

AC 2007-2767: CULTURAL MODELS OF THE ADMISSIONS PROCESS IN ENGINEERING: VIEWS ON THE ROLE OF GENDER

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Cultural models of the admissions process in engineering: Views on the role of gender

At the University of West State (UWest), a flagship, state university on the west coast of the United States, students generally apply to the engineering college after they have finished 2 years of prerequisite courses. Admission to the college is highly competitive, and although the college regularly offers informational sessions about the application process, our analysis shows that the process remains occluded to students. The mystery surrounding the process makes navigation of the process difficult, so we find students attempting to construct an understanding of the process by assembling a number of resources (e.g., advisors, department websites, classmates, sorority sisters) in order to aid them in this navigation.

We analyzed the field notes from observations and transcripts from interviews with sixteen students, who when they enrolled at UWest, planned to major in engineering. The interviews and observations took place over the course of the students' first three years at UWest, focusing on the period of time when they were readying their applications for admission to the college, the spring of their sophomore year, to examine the implications of the uncertainty that students feel about the admissions process. We describe:

- the uncertainty that students have about their futures in the engineering college.
- students' speculation (speculation that is often not based on fact) about the process itself.
- how such speculation may impact women who are considering entering the college of engineering.

This paper seeks to answer the question, *what do students believe about the admission process at UWest and how do these beliefs impact the navigational practices and identity work of women engineering and pre-engineering students? Additionally, what cultural models are brought to bear on the students' attempts to navigate applying to the college of engineering?*

We argue that cultural models at once are constructed by the students and at the same time such cultural models are constructing them, as they allow students to make meaning of their worlds and shape their actions. In particular, we suggest that students construct a cultural model of the admissions process in order to better understand and navigate the process. To understand this cultural model we need to examine the beliefs that are born from it. In other words, to understand the students' cultural model of the process we must examine what they report their beliefs about the process to be. It is important to understand this cultural model, because it is an evaluative tool, one that allows them to assess themselves and others. This in turn shapes the students' view of themselves and others, and how others see them as well.

Gaining entry to a college of engineering is something that most people who eventually become engineers must do. However, for some this is not the straight-forward process for which a prospective student might hope, and because of this we are interested in *how students navigate the process of admissions*. This interest in students' navigation strategies has grown out of our broader interest in how students become engineers^{1,2}. We noticed the topic of admission coming up in ethnographic interviews conducted with engineering and pre-engineering students at UWest when we asked them about the differences they perceived between the experiences of men and women in pre-engineering/engineering at UWest. A common response to this question was that women had an advantage in the admissions process, because the college was seeking to become "more diverse". What is significant about this is that UWest is located in a state that, by a voter-passed state initiative, does not allow admission to be based on gender. This paper seeks to answer the question, *what do students believe about the admission process at UWest and how do these beliefs impact the navigational practices and identity formation of women who are engineering and pre-engineering students?* Additionally, *what cultural models are brought to bear on the students' attempts to navigate applying to the college of engineering?*

1. Theoretical framing

1.1 Research on gender and STEM fields

In this section we begin by looking at the body of literature that exists about gender and science, technology, engineering and mathematics (STEM) fields, then we turn to the notion of *cultural models*, which will be a frame through which to examine the beliefs students have about the admission process at UWest.

In the last 30-40 years, attempts have been made to increase the number of women who go into the field of engineering. Accompanied by these attempts has grown a large body of research investigating factors contributing to the disparity between the numbers of men and women who major in STEM.³⁻¹⁹ These attempts can largely be categorized in two major ways: One category of research identifies or prescribes a remedy for a presumptively inherent difference between women and men that prevents women from entering STEM fields in numbers equal to their male counterparts (e.g., women do not have experience tinkering, like men do); A second category of research identifies the culture of STEM fields as the source of the disparity in numbers. Critics^{8, 10} of this first strand of research link this research to the "gender-difference research" and argue that it suggests that there is something "wrong" with women. In response to this first strand, researchers examined the environment or culture of STEM fields for an explanation for the disparity⁵⁻¹⁰. We, like others, argue that these two approaches to understanding the disparity fail to represent the complexity of the problem for engineering education—the individual and the culture in which he or she lives and works cannot be so easily separated. Practice theory, and in particular situated learning²⁴ provide researchers a way around the impasse and allow one to see the interplay of individual and culture^{7-10, 20, 23-24}. In our efforts to understand/examine/look at navigational practices, identity work and content knowledge we find the culture of engineering education and the individual student inextricably linked.

1.2 Cultural Models

Holland and Quinn²⁵ describe *cultural models* as

presupposed, taken-for-granted models of the world that are widely shared (although not necessarily to the exclusion of other, alternative models) by members of a society and that play an enormous role in their understanding of that world and their behavior in it.²¹ (p. 4)

These models of the world provide us with the understanding necessary to make sense of our world and our experiences, and they shape the way we navigate aspects of our lives. Key to Holland and Quinn's definition is the term "widely shared...by members of a society", in the case of this study we are looking to see what cultural models are shared among members of UWest's engineering and pre-engineering students. The shared nature is important, as it is what allows one to make sense of the actions of others with whom we interact, serving as a common frame of reference. For example, consider the cultural model of "studying". When someone says she is "studying" one makes a number of assumptions about what she is doing—she probably will consult notes and books, she may do practice problems, it is likely that she is preparing for a class of some sort. Furthermore, "studying" signals different things within different populations—think about what "studying" would mean for an undergraduate engineering student compared to a law student. Their "studying" might look different when we compare the two (e.g., the law student might have case law to learn, the engineering student might be solving problems), but because of our own experiences we have an understanding of what it means to study, and it is in this way that "studying" is a shared understanding. Within specific groups, however the model is likely more specific and refined. If one asked an engineering student to describe what "studying" is for her, she'd likely be able to provide a rich description, however if one asked her what "studying" would look like for a law student, one would expect (unless she had known a law student) that the description might be less accurate and/or more vague. So, cultural models are tools that can be used to make sense of what we do and what others do, and they also shape our actions as well. In this paper we examine the "body of shared implicit knowledge"²⁶, behind engineering and pre-engineering students' talk about the admission process to UWest's college of engineering. In other words we seek to illuminate what students "take for granted" about the process. We believe this is key to understanding how they make meaning of the process and how these beliefs shape their navigation of the process, the formation of their engineering identity and their time in the engineering college as well.

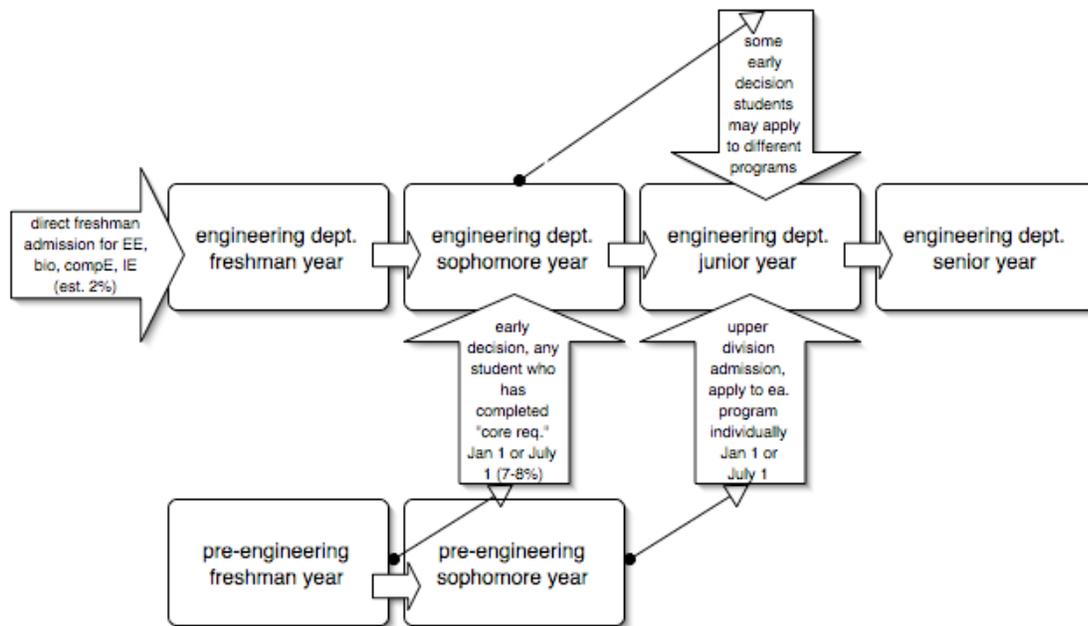
2. Study description and Methods

2.1 The Academic Pathways Study

The Academic Pathways Study (APS) is an NSF-funded, on-going, longitudinal, person-centered ethnography²⁷, currently in its fourth year of data collection. Its purpose is to study undergraduate engineering education, and seeks to understand students' development as engineers by attending to three facets of their development: first the content knowledge they gain in formal and informal settings; second how they (and others) come to identify themselves as engineers; and third their navigational practices and the impact of these navigational practices on their development. In this paper we focus primarily on the identity strand, and secondarily the navigational practices.

2.1.1 UWest

UWest is one of four institutions participating in the Academic Pathways Study. It is a flagship state school on the west coast of the United States, with a large engineering college. UWest is unique among the four APS schools in requiring that students go through a competitive application process for admission to the college of engineering before their junior year. A small number of students who the college considers highly qualified are admitted directly to the college of engineering as freshmen. But this only represents about 2% of the students who will eventually graduate from the college. Another group of students apply to the college after they have completed what the college calls “core requirements” sometime in their sophomore year, through what the college calls an “early admission” program. The departments within the college set their own policies about when to admit students, and only some offer direct freshman admission or early admission. The vast majority of students, however, wait until after they have completed all of the prerequisites for the engineering program, which consist generally of chemistry, physics and mathematics courses. For students who apply to upper-division admission they must commit two years to engineering, without a guarantee that they will get in. This investment of two years makes the admission process high stakes for students. The diagram below we have developed based on discussions with college staff and students, and reviewing of college materials (including websites and documents from the advising office). It illustrates, as we see them, the admissions patterns most common for students applying to UWest’s college of engineering. The most common entry points for students to the college of engineering are represented in the diagram by the large arrows.



2.1.2 Participants

Sixteen pre-engineering and engineering students at UWest agreed to participate in the study early in their freshman year (2003-2004) at UWest. Students were recruited through the college’s pre-engineering LISTSERV in their freshman year and of those who volunteered we selected eight men and eight women, over-sampling for women and students of color. We selected students who, to us, demonstrated a strong commitment to applying to the college or were already in the college. The students selected came to UWest from varied backgrounds. Domingo and Joe, for example are slightly older than the others in the study, having spent time after high

school doing other things—one spent time in the military and the other spent time in religious service. The students’ high school backgrounds also varied. Our sample included students who attended catholic girls’ high school, large urban or suburban public high schools, and small rural high schools. The chart below shows information relevant to the students’ (pseudonyms are used) admission to the college of engineering—namely, they type of admission for which they applied, the department to which they applied, whether they were accepted or not, their grade point average (GPAs) after sophomore and junior years, and notes needed to provide more information.

Pseudonym	Type of admission	Department	Accepted?	GPA after SP 2005	GPA after SP 2006	Notes
Bryn	Upper	TechCom	Yes	3.180	3.298	
Erica	Upper	Chem E	No	3.361	3.428	
Jane	Did not apply	AA (In business)	N/A	2.809	3.028	In Business Left soph. yr.
Maggie	Early	Mat Sci	Yes	3.378	3.407	
Mimi	Upper	CSE	Yes	3.820	3.760	
Renee	Early Upper	Mech E Civil	Yes Yes	3.883	3.879	
Suzanne	Early Upper	BioE BioE	No No	3.210	3.199	Switched to Microbiology
Anke	Early	Chem E	Yes	3.27	3.282	
Adam	Early	Mech E	Yes	3.290	3.273	
Colin	Direct	EE	Yes	3.406	3.410	
Domingo	Upper	IE	Yes	2.706	2.780	accepted junior year
Jake	Is “extended pre-major”		No data	2.086	2.083	Left study
Joe	Direct Upper	EE CSE	Yes Yes	3.653	3.664	
Johnny	Early Upper	IE IE	No Yes	3.454	3.300	
Randy	Upper	CS	Yes	3.499	3.524	
Simon	Upper	AA	Yes	3.018	3.148	

2.2 Methods

Sixteen students at each of the four schools participate in annual unstructured, ethnographic interviews, and researchers at the schools shadow eight of the sixteen as they progress through their undergraduate engineering education programs. In addition to this data, we also collect documents (such as, course syllabi and department information sheets) and we archive relevant websites and online documents. Student academic transcripts are also archived at the end of each academic year. This paper focuses on the interview data in the first three years of the study at UWest; field notes from ethnographic observations, transcript data and collected documents were employed for triangulation.

The interviews are conducted in the spring of each academic year, are generally an hour and a half to two hours long, and follow an open-ended interview guide. Interviews are audio-recorded and transcribed. To aid in identifying relevant passages and patterns in the data, transcripts of the

interviews were coded using Atlas.ti for talk that included either one or both of the topics of gender and admissions. These excerpts were then analyzed with an eye to emergent cultural models shaping the reported beliefs of students about the admission process. The excerpts chosen for this paper were chosen because they are representative of the notion being discussed or because they contrast or contradict a commonly held view among the participants. The purpose of this study is not to make generalizations about all of engineering education, but rather to identify and elaborate on a practice at UWest that has an impact on students. What is true at UWest may not be true at other schools, but we believe studies like ours can play a role in helping to set future research agendas.

3. Assembling an understanding of the admissions process.

In this section we show: A) That students at UWest are uncertain how they will be evaluated by the admissions committee; B) This uncertainty, we argue leads students to enlist different resources, both official (e.g., department websites) and unofficial (e.g., friends) to obtain information in an effort to both better understand and navigate the process; C) Information obtained from these sources point to two kinds of factors, which students come to believe the college weighs in admissions decisions—non-gendered factors and gender—and these beliefs are used to construct a cultural model of admission.

3.1 Uncertainty about the process

Admission was a source of worry for many students in the study throughout their first two years of pre-engineering, unless they were a direct admit to the college, a program that only a handful of the departments offered and only offered to a handful of select students. Getting into the major was such a big worry for students, because admission to UWest's college of engineering is highly competitive. Adding to this worry was the fact that the process was vague and uncertain in several ways to the students. For example, it was not clear to the students we interviewed how heavily the admissions committee would weigh one's extracurricular activities (e.g., belonging to engineering clubs, or being president of one's sorority) and work experience in the decision-making process. Jane's response below to a question we asked about how the admission process worked was typical of what the students we interviewed related knowing about the admission process before they applied to their majors.

Jane: I'm actually not too sure. But I know I'm supposed to take required classes such as physics and some chemistry, definitely math and technical writing, oh wait, wait, and English 131. And after that, you can apply to aerospace engineering program. ...Uh, the process, I believe you have to pick up an application, write an essay, send in a transcript and, I'm not quite sure what else, probably recommendations from teachers. (Jane freshman year)

Students were familiar with the stated “nuts and bolts” of the admission. They would have to submit to apply to their majors, an application, an essay, their transcripts and possibly letters of recommendation. Knowing what they had to submit however was different from knowing how these submitted documents would be used to judge them. Furthermore, knowing what to submit was not enough to alleviate the uncertainty they felt about their chances of getting into the college. Both Johnny and Suzanne talked about there not being “guarantees” that they would be

admitted. Johnny even talked about his plans should he not get into the major--staying at UWest and majoring in Economics. Suzanne also, in her interviews, talked of contingency plans. This was fairly common among the students in our study.

Only some of those with relatively high GPAs, as one would expect, seemed unfazed by the process. Joe, who had been a direct admit to one department and decided to change majors (which meant going through that department's upper-division admission process) said this in his junior year interview, "my GPA was a little, it was higher than the average and everything, so I was pretty sure that I would get in." Renee, who had been admitted to one department via early admission in her sophomore year, also told us in her junior year interview that she had "not really" been concerned about getting into the major into which she was trying to switch. She explained why she was not worried in this way,

Renee: Because my grades are high enough. And I got accepted to mechanical and mechanical is considered harder to get in to than civil. Civil is a large back-up for people that don't make it into mechanical. (Renee junior year)

The high degree of uncertainty about how the admission process worked, coupled with a consequential two-year investment of time in completing the prerequisite coursework led students to construct a cultural model of the admission process to aid in their navigation of the process. As stated earlier, cultural models may be informed by a number of sources. In the next section we discuss some of the sources enlisted by the students as they construct a cultural model of UWest's admission process.

3.2 Sources and navigational practices.

Our interviews with the students revealed the students used a number of different sources to construct a cultural model of the process. These sources consist of both those that can be labeled "official" (e.g., department advisors or department and college websites) or "unofficial" (e.g., friends, classmates or sorority sisters). In this section we discuss some of the more influential of these sources, and then discuss the commonly-held beliefs that emerged from our analysis of the interviews. These sources included, but were not limited to advisors, department/college websites, faculty, TAs and friends.

Every year the college held information sessions about the admissions process, and many of the students participating in this study reported meeting with department advisors in the college to gauge their chances of getting into their chosen major. Additionally the departments in the college had information posted online that the students could consult prior to their admissions. Generally the students in the study reported consulting multiple sources. Jane, in her freshman year at UWest, was asked where she learned about the admission process. She mentioned consulting the department's website and friends of hers who were in engineering, but who did not happen to be in the department to which she hoped to be admitted. Friends, for Jane, played a role similar to the one an advisor filled for others. For Erica and Domingo, an advisor not only helped one gauge one's chances of admission, but also offered personal recommendations tailored to an individual's circumstances. Domingo was told that his activities would help his case, and Erica was told that her grade in a particular class would not negatively impact her application, since the department did not "care" about the class.

These conversations with one's advisor, then, were key in the construction of one's cultural model of admission at UWest and one's navigation of the admission process there. Upon her advisor's recommendation, Maggie applied and was admitted to the college through her department's early admission program in the winter quarter of her sophomore year. In this excerpt she talked about her advisor's role in her decision to apply early.

Maggie: I applied last February, I applied early um because I met with the um materials science advisor and I told her my interests and she saw my grades and she's like, "yeah you should just apply early, you'll probably--you know, I strongly suggest it." And I was like, "OK." (Maggie, junior year)

People did not always get good news when they talked to their advisors. Suzanne, in her sophomore year interview related that she had applied for a second time to her chosen major and was rejected again. Upon being rejected she went to see the advisor for the department.

Suzanne: Um I applied once again to bioengineering this spring and did not get accepted, um went to the advisor and pretty much was told "You will never be accepted" sort of thing [laughs]. "You just, you just don't have the GPA." (Suzanne sophomore year)

The advisor cited one factor as evidence, her GPA. Through the lens of this cultural model of admission the advisor is able to evaluate Suzanne. Suzanne, then is able to use this assessment and information she has acquired from other sources to assemble her own cultural model of admission. In the next section we examine what the students "take for granted" about the admission process, in other words, what students' cultural models of admission look like, and discuss other cultural models shaping/informing their cultural models of admission.

3.3 What counts in admissions decisions

These official and unofficial sources feed into the beliefs of the students about what is factored into the college's decision about who gets in and who does not. We find that sometimes information from different sources conflicted, or that the information obtained conflicted with the students' own beliefs. When this happened students attempted to resolve the conflict by privileging one source over another. In some cases, we found examples of the students privileging unofficial information. In this section we discuss what the students believed counted in admissions decisions.

3.3.1 Grades, activities and work as factors

When asked to talk about the admission process at UWest, most of the students talked about GPAs and what kind of grades would be required to get into the major. Additionally, a student's activities were also cited as things that an "admission committee" would consider when deciding who would be accepted. One student talked about a list of references that he was prepared to share with the committee when he applied. Also mentioned were research projects and jobs in the field (both on campus and off) as being factors in one's chance of being admitted. Of all of these, however, grades seemed to be what most students thought was given the greatest weight in the decision about their futures in engineering. This is not surprising, given that much of the assessments given by advisors relied heavily upon GPA. The other things, like activities played a

supporting role. They were things used to bolster or prop up one's chances, if one's GPA was not believed to be strong enough.

The students who were most confident in their chances, like Joe and Renee, talked very little, if at all, about such supporting factors in the context of their discussions about the admission process. They seemed confident based primarily on having an above average GPA relative to other students applying. For others, with lower GPAs (and even for some with high GPAs) the other factors were things they hoped would be considered. Suzanne, in her freshman year, discussed some of the things that she believed would be factors in considered in application to the major.

Suzanne: Um, well, I've done fairly well in this quarter's classes, so I think that that'll raise [my GPA] a little bit and then if I do well next quarter too, then it should sit right around a 3.2 or possibly like, I think the highest I can get it is a 3.4. And that, I think, would be the bottom end of the acceptance, just based on GPA. Um, so, like right now I'm applying to the summer research program, and I just signed up for WiSE so I'm *trying* to make it look better [laughs]. You know, "Look, I'm involved in clubs at this school, look I applied to extra-curriculars," sort of thing, so, I don't know. Somebody told me that like it's not just based on GPA, cause if you have a crappy attitude about things, you don't get in either. So, I'm hoping that, more than just GPA will be a factor. (Suzanne freshman year)

The excerpt demonstrates that Suzanne was aware that her GPA was low for the major to which she was applying, and thus she talked about the other things she was doing to make herself a more attractive candidate. Note her reference to the negative effect of "having a crappy attitude" on one's chances of being admitted. It is unclear who the source she cites for this belief (somebody) was, but she appeared to be using this information in her navigational practices. One reading of this is that if attitude is something that is considered (in addition to GPA), then other things, like activities must be considered as well. This belief, that other things are considered, coupled with her sense that her GPA was not strong relative to others who were applying to the major motivated her to seek-out activities and research programs to help her make her case to the admission's committee stronger.

Domingo, like Suzanne, was concerned about his GPA being lower than the norm for those accepted to his program. He explained in his junior year interview that he had "work[ed] every angle" he could in an attempt to make-up a perceived deficit of having a lower than average GPA. He described retrospectively that the "good thing about the engineering application process" was that these other things (involvement in engineering clubs and leadership roles in these clubs) were considered. He even mentioned in that interview that the advisor with whom he met acknowledged being familiar with him and how "busy" and "involved" he was. He reported that she, because of this familiarity with all he did was willing to "put in a word" with the admissions committee on Domingo's behalf.

In addition to one's GPA, which students (and most sources) seemed to agree was the most important component of an application, and the other factors discussed (e.g., one's involvement in engineering-related activities), students believed that there were other factors which the

admissions committees considered, in particular one's gender. We discuss gender as a factor in the admissions process in the next section.

3.3.2 Gender as a factor

While students discussed GPA as the most important factor—they also thought that it was not that simple—one's gender, most believed, was a mitigating issue. Students, both those already admitted to the college as freshmen and those that were applying, held views about the role of gender in the admissions process. Many students cited the presence of the Women in Science Engineering program on UWest's campus and other women-targeted programs as evidence that UWest was striving to reach out to women. For some these programs the college had in place were evidence that women needed more help or were disadvantaged in some way. For example, when asked if he thought there were differences in the experiences of men and women engineering students Johnny answered,

Johnny: I bet there is, um cause there's like Women in Science and Engineering, there's other females, or women's groups um tailored towards like science and engineers, and I guess the reason they're created is because there's not as much of a representation--representations of them, um in the field and just by having that kind of proves that there was a difference or there was a disadvantage for them. (Johnny junior year)

Others saw the presence of such groups as evidence that the college wanted to “encourage” women to be engineers, because of the relatively small number of women in the field. More specifically, students expressed a belief that the college was seeking to “be more diverse” and cited this as a reason for gender playing a role in the admissions process. For example, Colin, a student who was admitted to his department in the college as a freshman, spoke of his department saving spots for women, to this end.

Colin: cause they always have like, um, Women in Science seminars, and like they have all these things to promote, and they like guarantee--I don't know what it is, but they guarantee a certain number of spots to EE women, like if you want to be a woman in EE
I: They do?

Colin: Yeah, I think--I'm pretty sure, well someone told me that but just to promote like, um, getting some women in there, cause there's like none so. I think, I don't know, I think that for me if I--I think that would be sort of intimidating as a woman like, surrounded by a bunch of guys. (Colin, sophomore year)

Colin rationalized the view about the EE department saving spots for women with his observation that “there's like none” in the department. Jane too noticed the disparity between the number of women and men in her chosen major.

Jane: I always wanted to get in there and see if I can become one of the, um, girls that get the aerospace engineer degree, but I mean I look into their site, and only like a few girls have done so, and it'll be great if I can be one of them too. (Jane, freshman year)

Jane had a sense from what she had seen on the department's website that women were rare in aerospace. It is not clear, however, if this awareness was motivating or discouraging to her.

Either way, Jane knew that if she succeeded in the department she would be one of only a few women to have done so.

Men and women alike saw women as being encouraged to go into engineering. Joe, for example, described the phenomenon in his major, in the context of his answer to a question that asked if he thought there were differences in the experiences of male and female engineering students.

Joe: It seems that, it seems that the, the female students in, in computer engineering, there were obviously none in electrical engineering, but in computer engineering there's a little bit more, and, and they have been encouraged a ton, they've been almost like pushed to go into computer engineering. (joe junior year)

Here, in Joe's excerpt we see another person that related that there were but a few women in the college, specifically in the two departments in which he has been enrolled. He noted that in his current major, women have been "almost like pushed" to go into the field. Later in the interview Joe described one professor who devoted an entire day of his course to the achievements of women in the field, women we interviewed also noted receiving encouragement of this nature. Like Colin, Jane and Joe, Maggie recognized that "there aren't a lot of women in engineering". Shortly after she had been admitted for her department's early admission program she shared in her sophomore year interview that she saw the support that she as a woman in the college of engineering was receiving as evidence to support the notion that the college was seeking to "get the departments diverse".

Maggie: Um, being a woman in engineering, I see a lot of encouragement from people, because I am a woman. Like they understand that there aren't a lot of women in engineering and I, I mean the departments recognize that as well. And they-, it's not they're like, well who cares, you know kind of thing, or like good luck once you get in. I think there's a lot of people supporting women who want, in that [inaudible] because there has always been a large proportion of men. And so I feel a lot of encouragement, ... a lot of people like saying, "You know if you have trouble, just come and we'll figure it out," kind of thing. And there's a lot of people like are encouraging, they're like *trying* to make sure that, they're trying to get the departments diverse so that there's a wide range of um people's different opinions, different outlooks that are collaborating together in that department. (Maggie sophomore year)

Maggie made several points in this excerpt that are useful in understanding how she sees gender through her own cultural model of admission. First, she believes she got encouragement because she is a woman. Second, she believes this encouragement came because there were not many women in engineering, and that "they're trying to get the departments diverse". For Maggie the support does not seem to stop when one enters the major, but continues beyond admission—getting more women into the major seems to not be enough, rather the college wants to make sure they stay. Finally, she provided an explanation for this hoped-for diversification—to ensure that there will be a wide range of "outlooks...collaborating together in that department". Renee, in the excerpt below also seemed to share Maggie's view that her department was attempting to diversify itself.

I: *Uh are there supports or barriers, advantages or disadvantages as a Caucasian engineering student?*

Renee: I know the admissions does look at diversity just a little bit as far as trying to diversify the department. For me that doesn't really come in as a problem because I'm a girl. So I'm kind of in that group of "I guess we want more of you." So I know it's kind of hard for mechanical engineering. I don't know--I don't know exactly how true this is, but they say it's a lot harder if you're a guy and you're white and you don't have a very high GPA. Like you have to have a good GPA, a solid one. They just tell people it's harder. So. (Renee junior year)

Renee seemed to agree with other students in the study we quoted earlier who believe that those responsible for the admissions decisions in her department look at one's gender with a goal of diversification. This, she said was "not a problem" for her, because she is a woman. It is interesting that she used the phrase "not a problem" rather than calling her gender an advantage in the process. A possible reading of the use of this phrase is that Renee sees gender more neutrally, rather than as a positive in the admissions process. She seems to indicate that gender for men, on the other hand can be a disadvantage, reporting having heard that higher standards applied to the white men who would be applying to her major.

Erica, who applied the summer after her sophomore year also spoke of gender used in admissions decisions, but described it as a tie-breaker in the process. She explained that if a man and a woman had equal qualifications that the college might offer the woman admission instead of the man.

Erica: I still think that it might be an advantage because I think, you know, they want to be, everybody wants to be more diverse, especially in the university setting, you know. Like diversity's a really important part of it. So, um I think that there's still a slight advantage to being a woman, but in talking to the, um, advisor, she didn't make it seem like I was any less or any more than anybody else. Um, which was good, because I don't want to feel like I got in just because I'm a girl. Like I want to feel like I got in because I worked hard and I got the grades. Um, but I, I think you know, I think they still are gonna look at it and say, "Okay, well, you know," if I was exactly the same as a man, and it was either me or him, I think you know they might take me if they want more women in their program. (Erica sophomore year)

Erica saw herself as having an advantage over men, because she is a woman, and considering that diversity is widely viewed in higher education as being important. She also said, however, that talking to an advisor contradicted this view. This seemed to be a relief for her, as she explained that she wanted to get into the major by demonstrating her ability to do the work, and did not want to feel that she was admitted simply because she is a woman. She seemed to reconcile the views that diversity is important to the department and that gender is not a consideration in the process by constructing an alternative view – that of gender as a tie-breaker. This compromise of sorts suggests that she, as a woman, does have an advantage in the admission process, but only in a close call. In this way Erica is able to see herself as someone who has earned her spot in the major, but can still retain her belief that the diversity is important to the department.

One way to tease out what is going on here is to ask, “what must the students believe” given the statements they have made regarding gender’s role in the admission process? A possible reading is that the students believed that the college, department and/or field supports the cultural model of “the importance of diversity”. Through this lens (their understanding of the cultural model of “importance of diversity”), students made sense of the college’s Women in Science and Engineering (WiSE) program. In other words, students saw programs like WiSE as existing because the college supported the view that diversity is important.

Clearly the engineering and pre-engineering students (both men and women) in this study seem to have as part of their cultural models of the admission process that gender is a factor weighed in the process. Only one student presented a view that countered this widely-held belief--we will discuss this in more detail the Conclusions section. We next turn to a discussion of the impact of these prevalent beliefs on the women taking part in the study.

4. Impact of beliefs about the admissions process on women

We now turn to an examination of the experiences of women, post-admission, with an eye to possible impacts of the diversity discourse on their reported experiences. In particular we examined what they said about differences (if any) they noted in the experiences of men and women and how it had been for them as women in engineering. Three themes emerged from the data: First most women reported having no problems with faculty or peers once they were in the major; Second, they seemed to believe that there were important social differences in the experiences of women and men in the major that may impact women academically; Third, women reported feeling the need to “prove” themselves worthy of being in the department.

4.1 “I haven’t had any problems”

Both Mimi and Bryn reported that they had not had any “problems”. Bryn, in answering how it had been for her, as a woman in engineering, said,

Bryn: It’s been okay here. I haven’t really felt, you know, I have four younger brothers and I’ve grown up around boys so I—I’m not at all, you know, girly girly and not gonna feel offended. I mean, I’m gonna stand my own and if someone says something, I’m, you know, I’m not going to fight back, but I’m going to—not put them in their place in a negative way, but you know, remind them gently ((I: [laughs])). But I—I haven’t had any problems. ((I: *That’s good.*))Yeah. I think times are changing. It’s a little late, but. (Bryn junior year)

She explained that she is not girly, and has four younger brothers. One reading of her inclusion of this information in her answer is that her prior life experience has prepared her for being in the male-dominated field of engineering. Bryn seems to have a strategy for how to deal with a bad situation, “remind them gently”, but says that she has not had a bad experience in the college. However, Bryn’s last turn in the excerpt seems to point to a belief that this is a change, and perhaps she might have had a problem had she been an woman in engineering at an earlier time. In other words, for Bryn, women now have a better experience in engineering than women in the past have had. Like Bryn, Mimi reported having no problems, but expressed a belief (when asked

what she thought was different about the experiences of men and women) that all the people who “know a lot more than the rest of the class” in her major were men. Mimi, then, did not see herself as one of the elite in her program, and did not see other women in this position either. Renee, too, related that in classes her experience had been “fine”, but felt that her experience was likely different, even harder, than that of her male peers socially.

4.2. Social differences

Renee remarked on the following perceived difference in the experiences of men and women,

Renee: Um (.) I think for the girls it might just be harder because there’s fewer of us. So, I don’t think that like within the classes there is [a difference], but socially maybe.

She believed that it was not harder for a woman academically, but rather that it was likely more difficult for her socially. She seems to attribute this to the relatively small number of women in her department. We followed up by asking how it had been for her as a female engineering student.

Renee: I mean it’s--in classes it’s fine. It is a little weird having a bunch of guys ((laughter)) and they’re all just kind of different. Guys are guys. ... I’ve never got any different treatment [from a professor]. So. (Renee junior year)

In her junior year interview Renee also discussed how difficult it was for her to make friends with women, because there were so few. Renee was not alone in noticing differences in the experiences of men and women socially--Erica, Mimi and Maggie reported these differences as well. For example, Erica and Maggie both talked about strategies that they (and other women they know) employed in classes. Erica discussed choosing to work on teams in classes that were predominately women when she could and Mimi pointed out that her work in engineering was so demanding that she had lost contact with friends. This loss for her was exacerbated by what she described as “anti-social” people in the major. Both she and Maggie talked about women feeling most comfortable going to another woman for help with homework. Maggie, who is a member of a social sorority for engineers at UWest, explained that her sorority sisters had employed this strategy,

Maggie: I [hear] this from, um, my sorority sisters who are in their majors, and been in their majors like, you know if they don’t understand something, “you’re gonna call a *girl* in your class first, instead of guy, cause you don’t want to seem like, ‘Oh, the woman doesn’t know what she’s doing...’” like they don’t want that like stereotype. You get kind of, like, you kind of fall into that like, “Well, I don’t want them to think that,” kind of thing. And I think that’s like the downside ... you’re afraid that you don’t really want to interact with them [men] at first in that sense. But I think you might, I think people [we all] get over that in just the sense that it’d be like, if I prove like, hey I know what I’m doing, I’m studying hard, I can prove to these guys, you know, I’m just as good as they are. (Maggie sophomore year)

This strategy of seeking help from women rather than men was employed, as Maggie related, to avoid perpetuating the “stereotype” that a woman in engineering would not “know what she’s

doing”. She further pointed out that this caused women to avoid interacting with their male peers, which she saw as an obvious downside of worrying about perpetuating the stereotype. Women, who employed this navigation strategy, then, were limited to having a much smaller pool of peers with whom they could collaborate, which in turn may have had a negative impact on them academically.

The stereotype that Maggie presented can be read as being related to the notion that the engineering college applied a different set of standards for admission to women applicants. If lower standards were applied to women applicants to the college, then women who got into the major could be viewed as less capable than the men who were admitted. This led to the stereotype that one who was a woman and an engineering student did not “know what she’s doing”. Not only did women, according to Maggie, try to avoid perpetuating this negative stereotype, but they also felt the need to contradict it. We examine this notion further in the next section.

4.3 Proving oneself

Prevalent in the talk of the women (even those with high GPAs relative to their counterparts in the study) was the notion of having to prove oneself to others. Even though they were admitted to the college and have proven themselves worthy of admission, women still talked about the need to demonstrate, especially to their male peers, their knowledge and abilities to do the work well, or that they deserved a place in the field. For these women, getting into the major did not mean they could stop trying to “prove themselves”. What changed after admission was the audience—instead of trying to prove to the admissions committee that they deserved a spot, some reported having to prove themselves to their peers and the field at large. As we argued above, this seems to be related to the perception that there were different admission standards for men and women. Consider this statement, also from Maggie’s sophomore year interview.

Maggie: I have to prove [to the men in my class that I’m as good as they are] a little bit more, like “I know what I’m doing,” kind of thing. Like obviously everyone in my classes are gonna-well they must know what they’re doing, because they got there. I mean, you had to apply and get accepted into the department ... And just like, you know, um, then you have to prove, well like, “I’m here for a reason, I can do better than you. I can get on the higher side of the curve.” Um, but I think there’s a little bit of that pressure like, “Well I gotta prove a little bit more that I’m worthy of getting this, and they’re not just doing it because I am a woman.” Cause there’s a lot of things like, “Oh we want to make, you know, the demographics you know, we would love to get it at 50/50, so we’re gonna accept as many women as possible, or as many minority students as possible.” You kind of feel that little extra like, “Oh I gotta prove that I am worthy of being here because, not just because they’re trying to fill some kind of quota,” So, I feel it a little bit, (Maggie, sophomore Material Science major)

Here Maggie referred to the notion that the department wanted to improve the “demographics” and let as many women as they could into the major. This echoes our discussion about the students’ perceived belief about the role of gender in the admission process. She feared being viewed as filling a quota. Because of this fear Maggie felt “pressure” to “prove” or demonstrate that she was “worthy” of being in the department and that she could not only compete with her

male peers, but also outperform them academically. It is interesting that Maggie stated that people who got into the major “must know what they’re doing”, as it seems to contradict the notion that people could be admitted simply to improve “demographics” or to fill a quota.

Erica also related that she felt the need to prove herself to her peers. She related an experience with a male peer in which she felt that he was scrutinizing her work more than he was scrutinizing her teammates’ (who were men) work. She concluded by telling us,

Erica: ((laughs)) Well because I'm a girl like, when I'm in a group of all guys and they're all like poo-pooing my ideas, you know, saying you don't know what your talking about. Like of course, it's natural to think 'Oh, it's because I'm a girl.' you know? Even though it might not be, like if a guy had the same ideas they might be like, you know, “what are you thinking?”, you know. But when there are obvious differences, I think it's easier to blame those differences. (Erica junior year)

Erica, then, found herself expecting the men she worked with to see her as not knowing “what she’s doing”, and then analyzed her interactions with them through this lens. She admitted, that if a man she was working with criticized her ideas, it could be that her ideas deserved to be criticized, or it could be that he was using a different standard to judge her work than he would to judge the work of men. For Erica, it was “natural”, even “easier” to attribute someone “poo-pooing” her ideas to her being a woman.

Not only did some women put the pressure on themselves to perform well, but Maggie also noted that she felt external pressure by virtue of the fact that she believed she had been given an opportunity and that there were not many women in the field. Women had to perform well to prove themselves as individuals, but also felt the need to prove that women more generally could succeed in the field.

Maggie: But at the same time they [the department] want to prove it’s not just because you’re a woman you’re getting [into the major]. So we’re going to push you harder than they’d push maybe a male student because they want to prove that it’s not just-- you’re not just playing the minority card and saying, “Well you don’t have enough women engineers so you gotta pick me over this other guy that you know might be a little more qualified than me.” And I think that’s what they’re trying to—I believe I see more of them trying to prove—put more work on women. So that they can prove it but at the same time they’re kinda you get a little bit more of a break so I mean I see both sides of it. I’m just trying to like use whatever I can, so. ((laughter)) It’s like throw what you got at me, you know, if I can’t handle it, I can’t handle it, you know. If I do, I do, so. (Maggie junior year)

Maggie related that women were pushed harder than men, so they could justify that they were doing more than just filling a quota. While Maggie and the other women, through their performances as engineering students were responsible for proving they deserved a place, they also, she indicated, simultaneously “get...a break”. Her reference to “seeing both sides” reveals that she was aware of the competing beliefs. Anke also seemed to feel the need to represent others in her performance in school. In this passage she even mentioned a female professor and a

mentor that have succeeded in the field as being examples to her. She wants to do the same, for others who will “come after” her. Anke also mentioned a minority engineering program with which she has been involved since her freshman year as a source of her motivation to stick with engineering and get a degree in the field, even if she was not going to study engineering in graduate school (her plan instead was to study another science).

Anke: I don't know, at this point I have to, I can't quit, I have to keep doing it. Like even if I'm not necessarily gonna study engineering, like it's important that I get through it, cause then other people will come after me. And then, like the same-, and probably the same way I feel about like my one female professor and my mentor that they made it through, so it helps other students. And I think it'd help my program too, because to show that they have successful students coming out of it, for getting engineering degrees. I don't want to just quit on the program. Cause they've really helped me a lot in college so, yeah [sighs] it's hard though.

I: So you're, I mean you're taking a lot of personal responsibility on for, um, for making things different.

Anke: I don't know, I just feel like giving up won't help anything, so. It's probably not what I'll end up doing, but I'm still gonna get the degree. (tarja sophomore year)

Anke explained sticking with engineering by citing those students who would come after her. She saw her act of staying in the major as an act supporting these students, as well as the program with which she is involved. Women, then seemed to feel both internal and external pressure to succeed, to prove their place (and the place those that will follow them) in the field is merited.

5. Conclusions

Every engineer who is awarded a college degree has to navigate the admission process, yet not much is known about the impacts of the process on engineering students. We argue that students assemble a cultural model of admission, which, for some, includes the view that women have an easier time getting into the major than men do. Students seek to understand the evaluative process of admission employed by the college. In doing so they construct a cultural model, based on the information they are able to assemble, as outsiders to the process. This cultural model informs decisions they make about when to apply and allows them to assess their chances of getting into the college. It also allows them to allot their time effectively and make decisions about with which engineering-related work, research or activities they chose to become involved. Students also use this cultural model as a way to evaluate peers. It impacts: (among other things), with whom they choose to do work, how they interact with a peer, or whether or not they seek help to understand a difficult concept.

This view, that women get into the college easier than do men, was prevalent among students, despite the fact that UWest has been effectively banned by state law from treating a student preferentially because of her gender for almost a decade. We only found one person we interviewed, Randy, aware of this initiative. Erica talked about her advisor telling her that she would not be judged differently than her male-counterparts, yet Erica also related having a belief that diversity was important in a university setting. Erica, then, had to resolve conflicting beliefs that she thought shaped the admissions process. One reading of the resolution she made (that

gender is a tie-breaker for close calls) is that her belief that diversity is something for which a university would strive is given equal, if not heavier weight than the diversity is important cultural model. Her view that gender serves as a tie-breaker is a resolution of these two views and provides an example of how students come to construct a cultural model of the admissions process.

For women the cultural model, we worry, may construct them as not being worthy of being in the major. The talk of the women in the previous section indicates that this cultural model of engineering admission at UWest has implications for their experiences in the college. This cultural model, by its very nature (and the nature of the process itself) is evaluative—used to judge oneself and others. So, with the cultural model as described by the students and discussed here, we see some women reporting a belief that if there are different standards for men and women, then women must be less able than their male counterparts. The women want to prove themselves to their peers, and to others in the field (and out of the field) that they are not just filling a quota. They feel pressure to represent positively all of womankind in their coursework and interactions with others. Not only do the women we interviewed feel the need to demonstrate their worth, but also they strategically avoid situations in which they, as women, could be seen to exemplify this view, prominent in the cultural model of admission described here. This cultural model, we argue is seen to impact the navigational practices (e.g., how they go about seeking help) and identity work (e.g., how they attempt to portray themselves as *not* being a quota filler) of the women in this study.

Furthermore, we contend that this shared perception may mean the conditions for what Claude Steele²⁸ has termed *stereotype threat* are present for women in this university. Stereotype threat, according to Steele is “the social-psychological threat that arises when one is in a situation or doing something for which a negative stereotype about one’s group applies.” One of the examples that Steele presents is that of “math-identified women” women who think of themselves as being good at math. He found that the awareness of the negative stereotype that women are not good at math influenced the math-identified women’s performance on activities in their college math classes. Similarly, we contend that if view is widely held, and if women in the college are aware of this negative stereotype of their group, then their individual performance in engineering-related activities might be impacted negatively. While Steele’s work has been lab-based, we believe that our data suggest this threat may extend beyond the lab and impact women’s day-to-day experiences as engineering students.

At UWest this study has helped to initiate conversations about revisiting the admissions process and policies. We continue to monitor these issues as we follow students in their senior years. We see several implications for engineering educators, beyond UWest, and offer some cautions. If the students in this study would have known about the state law, their views about admission might not have included this notion that women are given preference in admission to the college. We recommend to UWest and others that the admission process be made as open as possible. For example schools might require students to attend information session in which the process is discussed and students can have questions answered about the process.

We should also be concerned that this cultural model seems to force women to go underground when they need help, and avoid working in teams with their male peers. As McLoughlin¹⁹ found,

the presence of women-centered groups on a campus can “spotlight” women in ways that make them feel uncomfortable--this may be the case at UWest as well. Our study verifies McLoughlin’s findings, and extends them by adding the perspectives of men who are engineering students (her study had only women informants). We see evidence in the excerpts of the men presented here that suggests that it is not only women who feel they are being “spotlighted” by such programs, but the men also indicate that these programs for women mark women as different and needing support. We argue it is important that we understand what both men and women admit to believing about the reasons these programs exist. For students at UWest their existence marks women as different and less capable than men and, we argue, shapes interactions and therefore identity work. It is important to understand what the men believe as well, because one’s identity is constantly negotiated with others with whom we interact. Our further work will continue to explore the impact of this cultural model of engineering in the context of senior capstone design projects, to determine if after at least a year in the major these beliefs are shaping student interaction.

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