The social construction of professional shame for undergraduate engineering students

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Abstract

Background: Shame is a deeply painful emotion people feel when they perceive that they have fallen short of socially constructed expectations. In this study, professional shame refers to shame experiences that stem from people's perceptions that they have failed to meet expectations or standards that are relevant to their identities in a professional domain. While socially constructed expectations placed on engineering students have been implicitly addressed in the engineering education literature, they have rarely been the subject of specific inquiry.

Purpose: As part of a broader study on professional shame in engineering, we investigated the co-construction of social worlds that place expectations on engineering students.

Method: We conducted 10 ethnographic focus groups with undergraduate engineering students from two universities. These groups were either heterogeneous or homogeneous, regarding racial and gender identity, to examine multiple social realities.

Results: We present significant findings related to engineering students' collective noticing, defining, and experiencing of social worlds. The findings give a sense of overlapping but distinct social realities among student groups and highlight how failing to meet expectations can contribute to deeply painful emotional responses. We also note when students' responses reproduce, resist, or redefine the broader cultural norms in which the students are embedded.

Conclusions: The study has implications for the theoretical exploration of shame, engineering education research on identity and diversity and inclusion, and the messaging and interactions in which the engineering education community engages.

KEYWORDS
cultural schemas, engineering culture, gender, professional shame, race/ethnicity, social construction
1 | INTRODUCTION

A White male engineering student described his typical experiences in engineering classes in the following manner:

One thing that I’ve noticed is that people, sometimes they’re nervous to ask questions, because there is this perception that people think engineers, they should know everything the first time and understand it. So it can be intimidating when you don’t understand it, and you need help.

As this student explains, the expectations that engineering students should understand things quickly can create an environment in which students are afraid to ask for help when they need it. In this case, a widely held belief about engineers’ presumed intelligence seemed to contribute to the student feeling intimidated. At the same time, the student then perpetuated the belief by participating in a social world wherein students project confidence rather than admitting they need help.

This quote exemplifies the focal phenomenon that we explore: that students’ painful experiences often occur in a social context of expectations created by and for engineers and engineering students at multiple levels of societal interaction. This article is the result of an ethnographically informed study of students’ social contexts at two universities. The article will document ways that students experience, notice, define, and redefine expectations placed on them within their social worlds. Our findings implicate the design of learning environments, conceptions of diversity and inclusion, and the propagation of engineering culture.

1.1 | Context of the study

A larger research project that focused on professional shame in engineering education informed the present manuscript. That project proposed the following three research questions:

RQ1: How do students psychologically experience shame in the context of engineering education? Huff et al. (2021) investigated RQ1.
RQ2: How are these experiences located and socially constructed within the institutional cultures of engineering programs? RQ2 is the topic of this paper.
RQ3: In the context of engineering education, how do individual psychological experiences of shame interact with perceived cultural expectations? Huff et al. (2020) examined RQ3.

In this study, we define shame as a strikingly painful, self-conscious emotion that involves a global devaluation of the self (Lewis, 1971; Tangney & Dearing, 2002). Yet, while shame is experienced at an individual level, it emerges in social contexts where, as Scheff (2003) described, there is “a threat to the social bond” (p. 255). We conceptualize shame, therefore, as a sociopsychological construct resulting from interactions between cultural expectations and individuals’ internal evaluations of the “real or perceived failure of meeting [those] expectations” (Brown, 2006, p. 45).

Building on this definition, we use the term professional shame to characterize shame experiences occurring on individual and collective levels within a professional domain. In this study, we view engineering education as a context of professional socialization where students are continually engaging in identity questions regarding who they are as engineers (Cech, 2014; Huff et al., 2019; Tonso, 2006a, 2006b; Walther et al., 2011, 2020) while evaluating the bond between themselves and socially constructed expectations. Accordingly, based on psychological and sociological literature, we conceptualize professional shame as having four key characteristics:

(1) Individuals perceive themselves to have failed to meet socially constructed expectations that are relevant to their identities in a professional domain; (2) individuals experience a painful emotional state amid such perceived failure; (3) individuals attribute the failure to meet expectations to an inadequate whole, or global, self rather than a domain-specific feature of a certain identity; and (4) individuals within professional domains not only experience the emotional state of shame but also contribute to expectations that establish the conditions for professional shame to occur (Huff et al., 2021).
For example, students might experience professional shame when failing to achieve a high grade on an engineering course exam. They perceive their performance as relevant to who they are as engineering students (characteristic 1) and experience a painful emotional state if they believe that their performance contradicts their perceptions (characteristic 2). In such an experience, they feel as if they are a failure as a whole person, not just as an engineering student (characteristic 3). However, they may also implicitly or explicitly propagate messages to other engineering students that it is important for engineering students to achieve high grades (characteristic 4). In our previous research, we used interpretative phenomenological analysis (IPA), which involves intensive one-on-one interviews to unpack participants’ emotional experiences, to examine White male engineering students’ internal emotional worlds related to professional shame (RQ1). The investigation yielded three key findings:

1. Professional identity development is deeply intertwined with the lived experience of professional shame.
2. In responding to the experience of professional shame, dominant individuals (e.g., White male engineering students) can maladaptively behave in ways that perpetuate the cycle of shame for themselves and others.
3. Professional shame can also constructively motivate individuals toward positive outcomes of self-improvement by encouraging them to cognitively reconstruct the experience in ways that separate their self-evaluations from their perceived failure.

Since White men make up the dominant race-gender social group in engineering education (Faulkner, 2007; Pawley, 2009; Secules, 2019), we were particularly interested in their experiences of shame and the relationship between their patterns of coping with shame and exclusionary behaviors that marginalize others (Bond, 2009; Tangney & Dearing, 2002). For example, when experiencing professional shame, some White male participants reinforced the very social expectations they failed to achieve, either by ego-defensive responses (e.g., blaming others for their failures) or by avoidant responses (e.g., not allowing others to see the failure). While the IPA study enabled us to examine the lived experiences of shame in White male students, we were limited in our ability to investigate the shared social contexts in which these emotional experiences occur (Huff et al., 2021). (NB: In this paper we use male as an adjective for masculine gender, although we recognize that it formally refers to biological sex.)

In this article, we report our findings from an ethnographic focus group study in which we sought to examine circumstances that create the emotional experiences of students’ private, intrapsychic worlds (RQ2). Our ethnographic study links to the IPA study through the construct of expectations, or the rules and ways of being that shape the social bonds within engineering cultures (Scheff, 2003). Rather than studying these individual experiences with the same focus as in the parallel IPA study, we asked broad questions about the socially constructed expectations, standards, and narratives influencing engineering students’ shared social realities. Since such expectations are the framework for students to individually experience a range of significant emotions, including guilt, pride, and shame (Tangney & Dearing, 2002), we focus on the collective processes that form socially constructed expectations.

2 | LITERATURE REVIEW: EXPECTATIONS AND EXPERIENCES IN ENGINEERING EDUCATION

We situate our ethnographic focus on expectations in relation to the nearest body of scholarship within engineering education research, namely qualitative inquiries that have focused on student experiences in engineering programs. Specifically, we review studies that have examined factors that influence identity formation and marginalization in engineering, and how institutional and classroom cultures intersect with student experiences. Across these studies, student experiences point to the presence of and sources of expectations placed on engineering students, but these expectations have not been formally or substantially analyzed in prior work.

Research on national-level media narratives suggests that national narratives shape student perceptions and experiences of engineering (National Academy of Engineering, 2008; Sochacka et al., 2014). Examples of these narratives include that engineers are well-paid, smart, and good at math and science (National Academy of Engineering, 2008, p. 74). In a study on the narratives present in national media (represented in articles curated for the American Society for Engineering Education’s First Bell newsletter), Sochacka et al. (2014) found several instances where these narratives were implied through the media text. In a related autoethnographic study, M. Brewer et al. (2015) explored the ways in which these national-level stories were communicated in situ through the experience of an undergraduate engineering student researcher (Brewer). Brewer, who was attuned to the national-level media stories from his work on the 2014 Sochacka...
et al. paper, reacted to interactions that implicitly or explicitly reified particular engineering narratives. Brewer experienced dissonance when the narratives contradicted his own goals and meanings for engineering work. This example showed how prominent national narratives create implicit or explicit expectations on students.

National policy makers also dictate expectations for engineering students. Lucena (2000, 2005) noted how national policy toward diversity and inclusion efforts shifted from social justice to a pipeline metaphor for economic competitiveness and national defense preparedness and how engineering education and minority support programs leveraged and built off those arguments (see also Beddoes, 2011). Others have observed that the argument for economic competitiveness filters into student experiences through justifications for classroom competition (Secules, 2019) and that the pipeline metaphor influences a view of education that removes the sociohistorical context and the agency to change the system (Foor & Walden, 2009). Recent debates over the revised ABET Student Outcomes show how setting formal expectations for engineering students can be contentious and active work (Riley, 2017; Slaton & Riley, 2015). Walther et al. (2011) noted one way these standards create expectations for engineering students: “Engineering graduates today are thus expected to be equipped not only with a whole set of new technical abilities ... but also with a range of broader attributes” (p. 705). Standards and accreditation create expectations that are noted implicitly in the engineering education literature, but the connection of expectations to student experiences is important for further empirical study.

Much of the qualitative research on Science, Technology, Engineering, and Math (STEM) student experiences is broadly focused on diversity and inclusion and documents experiences of marginalization. Documented expectations include gendered narratives and norms in physics lab spaces (Danielsson, 2014), racialized narratives for mathematics abilities (Nasir & Shah, 2011), the perception of lowered standards for Black women in STEM (Ceglie, 2011), and the experiences of belonging, persistence, or attrition in STEM (Seymour & Hunter, 2019). Experiencing these marginalizing expectations is often painful for individual students, as shown in “small n” studies that focus on ways expectations intersect with individuals’ emotional experiences in engineering (Foor et al., 2007; Pawley, 2019; Secules, Gupta, Elby, & Tanu, 2018). Thus, expectations placed on students that stem from demographic norms are a central aspect of student experiences and emotional wellbeing.

Finally, research on educational culture and social norms uncovers the ways that expectations are communicated interpersonally and interactionally. In Godfrey and Parker’s (2010) study of engineering educational culture in New Zealand, they noted how participants interpreted several normative aspects of engineering culture, including relationships, working styles, and acceptance of difference. These experiences included several implicit expectations, including social expectations to engage in masculine binge drinking culture. Tonso (2006a, 2006b) further noted how design teams’ classroom interactions embodied normative masculine culture, so that rules of engagement surrounding social categories (nerd, academic achiever) were communicated, embodied, and interpreted via gender. Secules, Gupta, Elby, and Turpen (2018) noted how expectations related to academic ability are communicated to students through the language of PowerPoint slides, laboratory class interactions, and the question-and-answer patterns of teachers and students. In a recent work on hidden curriculum, Villanueva et al. (2019) explored the role of implicit messaging in communicating expectations and values to students and faculty.

Although the engineering education literature has not identified expectations as a formal topic of study, it often alludes to expectations through other literature bases. The sources that communicate expectations to engineering students include but are not limited to (1) national-level narratives, (2) national-level policy, (3) demographic norms, and (4) local interactions. This article focuses on student emotional experiences with an understanding of national-level cultural narratives and policy as well as local-level cultural understandings and processes.

3 | METHODOLOGY

The following section presents the theoretical framework that guided our data collection, methodological details of the ethnographic focus group study, and an analytical approach that applies the theoretical framework to the focus group data.

3.1 | Theoretical framework: Construction of social worlds amid professional shame

This ethnographic focus group study examined the social worlds of significance for engineering students amid experiences of professional shame. Earlier, we defined professional shame as stemming from an individual’s perceived
failure to meet socially constructed expectations or standards that are relevant to their identity in a professional domain. We also argued that all individuals contribute to the co-construction of expectations, standards, and narratives that inform professional cultures. In fact, as we found in the IPA study, in responding to professional shame experiences, some individuals behave in ways that reinforce the very expectations that they judge themselves for not meeting, thus perpetuating the cycle of shame for themselves and others. The goal of this study, then, is to examine student experiences and expectations as socially constructed, including the acts, sources, and consequences of that social construction. More specifically, we conceptualize students as living within multiple overlapping “social worlds.” We highlight that there are rules and expectations associated with the physical or figurative social worlds that students can experience and articulate.

We conceive of social worlds as similar to frameworks for culture from educational and social sciences. In Schütz (1967), social phenomenology attends to the active and contextual processes of meaning-making by which individuals construct their understanding of the social world. Social phenomenology emphasizes participants’ agency in meaning-making and the intersubjective setting in which they negotiate that meaning (Walther et al., 2020). Similarly, in Holland et al. (1998), cultural (or figured) worlds are the systems of meaning that organize a social context and in relation to which identity and agency are constructed. When considering a particular cultural world such as love or achievement (Holland & Eisenhart, 1990), there is both subjectivity and intersubjectivity in the continuity of the worlds. Goffman’s (1986) construct of framing could also be conceived as a kind of social world, where an individual’s perception of and engagement in a social and physical environment is contingent on the individual’s interpretive frame of the situation. In science and technology studies (STS), the concept of “boundary work” and “boundary objects” (Pawley, 2012; Reddy et al., 2019) emphasizes the co-construction of partially shared meaning in a particular setting across individual and disciplinary perspectives. In all four frameworks, the participants in the social world are in part constituted and reconstituted by that social world through their interactions. Construction of a social world takes place through all levels of interaction, interpretation, and expression within that context.

By examining student experiences of shame through a social worlds framework, we can look more broadly at complex social scenarios that create student experiences and emotional phenomena. Importantly, since social worlds are socially constructed, they can be resisted or remade. Unlike frameworks that center on individual students, a study of social worlds could provide information for shifting the social interactions, systems, and cultures that create painful scenarios for students.

### 3.2 Data collection method

According to J. Brewer (2000), ethnography is “the study of people in naturally occurring settings ... by means of methods which capture their social meanings and ordinary activities” (p. 10). This focus on capturing social meanings in naturally occurring settings informed our decision to conduct what we refer to as ethnographic focus groups.

As engineering education faculty and researchers, we recognized that time restrictions and our relative positions limited our ability to be participant observers in how undergraduate students construct meanings around social expectations in engineering. To work around this limitation, we chose the focus group format to simulate these meaning-making processes. As Wilkinson (1998) described, “The particular advantage of focus groups is the opportunity they offer for researchers to observe how people engage in the process of collective sense-making: how views are constructed, expressed, defended and (sometimes) modified within the context of discussion and debate with others” (p. 186).

We conducted ethnographic focus groups at two institutions: a large, research-focused public university (RPU) and a medium-sized teaching-focused private university that is faith-based (TPFU). Both universities were predominantly White institutions (PWIs) located in the southern United States. The parallels and contrasts between the two institutional contexts enhanced our ability to arrive at an in-depth and coherent understanding of the social reality under investigation (Walther et al., 2013). Contrasting dominant narratives at each institution often framed the process of constructing expectations; for example, RPU students tended to frame expectations in a competitive paradigm while TPFU students often viewed socially constructed standards in relation to their holistic spiritual development as Christians. At the same time, similarities in students’ processes of forming socially constructed expectations relevant to engineering student identities suggested dominant narratives in engineering cultures that transcend the boundaries of institutions.

We invited students to participate in a research study on experiences in engineering education through flyers posted at many locations throughout the primary engineering instructional building (RPU) and emails to second-year and
third-year students (TPFU) or all engineering majors (RPU). Interested participants filled out and returned a survey that captured basic demographic information. We did not emphasize the construct of shame or difficult experiences in recruitment materials to prevent those topics from being a factor in who chose to participate or how they chose to share. As shown in Table 1, we scheduled heterogeneous or homogeneous groups based on race and gender. We conducted four homogeneous focus groups with White men to observe how members of the dominant group in engineering (in the United States) discuss expectations. We conducted an additional six focus groups with underrepresented students of varying nondominant intersectional identities to examine how their perceived expectations compared with the all-White men focus groups. Taken together, we posited that the homogeneous and heterogeneous focus groups would provide a nuanced understanding of how students co-construct expectations in engineering.

The purpose of the focus groups was to examine students’ social realities related to the construct of shame as operationalized through the notion of recognizing and striving or failing to meet expectations. The facilitator, Secules, explained that the study intended to uncover students’ life experiences as engineering students. To build rapport with a relatable question, the facilitator began each focus group by asking students how their semester was going, and students often answered in terms of the relative challenge of the term compared with previous terms. The facilitator then asked each participant to provide a specific example of a challenge they had faced recently. The challenges that students described became starting points from which to explore the expectations students believe are put on them.

During the opening sharing, students named some of the underlying relationships they believed were at play in their challenges, such as that professors did not explain everything slowly and clearly because, as engineers, they would be expected to learn for themselves. To establish a shared framework and vocabulary, the facilitator named and clarified these underlying relationships as “expectations” (e.g., the expectation that an engineer must learn quickly and independently). The facilitator then built on the shared definitions and asked for more examples of expectations on engineers and when and how they came up for students. Sharing and clarifying these expectations constituted the bulk of the focus groups. The facilitator also asked students for specific experiences when they failed to meet expectations, when it happened, and how they responded. We based this question on the theoretical understanding that failing to meet deeply held social expectations induces the experience of shame, but we avoided asking directly about the emotion of shame. We anticipated that discussing experiences of unmet expectations (or the fear of unmet expectations) would provide a way to discuss experiences of shame without reliving the deep emotions associated with them.

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Noting that these were important and widely shared experiences, the facilitator then asked participants to share advice or coping mechanisms. This question helped connect students’ experiences to strategies that might provide significant findings for the research while also identifying possible maladaptive consequences of shame reactions such as hiding from the source of stress or persistent overachieving. Finally, the facilitator asked for thoughts on the ways students’ identities (as men/women, White/people of color, a specific personality or background, etc.) related to the content they shared. The facilitator asked this question for a measure of consistency, since some groups had spoken at length about their group identity and perspective and others had not, and because we theorized that experiences of shame relate to one’s identity position within engineering. The question also stemmed from the study design, which conceived that

| Focus group # | Institution | Gender identification | Racial identification | Participant pseudonyms |
|---------------|-------------|-----------------------|-----------------------|------------------------|
| 1             | RPU         | 4 Men                 | 4 White               | Jackson, John, Wade, Edward |
| 2             | RPU         | 4 Men                 | 4 White               | Jay, Chase, Alvin       |
| 3             | RPU         | 2 Women               | 1 African American, 1 White | Jade, Kia               |
| 4             | RPU         | 4 Women               | 1 Asian, 1 Middle Eastern, 2 White | Rebecca, Samantha, Meagan, Tehzlyn |
| 5             | RPU         | 5 Women               | 1 African American, 2 Asian, 2 White | Kassidy, Abby, Peace, Jaslyn, Elisa |
| 6             | TPFU        | 3 Women               | 2 Hispanic, 1 White   | Lucy, Faith, Robyn      |
| 7             | TPFU        | 4 Men                 | 4 White               | Jaspey, Clay, Jax, Benny |
| 8             | TPFU        | 5 Men                 | 4 White               | Neo, Joel, Dixon, Wayne, Jalen |
| 9             | TPFU        | 2 Women, 3 Men        | 2 Hispanic, 3 White   | Alison, Mateo, Lucas, Raven, Tobias |
| 10            | TPFU        | 5 Men                 | 1 Hispanic, 4 White   | Cayson, Calvin, Ace, Dale, Charles |

Note: See Appendix A for additional details about the focus group demographics. Abbreviations: RPU, research-focused public university; TPFU, teaching-focused, private, faith-based university.
different groups play different roles in constructing the social expectations that may lead to shame. To conclude the focus group, a debriefing provided students with transparency on the focus of the study on shame and allowed students to provide follow-up comments. Students often reflected on how shame related to the content they had shared, but we considered these comments beyond the scope of the study, so these final discussions were not included in the data analysis. The facilitator encouraged confidentiality about what others shared in the group and advised students to seek support if the discussion uncovered any further emotional reactions they wished to explore.

The facilitator, Secules, is a White cisgender man and former engineering student who focuses his education research on equity in engineering education (Secules et al., 2021). His presentation likely impacted what each focus group shared with him. In both the heterogeneous and homogeneous groups, Secules tried to respond to difficult experiences with empathy and curiosity, and he unpacked student meanings across a range of experiences that were previously familiar and unfamiliar to him.

3.3 Data analysis and application of the theoretical framework

We recorded each focus group, and then the audio was professionally transcribed and assembled into Dedoose analysis software. The first author selected all excerpts that were powerful for students or relevant to the research question and tagged them with descriptive codes. As the codebook emerged, a hierarchy of codes tracked overarching themes such as expectations and coping mechanisms. The codebook also facilitated tracking nested themes (see Appendix B). For example, we interpreted the theme “engineers are smart” under the category of stereotypes, which we nested under the category of expectations. We applied these codebooks across all transcripts, which allowed for patterns of similarities or differences across demographic groups to emerge. We summarized specific codes into analytic memos that included the code and the focus group it came from (i.e., date/time and demographics).

Our analysis revealed that students in the focus groups delineated the shared “social worlds” they found most relevant to their expectations and experiences as engineers. As social worlds, we noted the importance of people at every stage of the process. Without people doing this work (i.e., students or other people that students mentioned), the social worlds do not carry the meaning and weight that make them worth sharing. We also noted that social worlds carry a high level of social subjectivity. The worlds students described did not appear to be uniformly agreed upon objective realities. In fact, different focus groups conjured largely different social worlds, and when their accounts did overlap, they still diverged in subtle ways, sometimes based on the racial and gender makeup of the group. Nonetheless, as intended in the research design, there was a level of intersubjective agreement in co-constructing the focus group content, so the accounts existed at some level of intersubjective shared knowledge beyond the purely individual perception.

The social worlds that students shared and identified are not presumed comprehensive of all worlds they experience, generalizable to all institutions of engineering education, or even translatable in those exact terms to other students at the same institution. We treated student accounts of their social worlds as encapsulations of shared meaning within the focus groups and within students’ shared educational settings. By studying the co-construction of the worlds in focus groups and in the broader educational context, we can better understand how problematic divisions are inculcated, how educational systems and policies translate to students, and how painful emotional experiences (including shame) arise from engineering students’ everyday social processes.

Through collaborative analysis, we developed focal codes, noting that all significant social worlds are noticed, defined, and experienced by people. Figure 1 presents a conceptual framework for the production and maintenance of social worlds in engineering education. To understand a focus group discussion of a social world, we categorized the transcripts into events of noticing, defining, and experiencing. We note that such social worlds can only be ontologically real if students in the focus groups and students in general notice and reiterate them. While the tree that falls in the forest without anyone around to hear it does indeed make a sound, a social world that exists but is not noticed does not carry enough weight to create expectations or emotional experiences. Next, we note that a social world requires some definition that delineates the rules of engagement within the social world and enforces the rules, consequences, and boundaries associated with it (Pawley, 2012). Defining a social world can take place within an actual focus group transcript (in naming the insiders and outsiders, the reasons and rules associated with an expectation, etc.), or people outside the focus group could define the social world. Finally, we note that for a social world to be significant enough to share in the group, one or more of the students must have experienced it. Sometimes, students only alluded to these experiences in reference to friends; at other times, the focus group protocol conjured deeply personal and revealing
experiences. Frequently, a participant's experience of the social world pointed toward a painful experience while also reiterating the world's rules and definitions (i.e., how to avoid the painful experience in the future). As shown in Figure 1, this framework's interlocking sociopsychological nature can add conceptual nuance to understanding the emotional experiences that individuals notice, define, and experience as nested within social worlds.

4 | FINDINGS

The following sections explore student quotes related to the construction of social worlds of achievement and identity, experiences related to professional shame, and actions that counteract professional shame. The findings demonstrate processes of social construction that intersect with professional shame experiences in engineering education.

4.1 | Defining and noticing social worlds that give rise to professional shame

First, we focus on the processes of social construction that are precursors of professional shame. In two contrasting subsections, we highlight acts of construction that took place within the focus group discourse. In Section 4.1.1, we see how White male students, as insiders to the social world of acceptable academic performance, defined acceptable and unacceptable forms of academic struggle. In Section 4.1.2, we see that women and minoritized students noticed socially constructed expectations (e.g., salience of race or gender) that they were able to see clearly from living at the periphery of the social worlds described by the majority.

4.1.1 | “There are two kinds of struggling students”: White male students defining the social world of achievement

In one of the focus groups with White male students at RPU, a conversation on sources of academic stress led to a more explicit probe about the specific sources of expectations that lead to stress. Students responded with several specific sources of information:
Edward: One thing that I’ve noticed is that people, sometimes they’re nervous to ask questions, because there is this perception that people think engineers, they should know everything the first time and understand it. So it can be intimidating when you don’t understand it, and you need help.

Facilitator: Right.

Jackson: I think you can spot—I don’t want to classify it, but I think there’s like two kinds of struggling students. I think you see the ones that are constantly asking questions, taking notes, talking to the professor, you know, saying that they’re struggling and they need help, and you have the ones in the back that never show up, that you know, take terrible notes and then they ask not the greatest questions … I think you can really tell which one’s going to actually make a really good engineer, even if they both have the same grade—are both going to get the same grade.

Edward’s initial response, he “noticed … sometimes they’re nervous to ask questions,” suggests an abstract observation rather than a personal experience. Yet his explanation also seems to contain intuition about the personal experience of feeling intimidated when he does not know something (“it can be intimidating when you don’t understand it”). Edward also notes the cultural stereotype that engineers “should know everything the first time and understand it,” which undergirds the experience of this category. In this sense, one could argue the cultural narratives for engineers are prefiguring the classroom to create social categories in which students can be recognized (e.g., “not cut out for engineering,” Secules, Gupta, Elby, & Turpen, 2018).

Jackson expanded on Edward’s experiential account by classifying “two kinds of struggling students”: those who try hard and those who do not. By noticing these student types, Jackson defines some effective rules for engineering engagement: Students must persevere through an academic struggle rather than disengaging if they want to become a “really good engineer.” Nevertheless, this category ultimately comprised students who are publicly struggling, as noticed and defined by their classmates. With the limited narratives Jackson, Edward, and ultimately engineering culture create for student struggles, it is not surprising that students “are nervous to ask questions;” they do not want to risk being publicly labeled as struggling students.

The students in this focus group indicated other ways they spotted struggling students, thus co-constructing the social world of academic success:

John: A good indicator of someone who is probably a little behind is you’re asking question one in the GroupMe when the homework is due the next day (laughs).

Jackson: Yeah, yeah. (laughs) You can spot it pretty easy in the GroupMe, oh my gosh, yeah.

Wade: I think too in terms of not wanting to ask questions or whatever, it really piles up or starts snowballing if you miss class one day or something and that’s why you don’t know the answer, and so you don’t want to ask, and then it just gets worse and worse and worse.

These students were conscious that the ways (e.g., the group messaging app GroupMe) they notice their peers’ struggles were also ways their peers could judge them. Wade’s language of things “snowballing” and getting “worse and worse and worse” once again indicates emotional turmoil associated with being identified as a struggling student.

These students elaborated on how they categorized student performances, including students who are “naturals,” those who are apparently smart without trying, and students who achieve through hard work. The following passage comes from a conversation about “naturals,” in which students revealed that being labeled a “natural” can carry negative connotations and social consequences:

John: I had one guy that came up to me. It’s a guy that I kind of like just sort of knew, came up to me when I was in statics and just kind of started going off to me about his test grades or the test questions, and your first response is I don’t care, cool, nice.

Wade: Cool, dude. Nice.

John: Like good for you. You’re like no one really cares how smart you are, so even if you are a natural if you tell anyone, all they’re going to do is go, well, I don’t like you, so—. No one likes being told they’re dumb.

Jackson: Yeah. (laughs)

Facilitator: You felt like that grade conversation was—

John: I felt like that was not beneficial to anyone at all, because it made me view him negatively, and yeah.
Facilitator: Yeah. You felt like it was just—but it was essentially because they were like— it was unnecessary information about his—
John: It wasn’t even like—that wasn’t even a topic of conversation at the time. (laughs) I don’t know why he brought it up. And then he did it a couple more times across the semester, so this guy’s a civil, so I think we don’t have to see him. (laughs). I don’t have to see him anymore.

John’s example reveals the social consequences of discussing good grades. Although his peer essentially constructed himself in the conversation as naturally smart, he suffered the ultimate social consequence (exclusion) for volunteering his good grades, because John felt that the student was calling John dumb. Grade conversations, then, are not only a way of noticing this social category, they are part of the rules of engagement around academic success. Students noted that it is appropriate and welcome to discuss grades when you know you received a poor grade, but such conversations are sensitive or unwelcome if you received a good grade.

Next, the focus group participants constructed a final category related to academic success narratives—Students who try hard to succeed are seen as humble and not prone to bragging. As Jackson describes, this category comes with additional social consequences:

Jackson: There’s them, but there’s also the quiet, hardworking ones that get the good grades, and you know, they fly under the radar until someone becomes friends with them. They realize how smart they are, then everyone’s poaching them. So I’ve met some people like that too. It’s just you know, [I] feel sorry for them because everyone’s asking them questions because they realize that they’re the one to go to, but that’s their burden to bear. (laughs)

In this somewhat bleak construction of the social world of achievement, the social consequence of being seen as smart but not an arrogant “natural” is an increased risk that other students will take advantage of them.

The rules of engagement in this social world of academic success appear to include noticing and categorizing others while attempting not to be categorized into any of the undesirable extremes: the natural, the quiet hard worker, the public struggler, or the disengaged struggler. The need to escape categorization appeared explicit when the facilitator asked students whether any of them were “naturals.” None claimed to be naturals, and they wondered aloud whether any students would ever claim that identity. Edward then discussed avoiding landing in a different category:

Edward: Sometimes in class I feel like I’m viewed as dumb and hard working at the same time because I’m always asking questions usually. I try not to ask dumb questions, because there’s a little line between smart questions and dumb questions.
Facilitator: Uh huh, but there still—there may be still clarifying questions, but you try not to ask a question one. You try not to ask like a—
Edward: Yeah. If I need to ask a question one then I’ll go to like office hours or a TA.

Once again, Edward reiterates the danger of being categorized in the social world of academic success and the role that self-regulation (“not [asking] dumb questions”) plays in surviving engineering culture while preserving its definitions for others.

In this section, students described in detail how they notice their peers’ academic struggles and successes, which suggests a level of consequence for the students: Certain facts and experiences rise above the fray of academic life. The underlying emotional significance of these categorizations offers a clue about why people notice and remember certain aspects of social worlds. Further, students exhibited powerful forms of reproducing cultural definitions of engineers, smartness, and in-group social circles. Categories surrounding student success appeared to carry significant weight for self-regulating student actions and interactions.

The co-constructed classifications these White male students made about their classmates were not gendered or raced at face value. While there were several moments when they gave proverbial students masculine pronouns, these students did not explicitly connect these social rules to gender or race. Indeed, White men’s focus groups did not discuss gender or race unless explicitly asked about it. It is a feature of Whiteness, and identities of privilege in general not to have to think about identity within day-to-day social worlds. Yet, these positions of privilege can inscribe identity-laden contours on the social world of academic success and failure. While White male students noticed how stressful it feels
when caught in a struggling/losing category, they nevertheless appeared to reproduce and co-create these categories. We can imagine how these acts of noticing and defining social worlds may impact other nondominant students in their midst. Understanding classroom spaces as opportunities for spotting student struggles or successes has consequences for everyone in the classroom, and particularly those most likely to be spotted.

4.1.2 | “What’s she doing here?”: Noticing social worlds of normative identity that others do not

Across all focus groups, we noted that the topic of identity in terms of race or gender only emerged unprompted when women or people of color were present. In response to the same protocol, focus groups consisting of White women and women of color tended to topically center around identity categories and frame responses to questions about expectations with answers about gender and/or race.

In a women’s focus group at RPU, a Black female participant discussed the ways she has noticed race permeating her college experience in both academic and social settings:

Abby: I could sit here for an hour and talk about all the experiences I’ve had on campus, off campus, with places where I felt discriminated against or just something—just I can tell something's not right. And it's not like I go into every situation thinking about race, but it's also like very much a part of who I am now. But yeah, I don't know. Like I definitely see how just in my experiences personally where there have been plenty of times—like I said, in school, at restaurants, around campus, things like that, where I definitely feel like me being Black not only stands out, but it's also very much a factor into how people treat me or deal with me in general.

Abby reflects on the pattern of racialized experiences she has noticed on campus, in social interactions, and in the community. Like many universities in the United States, the social worlds of on-campus and off-campus spaces contain a social expectation of Whiteness to which her Black identity is marked. White participants never expressed social expectations of being White or described participating in co-constructing racialized social worlds. This contrast suggests an often noticed but remarkable dichotomy between the overlapping experiences of majority/privileged and minority/marginalized groups. The students in these two focus groups shared a social world but had markedly different experiences based on their individual identities.

Abby continued:

I definitely think that [RPU] being such like—so known for its fraternities generally is you know like Greek, White fraternities, I remember literally my first day here—it's a long story, but basically we ended up at a frat party. A friend we were with was invited to it, and it's like the people who invited us who were at the fraternity didn't realize we were Black, so when we got there it was kind of like oh, you guys can't really come in, and you know, those people are those same people that I have classes with now. So I feel like I—it may not be so like out there when I'm in class with these people, but then I still remember—it was just a few in particular. Like I remember you guys were the fraternity that wouldn’t let me and my friends come to the party because you didn't know we were Black. And it's like these are the same people I see in class, so ... I definitely know it's there, especially in those types of situations.

Abby’s statement demonstrates how social worlds outside of engineering classrooms cross over into classroom experiences. These crossovers add to the stress that Black women consistently experience on top of ordinary academic stresses due to the racialized and gendered experiences of the shared academic, social worlds. Abby’s example also demonstrates that such experiences can be profound sources of stress and shame.

In another excerpt from TPFU, women reflected on similar ways that identity intersects with classroom experience. They sensed that the men in their classes were judging them:

Lucy: I get in here, and I sit down, and everybody's like—especially the ones that are top of their class and they're still so “smart engineering.” it's almost like when you ask a question, like I sit in the back a lot, and I will still hear people if somebody's asking a question like, don't get me wrong, but there are not a lot of girls in my class, so most of the time it's guys, and the guys will be like just whispering to each other, be
like why is he so stupid, why is he asking these questions? And that’s why I don’t ask questions. Because I don’t want them to say why is she so stupid, because it’s not—you know, it’s okay—it’s kind of okay because he’s a dude, but I’m a girl, you know? And it’s even worse when there’s not a lot of girls. And so they’re like she’s so stupid, what’s she doing here, you know?

Faith: Yeah. Especially about the whole thing about oh, what are women doing in engineering? Like that’s what I got from like back home. Like oh, you’re a lady in engineering? Like what are you doing here?

Lucy: Some guys are really nice. Some aren’t.

Lucy’s description of how male engineering peers judge other students’ performance is consistent with the prior men’s focus group. Lucy is aware that academic positioning is taking place, and her overlapping worlds of meritocratic competition and gender result in her staying quiet to avoid falling into the category of the woman who does not belong (“she’s so stupid, what’s she doing here?”). Similar to the prior excerpts, Lucy indicates an implied social expectation that engineers are men, so even ordinary instances like interacting with people back home become potential reminders of unmet expectations. As the socially constructed expectations for engineers include default masculinity and Whiteness, simply being a woman or person of color in engineering raises one’s risk of failing to meet expectations and, ergo, professional shame.

Viewing these excerpts as social worlds (rather than as microaggressions or bias) has interpretive affordances. In these focus group discussions of gender and race, society at large and demographic groups in power ascribed definitions on a much larger scale (“I’m a girl, you know?”). Yet, in addition, individuals localized and enforced these social classifications (e.g., individuals whispering about student performance or excluding someone from a party). To have an effect, the narratives governing women in engineering must be defined by a collective and experienced by the individual. When analyzing gendered and racialized experiences, we can highlight the social interactions, localized frameworks, and broad cultural processes that help create them.

4.2 | Emotion and experiences of professional shame

Next, we present contrasting examples of emotional responses to (what we interpreted as) experiences of shame. Although the IPA component of the project focused on the emotional experience of shame (Huff et al., 2021), the discussion of unmet expectations in the focus groups inevitably touched on painful emotions as well. Although these were private experiences, the students shared public versions of their experiences with each other, providing a window into their real private responses and coping mechanisms as well as what they deemed socially acceptable and appropriate to share within the demographically situated focus groups. This section demonstrates that the social construction described in Section 4.1 is consequential for students’ emotional experiences.

4.2.1 | “As soon as you let that wall down you’re going to freak out”: Emotionally suppressive responses to professional shame

In the White men’s focus group from Section 4.1.1, the facilitator asked about situations when students experienced or were afraid of experiencing unmet expectations related to engineering. The students in this group tended to share shorter stories of academic stress without delving into deeply emotional or detailed descriptions of shame or failure. Wade, a White male mechanical engineering sophomore, described his experiences this way:

There was one time last spring my freshman year that I was—I think it was my [mathematics] class, but regardless of whatever class it was, I was getting really behind, and had been working on a couple other classes that I’d had a test for, and just had a ton of homework piling up and a test coming up too, and I did not know how to do any of it, because in class I wasn’t quite getting it, and I wasn’t like going home and figuring it out before the next class. And it just really piled up, and I was like well, I’ve got a lot to do in these next couple days before my test, and just started sitting in the [student study space], started pounding it out and not at first like not really even knowing how to do it or even using Google or YouTube trying to figure out how to do it. As I just kept doing more problems and more problems I understood more why, but it was definitely a little bit stressful just because I realized I had so much work, and I was like—not a
whole lot of time to do it, but yeah, after sitting down, yeah, and a couple days in the [student study space] and finishing it up, and then going and taking the test, like I felt a lot better about it, and it was good to be done with it.

In this example, the student admits that it was stressful when his work piled up, but he moves quickly toward discussing the resolution. Several of the men’s focus groups followed this pattern of answering questions about stress or failure with answers about coping strategies and eventual success. This student’s coping strategy of “pounding it out” signifies an aversion to dwelling on negative emotions. Two other students in this group followed with parallel stories:

**Jackson**: [The engineering fundamentals courses] were just really stressful and everything, and I think the greatest thing I learned about that was just compartmentalizing everything. It’s like, hey, I’m working on this right now. I’m not going to think about anything else. I’m working on this. Get that done. Move to the next one. And I also think that helped a lot on tests ... I think each problem, you know, if you can’t do it, screw it, go to the next one, don’t even think about that one anymore. You’re working on this one, and I think compartmentalizing every single piece like that is really helpful from just a mental stability point of view, and just getting the most done you can in a period of time.

**John**: Yeah, that’s a really good way to think about things, just like kind of planning out what you’re going to get done each day. Like I’m going to work on my thermo today. I’m going to work on my strengths tomorrow. I’m going to get my circuits done Friday. Like just having a plan and sticking to it, and by the end of the week you’re done with all your work, and repeat that every week, and it’s just like a job.

Jackson: As soon as you let that wall down and other things start coming in, you’re going to freak out, and you can’t let that happen.

Jackson had strong experiences of negative emotions related to schoolwork and used “compartmentalizing every single piece” of the work as a coping strategy. John agreed and restated Jackson’s advice. Jackson’s final statement goes beyond planning and focus and appears to advocate keeping a “wall” up to prevent engaging with strong emotions. However, building an emotional wall to avoid negative emotions can create an emotionally suppressive response to situations of stress, and failing to process negative emotions could exacerbate their impact and perpetuate a repressive culture in engineering.

In another White men’s focus group at RPU, students acknowledged similar approaches to working through stress:

**Alvin**: Like Jay was saying, like most of the times you reach out to like one or two other people, but for the most part you just hunker down, do it, yeah. That’s really all you can do.

**Chase**: Yeah, I agree with that, definitely. If it’s like a project or an assignment I’m stressing about or I’m upset, I got a bad grade, I mean, me personally, I mean, you’ve just got to kind of tell yourself there’s nothing you can do about it. Just go do the project.

**Alvin**: Yeah.

**Chase**: Or like, you know, it stinks, and it’s a grind, and you don’t talk to anyone for like 10 hours.

Although participants mentioned stress several times during this focus group, they did not elaborate on their actual experiences of academic stress. The coping mechanisms that Chase and Alvin mentioned involve prompting themselves to simply do work, often in isolation, in spite of other significant emotional responses. While we cannot parse the perceived versus actual utility of these students’ coping mechanisms, we can notice persistent patterns where students claim to suppress emotions and work in spite of their feelings in response to significant emotional stress.

The ways White male students discussed academic stress in group settings were notably consistent. Students in focus groups at both institutions mentioned stress, which resonated with all members of the groups. Across White men’s focus groups, there was a largely shared script for discussing stress. These students consistently noticed and acknowledged stress as a clearly shared experience, but they did not delve into their experiences in the group setting. In contrast, we found that the one-on-one IPA interview component provided much more insight into the emotional lives of students, particularly male students (Huff et al., 2020; Huff et al., 2021). The implication here is that allowing deeply felt experiences of stress is not acceptable in the male engineering student’s social world. It is an example of engineering students’ defined social rules that they share a set of “right” ways to deal with stress. Considering White men dominate
4.2.2 | “A major is ruining my life”: Recognition and reflection on experiences of professional shame

The following emotionally charged excerpt comes from a group of women who identified as White and Hispanic (respectively) at TPFU. The conversation occurred when the facilitator was shifting from expectations and experiences of unmet expectations to advice and strategies for dealing with the experiences:

Facilitator: What advice would you give a future engineering student in your position?
Faith: I wouldn't be in engineering. (laughs)
Lucy: Yeah, that's what I was going to say. (laughs)
Lucy: Don't do it.
Faith: Don't do it. But
Facilitator: Oh, that's so sad. (laughs sympathetically)
Lucy: Don't do it.
Faith: (laughs) Like honestly, now that I see myself, like I didn't have any pressure of doing engineering. I was just stupid. I just wanted to be smart, and I was like, oh, engineering is cool. I was very arrogant. That's the thing. That was me three years ago or four years ago. I think I was just very full of myself, and I was like, “You can do it. You're smart enough.” And like I didn't even have the pressure, like my—I'm first generation of like my mom and dad's family of going to college. Like there's some side of my dad, but they have been to college, and most of them have studied finance, and like they just—there's this stupid—I think it's a stupid thing to do to shame other people because of the majors they have [chosen], and I used to do it, and I wish I [hadn't], like two years ago. I wish I had done something that I truly liked, even if—like I know people are like, oh, just study that. You're just going to—You're not going to earn money, and then you're not going to like be happy. And I'm not happy with engineering. Like—so sorry. (Participant is laughing and crying).

Faith’s statement gives one of the focus groups’ clearest and deepest reflections on experiences with professional shame. She notes how the pressures to major in engineering mostly came from her own identity and her interaction with narratives within the social worlds of engineering: She positions her own identity within a cultural narrative of engineers as smart and making money. The stereotype that engineers work harder and are better than other majors has been discussed in previous literature (Paretti et al., 2007; Stevens et al., 2007) and was also common across this dataset. Although she regrets it, Faith even admits to socially shaming nonengineering majors in the past. We surmise that Faith’s participation in the practice of shaming non-engineers is likely indicative of being embedded in engineering culture. Notably, Faith’s moment of clarity, in which she distances herself from the culture of engineering superiority, comes while recounting personal pain, questioning her identity as an engineer, and experiencing the professional shame associated with feeling like she does not belong in the field.

Also noteworthy is that this highly personal reveal was unintended as part of the focus group. The research team theorized that discussing deeply personal experiences of shame would not be socially safe for students. Instead, we considered social expectations to be a socially safer discussion topic, and unmet expectations would function in students’ lives as a proxy or trigger for experiences of shame. Nevertheless, this focus group delved into painful emotional experiences that prompted parallel and increasingly deep revelations from each participant. We designed the prompt “What advice would you give a future engineering student in your position?” to elicit socially shareable coping mechanisms. And yet, Faith's answer “I wouldn’t be in engineering” deviated from our expectations (that there is an easy social solution to this deep personal pain) and revealed a new depth to the experience of unmet expectations.

Faith continued to elaborate on her experiences:

Faith: But like now I have learned that I should have made myself happy by doing something else that I truly like instead of listening to my family and other people. Listening to my friends shaming other majors. I should have just concentrated on myself, on what makes me happy. And like I know money is important
because it takes you places, you know? ... I know when I go back home and I say, “Oh, I do engineering,” they’re like, “Oh, you’re going to earn so much money,” but I’m like at what cost? Like I don’t think engineering is worth the anxiety I have. I make jokes about it, but it’s just not healthy for me ... I have way too much pain in my life—and engineering is like the root of it. And it’s just—it sounds very stupid, but a major is ruining my life. But at this point it’s just too late to quit. Like I’ll just finish it, and then I’ll see what I do with my life, what makes me happy, something that I really want to do, and I’m just praying for God to give me like the courage to pursue something that I actually like and just live, be happy ... I’m sorry. (Participant cries.)

Faith’s statement that “a major is ruining my life” reveals the depth of her pain. She is reckoning with her own affective relationship with engineering and what it means for her future. She mentions the narrative of engineering and money and notes how friends and family members reinforce this message in a way that deeply intersects with Faith’s emotional experiences. Faith also reiterates concern about her peers “shaming other majors,” even though the facilitator had not introduced the idea of shame at this point in the focus group. Faith, her friends, and her family have participatory roles in defining and reproducing these rules and expectations, and Faith experienced deep personal pain from the dissonance she felt regarding the socially constructed box provided for engineers.

The pattern of discourse in female student focus groups centered around sharing deeply personal experiences, particularly when prompted about unmet expectations and challenges. The female students were often highly attuned to their own emotions and the emotional responses of others. For these conversations, it appeared that each student tried to share a parallel vulnerability to match the vulnerability of another student’s sharing. The definition of such social rules for sharing likely relates to women’s social spaces (compared with men’s social spaces). It likely also comprises a set of distinct (from men) coping mechanisms for women in engineering departments, which involves acknowledging pain in personal and social settings. Female students often noted the unique conversations that took place in the focus groups. Lucy and Faith referred to the group as a form of therapy. Women in a focus group from RPU noted how rare it was to find all-women spaces like the focus group in their daily interactions in the engineering school.

Because 9 out of 10 focus groups comprised only men or only women (self-identified), our results portray engineering culture through a gendered emotional lens. The homogeneous gender focus groups provided affordances for seeing women and men co-constructing social worlds. However, our results do not necessarily reveal a set of hardwired differences that correlate with students’ lived experiences. Men likely experience more extreme emotions than they revealed, given that their coping mechanisms focused on suppressing emotions (Huff et al., 2021). Similarly, women likely have a range of coping mechanisms that may sometimes mirror the ones men mentioned. Yet, the readiness with which women shared their vulnerable experiences suggests that female engineering students frequently process experiences of pain through social support. Since women are underrepresented in engineering, the social processes of sharing emotions will probably continue to be positioned marginally relative to social processes of compartmentalizing and suppressing emotions. Thus, the men’s focus groups’ defined social rules about suppressing emotions could affect the amount of “space” in which female engineering students feel safe expressing emotions.

4.3 | Redefining social worlds in ways that counteract professional shame

In the final two subsections, we present two approaches to redefining social worlds as a partial remedy to professional shame. The first happens on an individual or interactional level, while the second demonstrates alternative possibilities for institutional expectations when a collective has a different set of rules for the social world.

4.3.1 | Resisting and redefining stereotypes for engineers

Engineering stereotypes (e.g., engineers are smart, engineers are technical, engineers are antisocial) are formed at societal levels much larger than the scope of this study’s focus groups. Nevertheless, students often noticed, retold, and considered the meaning of these stereotypes within the focus groups. Oftentimes, stereotypes emerged in response to considering expectations on engineers, and participants often deemed the cultural narratives that they noticed and unpacked as unfair or untrue. Students then countered engineering stereotypes with their own experiences. In the
excerpt below, students at TPFU discuss how local perceptions that engineers are arrogant mixed with broader cultural narratives that engineers are smart:

Jax: I know it's often said on the internet that engineering students are the most arrogant of the students just because we think our major is so much harder than everybody's.
Benny: Well—
Jax: Which I don't agree with whatsoever. I couldn't do an art major's class work at all so (laughs)—I have so much respect for like art majors, just because they put in so much work.
Jasper: I have a bunch of respect for nursing majors.
Benny: Oh yeah, nursing majors—
Jasper: Yeah, like art majors, they have it rough, but nursing majors, I've seen them with ... like three or four Starbucks cups in front of them, finishing up like term papers.
Jasper: Yeah, my sister graduated from nursing, and just the amount she had to memorize, like every—She had to memorize everything about the human body. (laughs) And I'm just like why would you want to know all of that? (laughs)
Jasper: That's something I actually feel like hasn't been really tested for me. I always thought like my memorization skills were very good, but engineering, that's irrelevant, like because you have to—yeah, you have to know equations, but you have to derive them from certain things, so it's not just like this plug and chug method. It gets down to the nitty gritty ... You have to make up equations yourself, which is making it a lot more difficult as classes are getting harder.

Here, the engineering students reframe a social world formed around an engineering stereotype they have heard relayed in social interactions or another form (e.g., the internet). By redefining the social world, they repurpose available narratives to reflect their personal experiences. However, Jasper eventually shifts back and reinforces the narrative that engineering is harder than just memorization.

In a similar excerpt, female students at RPU discuss their relationship to the stereotype that engineering is harder than other majors:

Samantha: And it's weird like how little other people—people know about each other's majors. Like a lot of people don't realize that our number of required classes is like three times as many as theirs (laughs) in most cases, so that's something, but then we don't realize like the kind of work that they have to do ...
Tehzlyn: That's true.
Samantha: Judging them for something that we don't know about, and sometimes I feel bad about [it], but sometimes I do it, but it depends.

Here, Samantha clearly recognizes students' social contributions to the broader process of producing their social worlds, in this case, related to the stereotype that engineering is harder than other majors.

These excerpts provide insight into the limited but valuable agency that people can have when redefining a cultural narrative. Even in their redefinitions, the students wavered between the stereotypical narrative that values engineering as harder and more work than other majors and an alternative narrative that values other professions equally. When discussing engineering, the students inevitably evoked popular dominant cultural narratives about engineering, so their critiques may have been limited by the discourse of their social worlds. Nevertheless, Secules, Gupta, Elby, and Tanu (2018) suggested that redefining limiting or marginalizing cultural narratives within engineering on a personal and interactional level is an important strategy for supporting students. As these narratives are a form of socially constructed expectations that can induce the experience of professional shame, redefining them can become an important form of collective resistance.

4.3.2 | Defining contrasting social expectations for balance, purpose, and image

While the competitive individualism White men enacted at RPU (Sections 4.1.1 and 4.2.1) resonates with other assessments of mainstream STEM educational culture (Secules, 2019; Seymour & Hunter, 2019, p. 303), it presented a stark contrast with the social rules at TPFU. Several focus group examples showed that TPFU students adhered to
social definitions far from the accepted norms at secular academic institutions in the United States, particularly regarding the hierarchies of ability and performance in engineering classrooms. When discussing student lab pairings, for example, TPFU focus group participants assumed they were not allowed to pair with friends, so everyone in the class was included. When the facilitator (who is much more familiar with the competitive culture prominent at universities like RPU) asked TPFU students if instructors might also be concerned with distributing relative ability so high performers do not pair together and leave low performers behind (Seymour & Hunter, 2019, pp. 311, 314), the students did not appear to have considered that possibility. It is noteworthy that this is the cultural lens through which students perceived the actions of their instructors and the institution, regardless of whether that is the reality of instructor intentions for these pairings.

Instead, TPFU students primarily organized their social worlds around less normative expectations, such as balancing social purpose and academic life:

Neo: I think something that’s hard for me and particularly just recently is balancing class with not just social lives and stuff but just life in general is because like in this season of life we still don’t know really who we—we’re finding out who we are as individuals now, and what we thought in high school, I mean, it was easier, and now we’re somewhere else and we’re forced to do it on our own, and we’re just slowly figuring out like is this something I want to do, like is this something that’s going to make me happy … and even going from Bible [class] to where you’re asked kind of those questions and you’re reading the Bible and stuff, and you’re like this is who I’m called to be and stuff, but—and then I’m going straight to a class where it’s just nothing about life. It’s just numbers, numbers, numbers, solve these problems, solve these problems for somebody else, and I don’t really care … I want to feel like I’m doing the things that I need to do to better myself, but I feel like I’m just bettering somebody else for solving their problem, when I’ve got a million just life problems going on right now, I want to be able to focus on those without school kind of interfering … I don’t want to say school gets in the way, but it gets in the way. (laughs)

Joel: Yeah. I was about to say it gets in the way.

Neo: So I think TPFU as a Christian school does a good job of addressing those issues sort of in a way if I went to actually like [a nearby public university] or something like that and I don’t have a Bible class or a [religious assembly] where I get to self-reflect on things and have a lot of good influences. It makes it a lot easier to handle more intellectual courses rather than self-reflecting things, like classes like that.

The social expectation for students to balance different parts of life while in college contrasts with the sole social expectation for students to perform academically. Many students at RPU likely also sought similar forms of balance (e.g., to look after personal health, keep ties with friends and family), but balance did not appear to be a significant enough part of the official/shared social expectations at RPU for it to come up. Another participant in the same focus group echoed feeling a similar expectation to work toward a higher purpose and improve as a person.

Cayson: Since I came to TPFU, I just feel like, no, I don’t think a lot just about myself, you know? … we’re here for a purpose, so that’s kind of been kind of different for me.

Finally, the social world of TPFU included defining expectations around adhering to the image of a TPFU student:

Benny: Well, I mean, since you asked—There are some who are partiers, but they’ll try to hide it, and they’ll get like—they’ll put on this face like when they’re at [TPFU] that oh, we’re perfect, and then in the dark they’ll go out and party, and not really act in a way that’s reflective of a Christian behavior. Then there’s others who will more own up to it, and in their minds it just isn’t wrong, what they’re doing. I mean, they’re not going to like shove it in your face, but they’re also not going to be hypocritical about it.

Facilitator: Okay. Interesting.

Clay: Yeah, that is kind of a problem at [TPFU]. Sometimes you don’t know when you first meet someone whether or not they’re being genuine sort of, just because there are that group dynamic of, well, they say they’re Christian, but are they really, and are they really acting like it, because I grew up in a church where people would say they’re Christian, right? But I would see them on Facebook, and I’m like you’re not doing it right. (laughs) Something’s not right here. And so you kind of get in that mind set of always kind of like—whenever I meet someone I’m always like, yeah, but are you really? Which isn’t a good mind set to
be in, but it’s just one I’ve kind of been conditioned into growing up in my church to know who to stay away from, you know? ... It’s not a good thing, but it’s just kind of how my mind works sometimes.

Notably, these alternative social expectations for engineering students to remain balanced, fulfill a broader purpose, or uphold an image consistent with TPFU function in similar ways to social expectations at RPU. The social process of defining and reiterating these expectations is a shared action among the institution, leaders, and students. The expectations of succeeding at purely technical engineering (“number, numbers, numbers”) are not entirely dissimilar from the alternative expectations to succeed academically while maintaining a higher purpose and balance. The experience of unmet expectations still causes stress (“something that’s hard for me”) and provides the circumstances for professional shame.

Nevertheless, these alternative social expectations suggest just how malleable the rules of engagement can be in an engineering social world. If participants in an engineering social world create, understand, and reinforce a set of social rules that value the health and well-being of students alongside or instead of academic success, the engineering students in that social context might have a better perspective about their identity and a healthier approach to processing professional shame. Changing engineering culture, while challenging, is ultimately the solution.

5 | IMPLICATIONS

In conclusion, we suggest three implication areas for engineering education. First, we discuss theoretical insights related to professional shame that emerged from our analysis. Second, we suggest that our theoretical framework examining engineering education as a social world may be applicable for researchers of other related topics. Finally, we address how engineering education stakeholders can understand these findings, considering the emotional dimensions of engineering education and the importance of taking care with messaging about engineers and engineering culture.

5.1 | Theoretical insights into the construction of social worlds associated with professional shame

The overarching study for this work focused on the sociopsychological construct of professional shame. This article engaged with the social aspect, or ways that students interact in engineering educational culture to create the conditions for experiencing professional shame. We leveraged an ethnographic methodological orientation and, as a theoretical framework, we considered that for social worlds to be impactful, they must be noticed, experienced, and defined.

5.1.1 | Noticing social worlds

First, the act of noticing a social world is crucial for making it a salient reality. Many social worlds may exist within engineering education, but students do not notice all of them (e.g., a social world of faculty pressures around promotion and tenure). Also, different students can notice particular social worlds differently. The White male students who agreed they can “spot two kinds of struggling students” in Section 4.1.1 did not mention race or gender. Overwhelmingly, the White men’s focus groups followed this pattern of describing the social worlds of engineering in identity-neutral or implicitly masculine (referring to a teammate as “him”) ways. In contrast, the women’s and racially diverse focus groups (Section 4.1.2) noticed gender and racial dimensions of the engineering social worlds without prompting and with great specificity. In analytical terms, those who are on the periphery of a social world recognize its contours more readily. This phenomenon makes sense, considering how fitting into a culture allows people to operate within it seamlessly and without thought (Tonso, 1996). As with privilege, people tend to notice the headwinds that create personal challenges more than they notice the winds at their backs that push them forward (Howard, 2010). Those living most centrally within a social world will not recognize their role in dictating the expectations that reverberate for others, while those on the periphery likely see the roles more vividly.
5.1.2 | Defining social worlds

The social worlds that students noticed do not have emotional salience without the definition of associated rules and expectations. Students do some of the work of defining engineering social worlds themselves, as they notice, compare, narrate, and, in some cases, exclude or judge their classmates. Yet, a significant amount of this work is also done at a scale far beyond the individual students, by actors (e.g., instructors, friends, family, administrators, and media) and by systems and shared cultural understandings (National Academy of Engineering, 2008; Pawley, 2009; Sochacka et al., 2014). We found that students had different levels of agency for acts of defining social expectations. There was a sense in one of the White men’s focus groups (Section 4.1.1) that their agency is limited (by instructors, course expectations, and a larger class that is observing them) but significant, as they seemed to recount the rules of the game for life in engineering classes. A focus group excerpt from women (Section 4.1.2) revealed a significantly reduced sense of agency. Students perceived that acts of defining gender and racial normativity were being done all around them, primarily by their peers. A female student in Section 4.2.2 regretted previously shaming nonengineering majors, which recreated an engineering hierarchy that has consequences for both engineers and non-engineers. For the students in Section 4.3.1, similar stereotypes associated with engineering also limited their senses of self and profession, and their partial attempts at correcting these stereotypes became a source of limited agency. Nevertheless, the acts of definition for the various expectations associated with engineering social worlds were typically embedded within engineering culture, and students found that they must contend with those expectations to progress.

5.1.3 | Experiencing social worlds

Finally, the findings from this study and the prior IPA study suggest that the social worlds engineering students notice and co-construct are the source of significant emotional experiences that layer underneath the purely academic or intellectual aspects of being a student. Social comparison or implicit or unintended communication from an authority figure can trigger negative emotions in students. When an expectation that is externally communicated and internally validated is not met, the consequences for each student are significant. We note that certain experiences of stress or failure appear to recreate social worlds in particular ways. For example, White men responded to academic stress in Section 4.2.1 by suppressing, compartmentalizing, and powering through feelings of stress and failure. In contrast, women’s focus groups shared struggles verbally with peers to empathize (Section 4.2.2) or to place academic success and failure in an appropriate context. However, the White men’s focus groups’ emotionally suppressive responses likely increase the competitive and unwelcoming culture in engineering education for everyone. Considering the relative number and cultural access of White men in engineering, these men’s experiences and responses appear to be a mechanism recreating engineering culture. We conclude that experiencing, defining, and noticing a social world are strongly interlinked processes, where experiences of challenges may lead to acts of redefining a social world in new or old ways (e.g., more or less inclusively).

5.2 | Social worlds as a useful frame for engineering education

We suggest that the theoretical framework of social worlds may be useful for conceiving engineering education and its constituent parts. In a 2019 update to Seymour and Hewitt’s (1997) original pivotal work on persistence and institutional culture, Seymour and Hunter noted that “[a sense of belonging in STEM] is malleable and shaped by contexts, interactions, and resources” (p. 324). This finding resonates with our approach to understanding the social worlds within which students interact and create meaning. By identifying the tangible constituent components of otherwise intangible constructs such as belonging or shame, researchers can identify the available lever points that can help shift educational culture for the better. We offer two other examples of how analyzing a social world can help the engineering education community think about seemingly static or intangible constructs.

Researchers and practitioners often think of students as individuals with distinguishable levels of motivation, self-efficacy, or identity relative to one another (Carberry et al., 2010; Nelson et al., 2015). While this approach has some value, it ignores the social dynamics of engineering classrooms and extra-curriculars. Our analysis highlights how students’ thoughts of self-worth are tied not only to a sense of motivation or individual identity but also to their relative social positioning within an engineering program or specific course dynamic (Seymour & Hunter, 2019, p. 303).
Students act or make decisions because they are afraid of being noticed as the student left behind or the one too far ahead, or they do not want to be judged a cultural or demographic outsider. This reality suggests an analytic approach that views students’ emotional and learning states as interlinked. Viewing the classroom as a social world with co-constructed expectations that its constituents define, notice, and experience could help instructors understand the dynamics of engineering classes as interlinked rather than individualistic.

Similarly, society often frames diversity and inclusion as individual challenges: Individuals succeed or fail as representatives of their demographic identity groups, individuals experience marginalization, or (less frequently analyzed) individuals marginalize others. Our analysis suggests a more complex interaction between the social worlds of dominant and nondominant groups. We find dominant actors often inhabit their own social worlds without much thought and therefore help create exclusive definitions of engineering for others. The processes of noticing and not noticing a gendered or racialized pattern parallel the privilege and relative agency that members use to define a cultural norm. This frame may lead to more mechanistic explanations for marginalization and could help understand the production of local and broad diversity and inclusion patterns in engineering. For example, imposter syndrome, which is implied to be an individual pathology, could be reestablished as based on the norm-defining work done by other specific individuals, systems, and society, the noticing of those norms, and finally, the emotional experience we typically associate with imposter syndrome.

5.3 Future research directions on shame in engineering education

Our findings establish a powerful framework for future work to examine the well-studied construct of professional identity through the lens of professional shame. Examining people’s experiences in engineering through the lens of professional shame can generate meaningful outcomes that prioritize systematic care of students rather than asking whether or not they were simply retained within a degree program. Our findings also enable educators and engineering education researchers to generate meaningful interventions that acknowledge the potent emotional experiences of professional shame and facilitate healthy ways to cope with shame.

Our future work on professional shame in engineering education will examine the significance of how engineering faculty emotionally engage in the social construction of expectations for students. Although research on engineering faculty experiences is growing (Boklage et al., 2019; Stefl, 2020), the dominant research trend is to provide complex examinations of students and regard faculty members as static, supportive or unsupportive fixtures of student outcomes. When researchers examine the emotional experiences of engineering faculty, we may uncover how and why faculty perpetuate narrow, dominant narratives of engineering expectations among students (Pawley, 2009). If engineering programs can better meet the emotional needs of students and faculty, they will better equip engineering education stakeholders to promote inclusive narratives rather than reinforcing dominant narratives of what it means to be an engineer.

6 CONCLUSION

In conclusion, the processes of learning within social worlds can be intensely painful. The pain often stems from students’ social positioning and is driven by myriad social comparisons. While social expectations and painful emotions from unmet expectations may be present within all educational processes, they may be magnified by the particular narratives of engineering student success and exacerbated by the coping strategies of dominant groups. As shame is one of many emotional aspects hidden beneath the surface of learning experiences, increased knowledge about those emotions may help instructors and other engineering stakeholders communicate expectations in more empathetic and sensitive ways.

Ultimately, we in the engineering education community may need to consider the messages we convey to students when encouraging them, critiquing them, constructing learning environments, or presenting the attributes of ideal engineers. Students are listening and interpreting these messages, and our words have consequence. Does the ideal engineer make their needs known to others when they encounter difficulty, or do they “pound it out” in isolation? Does the ideal engineer ask questions when they feel confused, or should they be “smart enough” to immediately grasp the concepts? These questions are being answered by the implicit messaging that many actors in engineering culture are doing on a daily basis to reinforce our existing culture. By collectively finding new answers, we can help create a more positive educational experience for students.
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APPENDIX A

Additional details on focus group demographics

| Focus group # | Institution | Majors                                      | Year/level                                      |
|---------------|-------------|---------------------------------------------|------------------------------------------------|
| 1             | RPU         | Mechanical                                 | 1 first-year, 2 sophomores, 1 junior            |
| 2             |             | Mechanical                                 | 2 sophomores, 1 junior, 1 senior                |
| 3             |             | Civil, mechanical                          | 1 first-year, 1 senior                          |
| 4             |             | Biological, computer systems, mechanical    | 1 sophomore, 2 juniors, 2 seniors               |
| 5             |             | Biological, computer, mechanical           | 1 first-year, 1 sophomore, 3 seniors            |
| 6             | TPFU        | Biomedical, electrical, mechanical         | 1 sophomore, 2 juniors                          |
| 7             |             | Biomedical, electrical, mechanical         | 2 juniors, 2 seniors                            |
| 8             |             | Computer, electrical, mechanical           | 5 sophomores                                    |
| 9             |             | Biomedical, electrical, mechanical         | 1 sophomore, 4 juniors                          |
| 10            |             | Mechanical                                 | 5 juniors                                       |

Abbreviations: RPU, research-focused public university; TPFU, teaching-focused, private, faith-based university.

APPENDIX B

Inductive codebook

| Themes/primary codes | Secondary codes | Tertiary/topical codes                                                                 |
|----------------------|-----------------|----------------------------------------------------------------------------------------|
| Environment          | Course environment | Capstone; classmates/community; competition; exams; flipped classes; grades; group projects; GroupMe; instructor questions |
|                      | Extracurricular environment | internships; lab research                                                                  |
|                      | Student life     | Balancing priorities; family friendship; money; personal health; role models; spiritual; life; study time |
|                      | University       | Timeline                                                                                  |
|                      | Implicit/explicit messages |                                                                                       |
| Expectations         | Engineer stereotypes | Independence; math; money; only engineering; smartness; techy; timeline |
|                      | Reactions to expectations |                                                                                       |
|                      | Unmet expectations |                                                                                       |
| Strategies and advice |                                              | Adjust values and expectations; advisors; alleviate stress; ask for help; compartmentalize; contextualize; honesty; humility; independence; leave; organization; peer support; plan; power through; teach others |
| Engineering student types |                                             | Lost hardworking; naturals; perceptions; quiet hardworking competent; slacker |
| Affect and identity  |                              | Confidence; disability; engineering identity; gender; interest; language; race; self-consciousness/stereotype threat; shame; student empathy; visibility |
| Bias                 |                              |                                                                                       |
| Comparison           |                              |                                                                                       |
| Rationalization      |                              |                                                                                       |
| Purpose of experience|                              |                                                                                       |
| Risk                 |                              |                                                                                       |
| Focus group rapport  |                              |                                                                                       |