for chemical engineering students who did not experience a growth mindset intervention [3], which aligns with our student population, but we did not find the same result.

We found a significant negative correlation for women between GPA and growth mindset, but that correlation was absent for men. This finding suggests that having a growth mindset may have different academic impacts for women compared to men. According to the correlation, women who perform better according to GPA have more of a fixed mindset. Given the significant positive correlation for women between belonging and GPA (see Table 4), women may measure their belonging in chemical engineering primarily through their academic performance. Therefore, they adopt a fixed mindset because they already belong as engineers and are performing well.

We also found a significant gender difference in performance/competence of engineering identity and membership of collective self-esteem. These two factors were also significantly and positively correlated with a growth mindset for women, but only membership was significantly correlated with a growth mindset for men. Performance/competence and membership both address how students evaluate their ability to perform as an engineer and group member, and the connection to growth mindset implies a connection to intelligence and performance that is different than that of GPA.

There is a significant correlation between social factors, such as hegemonic masculinity and peer inclusion, and growth mindset for both men and women. In prior work [7], we found a negative correlation between peer inclusion and anti-femininity for men, meaning that men who endorse anti-femininity are more likely to feel excluded by their peers, which was replicated in this analysis and extended to include women. The positive correlation between growth mindset and peer inclusion, the negative correlation between growth mindset and hegemonic masculinity, and the negative correlation between peer inclusion and hegemonic masculinity suggest a triangulation of these factors. This finding could have implications for determining the role of hegemonic masculinity in the experience of inclusion, identity, and belonging, but further analysis is required to develop a model of these factors and their interactions.

For identity factors, the only correlation for women with a growth mindset was the recognition component of engineering identity, which insinuates that a growth mindset for women in chemical engineering may benefit from external acknowledgment of their engineering abilities. For men, growth mindset was significantly correlated with the public and private components of collective self-esteem, which implies that their growth mindset may be influenced by their own and other's views of chemical engineers rather than their embodiment of a chemical engineer.

Conclusion

This work originated with an interest in the connection between a growth mindset with hegemonic masculinity but has expanded into an empirical analysis of how growth mindset is related to various academic, social, and identity factors across gender and year. While we found no significant differences between students of different genders and years, the strongest series of growth mindset correlations for both men and women were found with social factors, such as peer inclusion and hegemonic masculinity. While future work will develop a model for the triangulation of peer inclusion, growth mindset, and hegemonic masculinity, we offer the conclusion that growth mindset should be explored further as a social phenomenon.

This work suggests growth mindset interventions have the potential to improve a sense of inclusion among all students and to improve women's beliefs about their academic performance. Future work could include qualitative interviews to connect this data to students' lived experiences in the classroom.

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Appendix A. Consent Statement

You are being invited to volunteer to participate in a research study. This summary explains information about this research.

This study examines how engineering students feel about their classes and their major course of study. You will be asked to answer questions in which you indicate your perceptions of the importance of your major, your peers, and your engagement. We will also ask you to provide us with some simple demographic information. There will be no information that links your identity to your individual responses and all data will be kept by the Principal Investigator and Research Associates. Information collected in this project may be shared with other researchers, but we will not share any information that could identify you. You will earn course credit for participating. Alternative means are also available for earning course credit as specified. If you have questions, complaints, or concerns about the research, you should contact [name] at [email]. If you have questions regarding your rights as a research subject or concerns regarding your privacy, you may contact the [office] at [phone number]. Your participation is voluntary, and you may decide to stop at any time. You do not have to answer any questions that you do not want to answer.

Your participation implies your voluntary consent to participate in the research.

Appendix B. Complete Instruments Used in Survey

- Note: the scales appear in the same order they appeared to the participants.
- Note: (R) is used to indicate reverse scoring of an item.

Engineering Identity Godwin, A. (2016). The Development of a Measure of Engineering Identity. *2016 ASEE Annual Conference & Exposition Proceedings*

Instructions: To what extent do you agree or disagree with the following statements:

1. My parents see me as an engineer. (R)
2. My instructors see me as an engineer. (R)
3. My peers see me as an engineer. (R)
4. I have had experiences in which I was recognized as an engineer. (R)
5. I am interested in learning more about engineering. (R)
6. I enjoy learning engineering. (R)
7. I find fulfillment in doing engineering. (R)
8. I am confident that I can understand engineering in class. (R)
9. I am confident that I can understand engineering outside of class. (R)
10. I can do well on exams in engineering. (R)
11. I understand concepts I have studied in engineering. (R)
12. Others ask me for help in this subject. (R)
13. I can overcome setbacks in engineering. (R)

Collective Self-Esteem Luhtanen, R., & Crocker, J. (1992). A Collective Self-Esteem Scale: Self-Evaluation of One's Social Identity. *Personality and Social Psychology Bulletin, 18(3), 302–318.*

Instructions: We are all members of different social groups or social categories. Some social groups or categories pertain to gender, race, religion, nationality, ethnicity, and socioeconomic class. We earn our membership into other social groups, like professions and achievement-based groups. We would like you to consider your memberships in those particular groups or categories and respond to the following statements on the basis of how you feel about those groups and your memberships in them.

There are no right or wrong answers to any of these statements; we are interested in your honest reactions and opinions. Please read each statement carefully, and respond by using the following scale from 1 to 7:

1. I am worthy of being a chemical engineer. (R)
2. I often regret that I chose chemical engineering.
3. Overall, chemical engineers are considered good by others. (R)
4. Overall, being a chemical engineer has very little to do with how I feel about myself.
5. I feel I don't have much to offer chemical engineering.

6. In general, I'm glad to be a chemical engineer. (R)
7. Most people consider chemical engineers, on the average, to be more ineffective than other groups.
8. Being a chemical engineer is an important reflection of who I am. (R)
9. I am a cooperative participant in groups of chemical engineers. (R)
10. Overall, I often feel that being a chemical engineer is not worthwhile.
11. In general, others respect chemical engineers. (R)
12. Being a chemical engineer is unimportant to my sense of what kind of a person I am.
13. I often feel I'm a useless member in groups of chemical engineers.
14. I feel good about being a chemical engineer. (R)
15. In general, others think that chemical engineers are unworthy.
16. In general, being a chemical engineer is an important part of my self-image. (R)

Sense of Social and Academic Fit Walton, G. M., Logel, C., Peach, J., Spencer, S, & Zanna, M. P. (Accepted pending minor revisions). Two brief interventions to mitigate a "chilly climate" transform women's experience, relationships, and achievement in engineering. *Journal of Educational Psychology.*

Instructions: Answer the following questions about what **chemical engineering** is like for you. Indicate the extent to which you agree or disagree with each statement using the scales below.

1. I belong in chemical engineering at Penn State. (R)
2. I feel comfortable in chemical engineering at Penn State. (R)
3. Other people understand more than I do about what is going on in chemical engineering at Penn State.
4. I think in the same way as people who do well in chemical engineering at Penn State. (R)
5. It is a mystery to me how chemical engineering at Penn Stateworks.
6. I feel alienated from chemical engineering at Penn State.
7. I fit in well in chemical engineering at Penn State. (R)
8. Compared with most other chemical engineering students at Penn State, I am similar to the kind of people who succeed in chemical engineering. (R)
9. Compared with most other students at Penn State, I know how to do well in chemical engineering. (R)
10. Compared with most other chemical engineering students at Penn State, I get along well with people in chemical engineering. (R)

Peer Inclusivity: Connection to peer relations and engineering identity. Davis, S. C., Nolen, S. B., Cheon, N., Moise, E., & Hamilton, E. W. (2023). Engineering climate for marginalized

groups: Connections to peer relations and engineering identity. *Journal of Engineering Education.*

Instructions: Please indicate how much you agree with each statement about interacting with **peers** in chemical engineering.

1. My chemical engineering peers respect my ideas. (R)
2. In chemical engineering, people tend to ignore me.
3. Most of my chemical engineering peers are comfortable working with me. (R)
4. It is too hard to work with people who do not share my home language.
5. I have friends in chemical engineering with whom I can really be myself. (R)
6. Some of my peers think people like me should not be in chemical engineering.
7. Working in groups, I am able to influence our decisions. (R)
8. I am not appreciated for the work I do in chemical engineering groups.
9. My chemical engineering peers often interact with me based on stereotypes.
10. I often socialize with chemical engineering peers outside of class. (R)

Hegemonic Masculinity Thompson Jr, Edward H., and Joseph H. Pleck. "The structure of male role norms." *American Behavioral Scientist* 29, no. 5 (1986): 531-543.

Instructions: Please indicate your agreement with each of the following statements.

1. Success in his work has to be man's central goal in this life. (R)
2. The best way for a young man to get the respect of other people is to get a job, take it seriously and do it well. (R)
3. A man owes it to his family to work at the best-paying job he can get. (R)
4. A man should generally work overtime to make more money whenever he has the chance. (R)
5. A man always deserves the respect of his wife and children. (R)
6. It is essential for a man to always have the respect and admiration of everyone who knows him. (R)
7. A man should never back down in the face of trouble. (R)
8. I always like a man who's totally sure of himself. (R)
9. A man should always think everything out coolly and logically, and have rational reasons for everything he does. (R)
10. A man should always try to project an air of confidence even if he really doesn't feel confident inside. (R)
11. A man must stand on his own two feet and never depend on other people to help him do things. (R)

12. It bothers me when a man does something that I consider “feminine.” (R)
13. A man whose hobbies are cooking, sewing, and going to the ballet probably wouldn’t be my kind of guy. (R)
14. It is a bit embarrassing for a man to have a job that is usually filled by a woman. (R)
15. Unless he was really desperate, I would probably advise a man to keep looking rather than accept a job as a secretary. (R)
16. If I heard about a man who was a hairdresser and a gourmet cook, I might wonder how masculine he was. (R)
17. I think it’s extremely good for a boy to be taught how to cook, sew, clean the house, and take care of younger children. (R)
18. I might find it a little silly or embarrassing if a male friend of mine cried over a sad love scene in a movie. (R)

Appendix C. Separation of Measures by Subscales into Academic, Social, and Identity Factors.

Instrument	Subscale	Category
ENG ID	Recognition	Identity
	Interest	Identity
	Performance/ Competence	Academic
CSE	Membership	Academic
	Private	Identity
	Public	Identity
	Identity	Identity
SSAF	Academic Fit	Academic
	Social Fit	Social
Peer Inclusion	-	Social
HM	Power & Status	Social
	Anti-Femininity	Social

Appendix D. Significant Gender Differences for Each Subscale

Instrument	Subscale	Women	Men	*F*	*p*	η_p^2
ENG ID	Recognition	5.30	5.35	.191	.662	.00
	Interest	5.80	5.78	.015	.903	.00
	Performance/ Competence**	5.05	5.47	14.7	<.001	.04
CSE	Membership**	4.87	5.28	12.5	<.001	.04
	Private	5.13	5.25	1.02	.313	.00
	Public	5.89	5.82	.623	.431	.00
	Identity**	4.42	4.09	6.11	.014	.02
SSAF	Academic Fit	4.24	4.37	1.28	.259	.00
	Social Fit[m]	5.10	5.30	3.24	.073	.01
Peer Inclusion	-	5.16	5.16	.000	.984	.00
HM	Power & Status**	3.48	4.15	23.4	<.001	.08
	Anti-Femininity**	2.65	3.30	31.7	<.001	.09

* Indicates $p < 0.5$, ** indicates $p < 0.01$