# From Outsider to Advocate: *The Experience of Shame as a Minority Student in Engineering Education*

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*Abstract*— **This full research paper presents the findings of an interpretative phenomenological analysis (IPA) study of a student's experience of shame in an engineering program. Our overarching research question is: How do students from underrepresented gender and racial backgrounds psychologically experience shame in the context of engineering education? This paper presents the findings from the IPA study of an American Indian, female student who majored in computer engineering at a faith-based, teaching-focused university. We carefully delineate her experience in order to maximize her voice throughout the findings. The findings demonstrate that the participant, pseudonym Mano, interprets current events within her engineering experience in relation to messages and events associated with her community prior to entering the space. As she begins to process, she experiences the phenomenon of shame and begins to question her belonging in engineering. However, Mano's education is also impacted by messages that empower her to persist as a minority. From this perspective, she makes choices to be a representative and advocate for other underrepresented minority students. Mano's case presents a powerful example of the experience of a minority student within engineering and the underlying structures that shape the path that she had to navigate in order to be an engineer.** (*Abstract*)

*Keywords—(shame, identity, engineering, minority, belonging)*

## I. Introduction

I remember talking to a classmate of mine just asking them, like if what their major was, you know, just getting to know them. And they were a software development [major] and they were telling me, "Oh yeah, I did all this, this every day. I used to come home and just program the time" and they asked me if I did anything. I was like, I honestly haven't, I didn't even know if I want to be this. And at that time too, I was still kind of questioning if I really wanted to- because engineering in general is pretty… intimidating a little bit. (Mano, a female, American Indian computer engineering major)

The above quote demonstrates a compelling example of Mano's experience with perceived expectations in engineering and the ways she aligned with them. In this example, in her first year as an engineering student, we surmise that Mano experienced a moment of shame, an intensely painful emotional experience that stems from the perception that one has failed to meet expectations. In a discipline that prides itself on the rigor of its coursework [1], [2] while also carrying with it high expectations from outsiders to the field [3], [4] we demonstrate in this paper that shame experiences occur in engineering in ways that could permeate students' entire educational experience, a phenomenon that we define as *professional shame*. From this single experience of felt inadequacy, we can see how the emotional experience of shame can have a broader impact on a student's sense of belonging and future participation in engineering education. One of the first observations Mano made in her engineering education was a comparison between what she and a peer did in their free time prior to entering college. This comparison triggered thoughts of engineering as inaccessible for her ("I was still kind of questioning… because engineering in general is pretty . . . intimidating") From this moment, Mano assumed that her feelings of inadequacy were applicable to all of her engineering peers. Later in the interview, Mano went on to explain the thought processes that followed: "I just felt like I just didn't belong 'cause if it was already this one person and then how many other people have already had experience"? Thus, from this interaction with one peer, Mano entered into a cycle of maladaptive reactions to shame created by a felt inadequacy from the very beginning of her engineering education experience. In this moment and in the ones that followed, shame became a defining characteristic of the foundation of her emotional experience in engineering education.

In this study, we define shame to be the socio-psychological connection between cultural expectations and an individual's internal evaluations of how they meet these expectations [5], [6]. [7], [8]. [9]. Taking cues from relevant psychological and sociological literature, shame in professional settings has four important components: 1) individuals perceive that they have failed to meet social expectations that are relevant to their identity in a professional domain 2) individuals experience a painful emotional state within this notion of failure 3) individuals attribute the source of that shame to a holistic,

global self rather than specific to the action 4) these individuals then contribute to the social expectations within the professional and educational domain which recreates the context for professional shame [4]. As illustrated in the opening quote to this paper, Mano interacted with both psychological and sociological concepts as she took a message from her peer, interpreted them using her own lens, and then applied it to the greater whole of those around her.

Although in the present study, we focus on the psychological features of shame in the case of a computer engineering student who identified as an American Indian woman, we recognize that there are broader social patterns that can be studied in relation to this phenomenon. Even while studying an individual student, as opposed to the sociological approach of studying a group, it is clear that both Mano's gender and racial identities were salient within her individual experience of shame. However, Pawley presents evidence that although cultural dynamics are certainly at play, due to the small number of students who identify as underrepresented minorities in engineering, the individualized nature of psychological theories is more helpful in understanding these populations [10]. Our previous research [5], [11], [12] includes a more extensive review of the ways in which shame has been examined in prior education research, which highlights that studying an individual mandates a recognition that their environment cannot be separated out from their experience. With this individual-in-environment framework in mind, we chose to study Mano's shame experience in engineering education. Mano, was a junior level computer engineer at the time of the interview. Her identity as a American Indian woman was salient throughout her experiences told in the interview and were consistently related to ideas such as belonging and how belonging connected to shame. It is important to note, however, that Mano's experiences, although specific in the way that they manifested in her individual narrative and were certainly influenced by her gender and racial identities, they are certainly not solely applicable students with a similar demographic profile.

## II. BACKGROUND: BELONGINGNESS FOR STUDENTS FROM UNDERREPRESENTED RACIAL OR ETHNIC BACKGROUNDS

As illustrated in the example above, shame reactions occur when expectations are presented to the individual and, based on their own self-evaluation, they do not meet those expectations. Such failures send messages to the student about their ultimate ability to be an engineer. Thus, to rectify the negative global evaluation of their engineering experience, they seek belonging [13] According to prior literature, this need for belonging is heightened for students from underrepresented racial or ethnic backgrounds who receive fewer of these "belonging" signals simply by being aware of the demographics within their classes [14]. Foor demonstrated this concept with her study of a student who held multiple identities as a minority and sought belonging within the engineering group [15]. In fact, it has been strongly demonstrated in many studies that students perform less favorably in situations in which they have been made aware of their status as a minority student [16]. In a study by Blaisdel, for example, factors such as background and pre-college experiences, and not ability, were responsible for documented lower performance [17]. Additional external factors such as

ability to pay for college and amount of human capital were also linked to results showing lower performance on engineering related tasks from students of underrepresented racial or ethnic backgrounds [18], [19]. Further, in a study of Navajo student's phenomenological experiences in engineering, Jordan and colleagues found that there are ways that engineering education programs could be more culturally responsive and make pathways clearer for those students [20]. From such studies, one can begin to understand the ways students from underrepresented minority backgrounds, like Mano, experience the culture of engineering education and the factors that contribute.

While much of this research demonstrates that making identity as an underrepresented minority salient can have negative effects on performance, little research has demonstrated a positive effect on the development of professional identity amid multiple identities that are systemically marginalized, as is the case with Mano. Literature suggests that racial and gender identities do not exist as a dichotomy but are intersectional [21]. DeCuir et. al proposed that much of the emotional experience of those who hold an intersectional identity has to do with the salience of their racial or gender identity [22]. Mano's case serves as a qualitative description of how identifying as a minority, specifically as an intersectional minority student, does not necessarily imply an endless struggle to belong within engineering. By investigating Mano's experience with shame, we can begin to understand the ways in which a student who identifies as both a racial and gender minority in engineering makes sense of her identity in an adaptive way, both in and beyond her professional identity as a student.

## III. RESEARCH QUESTIONS AND METHODS

Within the context of being an underrepresented minority in engineering education, we investigated the overarching research question "How do women students with multiple salient identities psychologically experience shame in engineering education?" We approached the study using interpretative phenomenological analysis (IPA) to carefully examine the nuances of the contextual embodiment of shame. IPA is a qualitative research method that closely examines the experience within the individual concerning a specific phenomenon while maintaining the integrity of the data and detailing the intricacy of the participant's experience [23], [24], [25]. In our study, using IPA enabled close examination of the participant's lived experience so that connections could be found between the experience of the individual student and, with psychological theory in mind, the general way that students experience shame as part of their engineering education experience. This study was approved by the IRB offices of all of the authors and the study participant.

### A. Position of Authors in Relation to the Study

An IPA study is defined as an in-depth process through which investigators generate knowledge claims that are authentic to the lived experience detailed by that data. The role of the investigators is to examine of how individuals are making sense of a certain phenomenon. Thus, in this study, we analyzed how Mano was experiencing shame in computer engineering education. The investigators varied in closeness to Mano's

engineering educational experience and personal experience with IPA. Thus, we make clear the position of each author to the study. Mackenzie and James are both members of the same research lab, directed by James. The research interview was conducted by James and Mackenzie. Both of the authors who conducted the interview had briefly met Mano previous to the interview. Nicola and Joachim contributed to the theoretical framing and provided critical questioning and insights on the findings from this study. Neither of these authors met Mano.

## B. Data Collection

To begin data collection, we sent an online sampling survey to junior engineering majors at a faith-based, teaching-focused university The survey requested that respondents identify their race and gender in two open ended items and provide open ended, long responses to two questions relevant to the study: (1) What types of things do you believe are expected of you as an engineering major? And (2) Can you describe a time that you felt you did not meet these expectations? After collecting responses, Mackenzie and James reached out to Mano to discuss her participation in the study and conducted a joint interview with her on campus. James adopted a leading role in conducting the interview while Mackenzie asked follow-up questions to probe deeper into the responses given and continue the flow of the interview. In the interview, we adopted a semi-structured approach to understanding the participant's overall experience of shame. Through the guiding structure, we elicited descriptions of Mano's overall self-concept, perceived ideas surrounding what it meant to be an engineer and individual responses to failure to meet those expectations. The interviewers ensured that the participant guided the interview and utilized prompting to obtain enriched descriptions of moments related to shame. Toward the end of the interview, we discussed with the participant the explicit focus of the study, including our definition of shame and gave an opportunity for the participant to elaborate on the interview based on her understanding of shame. The interview lasted one hundred and ten minutes.

## C. Data Analysis

Following the interview with Mano, the data was professionally transcribed and [Author 1] began her role as primary data analyst in the study. We then created a second iteration of the transcript, guided by the audio file, which gave presence to the nuances, pauses and texture of the interview. In accordance with best practices of IPA research, Mackenzie completed thorough annotations of the transcript, noting descriptive, linguistic, and conceptual comments throughout [23], [24]

Following this level of analysis, intended to critically engage Mano's experience with shame, Mackenzie then annotated emerging themes that captured the connections between Mano's experience within her context and theoretical models of the construct found in psychological literature. From this analysis, over ninety-two themes were generated—each theme being directly linked to a quotation from the interview. These themes were then organized based on their contextual similarity and grouped into overarching themes. This process of data analysis is more thoroughly documented in the IPA handbook and in previous works [23], [24]

## D. Case Selection

We chose to present Mano's case of shame throughout her computer engineering experience because it serves to demonstrate the complex emotional processes found within the formation of identity throughout engineering education. Mano identified as an American Indian woman with strong connections to her family and a desire to help others. Additionally, she presented the narrative of her experience within engineering with connections to family obligations in mind. These features made her case valuable for insights into literature for two reasons. First, due to her salient connections with family, one can see the pattern in which students arrive at their engineering education with ties, often in the form of expectations from their family. These expectations, coupled with those presented to her within her educational journey, set the stage for moments of shame when she felt she had failed to meet these expectations. A look at Mano's case encourages engineering educators to be mindful of the messages they are sending and how, whether intended to or not, they may be connected with a student's past background as an underrepresented ethnic or racial minority.

Second, we choose to present Mano's case because she provided a unique insight of how a woman, who also identifies as a racial minority, navigated shame in engineering education. Her case demonstrates that her intersectional identity is often salient in this context. However, her consideration of multiple identities was not exclusively relevant in moments of failure or of success. Rather, throughout the narrative Mano presented, she described racial and gender identity commitments as important in her experience of both shame and resilience in engineering education. Through understanding this multi-dimensional two-sided phenomenon, presented through Mano's case, one can better understand how intersectional identity can, if it presents as a justification for exclusion, also be reframed to act as a mechanism for authoring one's own narrative in engineering education.

It is for these reasons that we chose to present a single case. Mano's case on its own is valuable in providing insight to the experience of underrepresented minority student. It is important to note here that the generalizability of a qualitative case study is distinct from that of quantitative research. The idiographic findings of this work offer transferability in that they describe a phenomenon that is deeply embedded in a social context [23]. Further the validity of the case study lies in the researcher's ability to stay true to the participant's lived experience. The qualitative case study offers a conceptualization that is nuanced in a way that more wholly reflects what it means to be a person when compared to the compartmentalized conceptualization of the quantitatively researched individual. By making visible patterns of shame in the case of an American Indian woman student, we are able to think about how such patterns might operate in students who identify as both gender and racial minorities.

## IV. FINDINGS

In order to coherently present Mano's complex experience of shame within engineering education, the findings of this study have been organized into three themes that capture the underpinning processes of her experiences related to

professional shame. The first theme is a recognition of how Mano's upbringing and experiences leading into engineering affected the lens through which she perceived her educational experience. The second theme presents Mano's reaction to the shame experience as she entered a cycle of withdrawal. Finally, in the third theme we present the way Mano found mechanisms to adapt shame experiences motivated by a desire to be an advocate Each theme is delineated below.

### A. Theme 1: Interpreting the present challenges through the lens of internalized expectations from pather to enigneering

Mano's narrative is proliferated with connections to family expectations and experiences prior to her starting college. Many events that contributed to her engineering identity and thus, her perception engineering, were explicitly tied to Mano's experiences with family. Mano's descriptions of her sense of self were primarily centered around family closely followed by her desire to help people and lead others to do so as well. These identity commitments were clearly connected to messages that came from her family. Mano not only framed herself as someone who is under an implied obligation to help others but also as someone whose purpose it is to do so. Expectations such as these were foundational not only to Mano's identification as a helper but also to her view of her purpose in engineering:

> . . .you always, you know, you go out and get the education, then you come back and you help your people. But that doesn't really-there's not very, you know, detailed—[did you] help him [a family member] in what way? Financially or did he, we help them build? You know, live a better life or they never really go into de[tail]—so they always just say, "You come back and help your people."

In addition to the explicit, although nonspecific, messages from family and other individuals from home, Mano also presented internalized expectations of how she is positioned compared to others in engineering. On multiple occasions during the interview, Mano connected her story to perceived expectations on what her path ought to have been based on demographic factors.

> . . . but I guess the statistics for single moms, you know, the, the children would go and do like do drugs and not, further their education. And as I said from then to here, it's a really big jump. Just me being in college is a big jump. But me being an out of state university, like it's even a further jump and I—it's just for me—I guess a milestone you could say.

Mano made many such hypothetical and real comparisons throughout the interview. These comparisons made it clear that being an American Indian woman raised by a single mother was a critical piece of her narrative. In fact, these thoughts culminated in an internalized desire to be able to justify the sacrifices her mother made by her success in engineering.

She describes her vision of success: ". . . for me it would be also just kind of like, yeah, we came from this and now I'm here, you know, from my mom's sacrifice." In order to create an understanding of her goals within engineering, Mano coupled her hopes with descriptions of meaning to her mom. She said "I mean it's just for the both of us too. Like I said, I wouldn't be a statistic if I did this for myself with the help of my mom and of course my other family members" In Mano's mind, she held a perception of an alternative pathway where simply deviating from expectations of a student from an underrepresented racial or ethnic background is a worthy aim.

### B. Theme 2: Responding to a struggle to belong with a shame reaction manifested as a cycle of withdrawal

As previously discussed, in this study shame is defined as the painful self-focused emotional experience that occurs when one fails to meet expectations. Thus, the expectations discussed in the first theme had the potential to induce painful shame experiences. The surrounding culture presented messages of inadequacy from the beginning of Mano's experience in engineering education. She talked about an encounter with a peer in an introductory engineering class:

> . . . and they were telling me, 'Oh yeah, I did all this, every day. I used to come home and just program the time' and they asked me if I did anything. I was like, I honestly haven't, I didn't even know if I want to be this. And at that time too, I was still kind of questioning if I really wanted to because engineering in general is pretty—it's kind of-I guess intimidating a little bit.

In this moment, Mano's peer, likely unknowingly, set forth an expectation for her experience, commitment, and skill levels which, by her own measurement, she did not meet. This sense of inadequacy compounded with internalized messages about the implications of that inadequacy and its effects on those who held stock in her success. Messages from those at home about her purpose for pursing engineering weighed heavily as she felt that even from the very beginning, she had failed. Due to the broad expectations for her success, failure was not a personal matter. Rather than being a singular event, failure became a global event that had deep implications for the opinions of those who mattered most. These messages broadened this encounter from one conversation with a peer to a general sense that she was unlike any of her peers and thus did not belong in engineering. She related that she ". . . just felt like [she] just didn't belong cause if it was already this one person and then how many other people have already had experience?"

It is with these thoughts that Mano proceeded through her introductory courses in engineering, which were critical to the formation of her sense of engineering identity and sense of competence. She felt an overwhelming sense of judgement coming from her peers, which caused her to both question her belonging and lose motivation to give her full attention to her studies. She recalled the period of time following this interaction: "Then I feel like because I had so much, I felt a lot of judgement, it did cause me to slack off my freshman year. I just started not caring because it was—I just didn't like to feel judged all the time." As she became fixated on her perceived inadequacy, she began to perceive others in the engineering space as judging her. This perceived judgement was not because they were aware of any particular instance of failure. Rather, Mano felt judged for simply existing in engineering because she did not feel that she belonged. It is clear that the moment of shame that led Mano to question her belonging in the engineering space had a negative effect on her performance

in engineering. Shame caused Mano to withdraw and, instead of calling for help, she silently progressed throughout the semester all the while building a negative idea of engineering. She did not do her homework assignments on time and, rather than explaining her predicament to professors when she turned them in late, she apologized and moved on in the same cycle. When professors asked about her progress with her coursework, Mano answered positively but stored away feelings of inadequacy:

> I definitely would probably—answer them honestly. Like, no, I haven't taken [coding courses] yet. But then I would also put it in like a jar where insecurity—like an insecurity jar. Like, Oh, I probably should have known that already. And then it would just make me—it would probably be one of these mini stacks of the heavy weights that it fell on me.

Without letting anyone, including her professors, know what she was experiencing, Mano withdrew from her interest in engineering. Messages of her inadequacy were stored within her mind in, as described above, an insecurity jar that filled over time and began to feel like heavy weights. Although she mentioned professors and peers who inquired, she hid what was happening and her withdrawal from her studies morphed into withdrawal from the engineering community as a whole. Her thought process surrounding interactions with others is demonstrated in the following excerpt: "And I guess that also kind of created this like—Hm, are other people gonna be like this to me? And I was very cautious so I didn't know like who, like who, if someone was going to judge me again, like what am I going to do or something. So it made me more cautious for sure of like trying to open up to other people." Without peers or professors to combat the prospective she was internally and quietly forming, Mano began to consider switching to another major entirely.

### C. Theme 3: Adaptation in responses to shame motivated by interest in being an advocate

As Mano continued to feel inadequate in engineering, her performance and commitment to the field weakened. Both her grades and thoughts of switching to another field were threats to her progression through the major. However, someone broke through Mano's cycle of comparison, feeling inadequate, and withdrawal to provide a counter message that changed her path. She recounted talking to her mother about her feelings toward engineering. At this point, Mano was toying with the possibility of choosing another major. This moment is the one she defined as the critical turning point for her engineering studies:

> But she was saying like, yeah, you're the only native there. And you being a woman and in, even just in engineering, in general, computer engineering in general, there isn't a lot of women in the field at all. So me being in it and me being a native, she was just really hyping me up and she was just like, you know what? You should just stick with it. I think you'll be okay. The next year will be better.

These positive messages counteracted what Mano had been experiencing. Instead of her path to engineering being a hindrance to her ability to progress, her background as an underrepresented racial minority became meaningful to her success. Mano internalized these messages so that her work was motivated by the notion that it is meaningful to others who might be able to follow the same path. She described this passion as follows:

> And there's not a lot of like natives in general in the STEM field at all. So I think it's really cool that us Natives, we can actually be a number. I mean, we can start growing our number. And especially me being a Native woman, I mean being a woman is already a minority and me being a Native woman is already a minority within a minority. So it already kinda makes me a little exclusive. So, of course I want to have other women to come into it, but I'm also open to like just everybody in general.

The shift of message that surrounded Mano's engineering education can be clearly seen in the way that she dealt with expectations in the forthcoming pieces of the narrative. The "insecurity jar" that she had been storing things away in disappeared. Instead of storing thoughts of inadequacy away to build up against her progress in engineering, she combatted them with the positive message from her mom:

> So, I feel like I don't have the insecurity jar anymore. Um, because as I said, just the moment, my mom had told me, you know, you were the only Native and the only engineering student and that's all she said. And that it stuck with me and there have also been incidents where it, you know, I guess it really is nice then I am here.

Without this pile of reasons for her inadequacy building up in her mind, Mano was able to defend herself against messages that would have previously taken over her experience within engineering. She set boundaries around whose opinion is valuable to the formation of her engineering identity.

> And then I think a lot of it too is just the way I present myself. You know, as to my classmate who, felt hurt. Um, I did present myself as more like, "I'm not going to take your crap, if you're going to say something to me, you better be respectful. You know, you better respect me cause if not, I'm not going to give you the time of my day any time of day," you know. So I think a lot of it is just the way I present myself. It's like you either respect me and I'm gonna respect you. If you don't, then I'm not going to pay any attention to you

Mano's development of defenses against those who, although they had little knowledge of her actual ability to succeed in engineering, previously would have done damage to her sense of competence, was critical in her determination in her coursework. With her self-efficacy growing, Mano approached her studies with a persistence to succeed motivated by her internal drive to become a good engineer. She described her way of navigating her coursework.

> So if I didn't do good on a project programming project, I'll actually go back and ask my professor with did I do wrong? And then he'll tell me and I'll fix it and then I'll ask him again, is this how it's supposed to look? And

he'll tell me, yes, it is actually supposed to be like that. And so I'll feel better about myself, even though I won't have the grade that I want. Just me wanting to fix it and knowing that I got it better makes me happy.

Her positive manner of approaching engineering proved to herself and others that she belonged in the community and could make valuable contributions. Previously, her reflections on her path to engineering seemed to add more pressure to her success and thus, more shame felt about her perceived inadequacy. Now, however, with the development of strong self-efficacy and the success that followed, Mano reflected on her path to engineering with a desire to help others down that path.

I do want to do a program or something over the summer, um, for aim towards middle school to high school students where you could teach them coding and just kind of go from there. Just maybe a month or not even a month, probably two weeks or something. And it'd be a lot to cram in. But I want to try and spark something. That way they can continue their education and get that like spark of like, Hey, I actually really enjoy programming.

Her efforts were not exclusively focused in the future. She presented a very inclusive idea of engineering throughout her interview. She actively sought to help others and did not view it as rival to her own success. As demonstrated in the quote above, Mano processed her heightened sense of visibility as a motivation to succeed as an American Indian woman engineering student. Oddly enough, these were the same mechanisms of visibility that had previously been causing her to have the very opposite reaction and withdraw from her studies.

## V. DISCUSSION

Mano's case provides insight into the experience of shame within a woman engineering student who also identified with an underrepresented ethnic minority in engineering. Her account offers a detailed narrative of how the complex emotional experience of shame presents within a real student, outside of tightly written theory. From hearing Mano's freshman experience, one can make connections to the path of a first year student who, seemingly out of nowhere to the faculty, begins to withdraw from their studies and eventually leaves the department.

This IPA study, true to the methodology, is intended to make connections between theory concerning engineering education, racial and gender identity, and the real ways that shame is experienced within the student. The themes presented above present a picture of the interactions between engineering space and the individual student.

Mano's experience with shame follows a pattern demonstrated through other studies of shame in engineering education [15], [8], simultaneously differing in the way that she, as the individual student, experienced shame. Mano's experienced shame in response to expectations set forth by both her peers and the demands of the major that aligned with the definition of shame within this study: a painful emotional experience triggered by the failure, real or perceived, to meet

expectations. However, the way that these expectations were communicated to Mano, and how they interacted with her conscious experience, were unique to her own experience. For example, when Mano received messages of inadequacy, her emotional response was connected to an expectation from family to use her skills to help them. While many students have financial or otherwise expectations coming from family that stress their success in engineering, Mano's experience was different in that the emphasis was not simply connected to making the grade but to being skilled enough and able, at some point, to give back to her community. Further, Mano described these expectations as vague but prominent. Although her family is clear that something is expected from her educational efforts, the non-descript nature of these expectations added to the weight being placed on her success. Here, shame experiences for the student from an underrepresented racial and ethnic background manufactured an engineering education in which the student felt a constant pressure to find messages that signal belonging. This occurrence is demonstrated in Mano's case as her reactions to shame took the form of questioning her belongingness which, led to withdrawal from her coursework and, more critically, her identity as an engineer.

With these expectations in mind, one can understand the cognitive process Mano went through when she started her studies and it seemed that others had a head start. Upon hearing comments from a classmate about their previous experience and commitment to being an engineer, she began to compare her own experience. Specifically, she connected her level of experience and identity commitment to background as minority student. Mano's did not have the same pre-engineering experiences as her peers and began to feel that those were criteria for participating in the program. Mano started her engineering education with a moment of shame. Further, after assuming a negative evaluation from that comparison, she generalized from that experience that interactions with all of her peers would be that way. Thus, a moment of shame transformed into a prolonged experience of shame that proliferated her education.

In line with prior research that demonstrates hiding as a reactive mechanism to shame, [27], [28] Mano began to withdraw from of her peers. Pulling away left her missing the critical element of belonging and gave no chance for her to experience other interactions with peers with similar background that might have alleviated her emotional distress.

Thus, any programs in place to help students from underrepresented backgrounds are diminished if not eradicated in their effectiveness as Mano withdraws from the community. Mano demonstrated a cycle of withdrawal in response to shame that accentuated her feelings of not belonging. As she began to feel like engineering was not her niche, Mano withdrew further. Thus, lack of commitment to engineering led to increased messages that she did not belong in engineering, which caused her to withdraw further and repeat the process. After a few months of this at the start of her freshman year, Mano explored other majors and paths as she looked into dropping engineering altogether.

For many, this cyclical experience likely would have been the end of their engineering education experience. However,

when she was talking to her mother about leaving engineering, her mother emphasized the importance of her persistence as a minority student. Summers and Harabowski validated the meaning of Mano's presence in the department in their study of minority students and factors that affect choice to be an engineering major. Summers results showed that factors such as motivation, lack of peer celebration of success, cultural isolation and performance vulnerability often prevented minority students from ever entering the major [29]. As a reflection of the truth in this notion, we see that Mano began to interpret events differently in efforts to form and protect her engineering identity. Academically, she developed a drive to learn separate from external motivation like grades. Instead, she focused on her development as a competent engineer. Socially, she differentiated between individuals when giving value to their opinions. To those peers who previously felt unreachable, she remembered that those individuals are still doing the same coursework and thus, are not so far ahead. She gave credence to voices who recognized her worth and contributed to her belongingness in the field and disregarded those who were not contributing to those goals. Through these practices, Mano eliminated the insecurity jar in which she had been storing away moments of shame and traded it for a determination to become a competent engineer.

Navigating engineering with persistence created a model for a path through engineering that spurred the development of a desire to help others as well. Mano's belief about the importance of minority students in engineering translated to a desire to advocate for that belief in others, with and without minority status. She adopted a welcoming attitude to engineering and emphasized that one does not have to be exceptional to be an engineer. Thus, she became an advocate for an engineering space that is open to whoever might have interest. Even greater than that, she formed a plan to spark interest and feelings of self-competence in engineering tasks though an engineering camp in her home town, which, as shown by Herrera and Hurtado (2001), is a critical element in bringing students from unrepresented racial backgrounds into engineering [30], [31]. This program would give future students the pre-college experiences a decreased incidence of the kind of moments of shame that Mano experienced at the beginning of her engineering education. Rather than perceiving herself as an outsider to the engineering space as she did Freshman year, she authored her own narrative through engineering and actively sought to help other students from underrepresented racial and ethnic minorities do the same. and actively seeks to help others along that path.

## VI. CONCLUSIONS: IMPLICATIONS FOR PRACTICE

With regard to Mano's experience of shame and its connections with both psychological theory and broader patterns in engineering, there are some approaches that engineering educators can consider to improve practice. First, from the insight into Mano's inner experience shared in the interview, it is our hope that educators be aware of and imagine the incidental connections that students are making between expectations and their experiences prior to entering enginbureering. Just as Mano was connecting conversations with her professors and peers to messages she had received from her family and childhood, we surmise that students often interpret engineering experiences through a lens that educators are not privy to.

A request for awareness as mentioned above may be misperceived for a demand to be able to anticipate every student's internal thoughts. In anticipation of such a response, we make our intentions clear. Drawing attention to a student's internal world does not place responsibility on the shoulders of educators. Rather, it offers insight to the emotional experience of shame that underlies the student in the classroom who can be observed shying away from participation and putting little effort towards assignments. Attempts to explore emotional reasons for these behaviors aligns with literature that suggests engineering education research diversify the ways in which educators search for explanations of student outcomes [32]. With knowledge about the how shame may cause students to behave instead of focusing solely on academic factors, the educator can give attention to emotional factors and reach out in an informed way to restore the student's path to success [33].

Mano's case also demonstrates an example of how the individual student succeeded despite exclusionary messages from surrounding engineering culture. Yes, Mano was able to forge her own path to belonging but that does not justify the obstacles she had to overcome to do so. It should draw attention to what can be done to lessen the requirement for students from underrepresented racial and ethnic backgrounds to fight in order to reach the same achievements as their peers.

One of the most critical policies that educators can adopt with students, outside of individual interactions, is signal belonging in engineering. As evidenced by Mano's case, belongingness is linked to the experience of shame and can often act as a reparative mechanism to the maladaptive features of the shame experience. Thus, faculty members can broadly counteract shame by ensuring that their voice, which is powerful in saying who does and does not belong, is communicating that individuals are welcome in engineering space regardless of their gender, race or even beginning experience level. In Mano's case, experience level was the voiced comparative mechanism for understanding her value as a prospective engineer. However, due to the discrepancy between racial groups in engineering related opportunities pre-college, that message implied deeper connections to her background as an American Indian woman. Further, when she began to deeply experience shame, belongingness was the element of her engineering experience most salient in Mano's questioning of remaining in the major. To signal belonging to all students, especially minoritized students for whom belongingness is not always evident, is to take steps to counteract maladaptive mechanisms fueled by shame which are harmful to student success.

Finally, one can take something away from Mano's transformation from a student on the verge of switching majors to one who is formulating a program to spark interest in other minoritized students. As she cited her mom's empowering message as the source of this turnaround, special attention ought to be given to the idea that showing respect to the importance of minority students within the major is powerful.

With demographics being as they are, factors such as race and gender are going to be frequently salient for minority students in the engineering space. Perhaps it would be wise to instead take advantage of this salience to value diverse input. The identity that students hold as an underrepresented racial or ethnic minority does not need to be dialed up or down. Attempts to downplay or even spotlight this identity often have adverse effects. Rather, just like in Mano's case, the same message, which highlighted her differences, within the same student can be interpreted in a way that takes a student who feels like an outsider with little value in engineering and demonstrate instead the great value to be found in being an advocate.

## VII. ACKNOWLEDGMENT

## VIII. REFERENCES

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