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Carroll Seron is a Professor in the Department of Criminology, Law and Society and the Department of Sociology at the University of California, Irvine. Building on her earlier work in the sociology of the professions, with Susan Silbey, her current research seeks to explain the persistent under-representation of women in engineering. She has published in Law & Society Review, Work & Occupations, Criminology among other journals. She is currently the Editor of Law & Society Review.

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Professor Rubineau’s research focuses on the informal social dynamics that generate and perpetuate inequalities in organizations. This focus has yielded three primary research streams: (1) referral dynamics and job segregation, (2) social network effects and sex segregation in engineering, and (3) professional socialization of physicians and racial disparities in patient care. The first stream, referral dynamics and job segregation, explores practices and policies organizations can implement to reduce the segregating effects of recruitment using word-of-mouth referrals. The second stream, social networks and sex segregation in engineering, scrutinizes the role of a person’s social milieu on their career choices, and examines gender differences in both the operation and effects of these social influence processes. The third stream, professional socialization of physicians and racial disparities in patient care, seeks to understand whether and how the professional culture of medicine and socialization into that culture contributes to the pervasive and intransigent problem of differential treatment by patient race.

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Abstract

Engineering is often described as one of the last bastions of a macho culture where women continue to experience minority status. In this article we ask, how do women make meaning of this status? We explore this question in the context of students’ socialization into the profession over the course of their engineering education. Drawn from diary data, our findings show that young women hold multiple and contradictory perspectives about their status as women in engineering. The strands of these perspectives are articulated around (a) a feminist critique, (b) gender essentialism, (3) meritocracy and individualism, and (d) exceptionalism. These findings suggest that their taken-for-granted assumptions about essentialism, meritocracy, individualism, and exceptionalism trump the opportunity to take a feminist critique to its logical conclusion. We end by exploring the irony of their simultaneous adherence to and rejection of feminist critiques of engineering.

Introduction

At each career stage, engineering is persistently white and male. Whether in the classroom or the workplace, research continues to show that women confront a “chilly climate” where they experience token status. At the stage of credential acquisition, where engineers encounter professional socialization for the first time and earn their degree, research has also shown that this climate has consequences for women’s career plans, whether measured by the likelihood of their persistence in the major or their intentions to stay in the profession post-graduation. Much of this research has focused, moreover, on how the culture, climate, and professional socialization itself push women out of the field. In this article, we turn this question on its head and ask: how do women conceptualize their token, or deviant, status as engineering students? In asking this question we contribute a new perspective for understanding how women construct rationales for persistence and exit.

Women’s tokenism in engineering education is structurally and culturally organized. Structurally, women remain a numerically small proportion of their classmates at most major institutions of engineering education. Culturally, engineering education focuses on the cultivation of technical and substantive knowledge embedded in an apolitical, individualistic and meritocratic orientation. We elaborate on these themes in the next section.

The findings reported here are drawn from a larger, longitudinal study of engineering students at four sites, Massachusetts Institute of Technology (MIT), The Franklin Olin College of Engineering (Olin), Smith College and the University of Massachusetts (UMass). Students were followed for five years, beginning with freshmen orientation in 2002, and concluding one-year post-graduation (for most of the participants in the study). Data collection included yearly surveys to the panel (n=781), in-depth interviews in years one and four with a sub-sample of the panel (n=100), bi-monthly diary submissions from a sub-sample of participants (n=41) as well as class observations and interviews with faculty and administrators at the four sites. The findings
Our close reading of women’s diaries shows that they hold contradictory conceptions of their identity as engineering students, on the one hand, and as young women, on the other. In reaction to experiences in the classroom, worksites, and informal encounters with peers, these young women point out the limitations of an engineer’s mindset that, many would agree, comport with what might be described as a feminist critique of STEM disciplines. For example, they note the ways in which the profession claims to engineer and design solutions in response to social needs, but such claims seem to be a gloss on what is otherwise much greater displays of deference to technological prowess. Yet, their critiques sit comfortably next to familiar values that underlie both the culture of engineering in particular and social values of American society more generally. For example, their diary entries reveal that they do not question essentialist views of a gendered division of labor or the belief that American occupations are meritocracies that valorize individualism. Finally, these young women see themselves as “good in math and science” and hence exceptional or different from other women. We elaborate these themes in our discussion of our findings and explore their implications in the conclusion.

**Becoming a Token Engineer**

In the vast majority of engineering programs in the U.S., women are a minority of the student body; women’s minority status is accentuated over the course of their education, as women are disproportionately more likely than men to leave engineering for other majors. In practical terms, those women who stay the course are a smaller proportion of the graduating class than they were of the entering class. Women’s minority status in engineering is, moreover, not a new phenomenon; the pattern of admission and attrition has held relatively stagnant since the mid-1990s. Further, as other traditionally male-dominated professions such as law and medicine began to enjoy gender parity, the engineering profession has expended significant energy to catch up by developing programs to encourage women to enter and stay the course in STEM disciplines, including engineering. Today, women’s minority status and programs designed to address gender imbalance in the profession are part and parcel of engineering education in the United States.

The persistence of women’s minority status in engineering education has cultural consequences. In her seminal study of women’s entry into the corporate world, Kanter argued that the minority status of women rendered them tokens who, by their very presence, received more attention than they necessarily desired, exposed the culture of the dominant group by creating a “contrast” effect, and experienced assimilation into the group in gender stereotypical ways. “So tokens are,” Kanter writes, “ironically, both highly visible as people who are different and yet not permitted the individuality of their own unique non-stereotypical characteristics.” What is perhaps relatively distinct about engineering is the longevity of the token status of women at various stages of an engineering career. Today, the longevity of tokenism is a distinguishing characteristic of engineering at both school and work.
Additionally, research on professional socialization suggests that the underlying value orientations that are conveyed to students may further exacerbate women’s token—and deviant—status. A large body of research has consistently shown that professional education involves more than the mastery of technical skills or expert knowledge.¹⁰,¹⁷,¹⁸,¹⁹ Rather, professional socialization is partly about learning to “think like” an engineer by learning to identify with the profession’s “myths” about itself.¹⁹ Students often begin their education with a layperson’s “myth” about what engineers do.iii Through various informal encounters—design projects with peers, lab assignments, discussions with professors, jobs, or internships,—students begin to “try on” the “myths” and values of the profession.²⁰ Through interaction with faculty and peers and experiences inside and outside the classroom, students engage in anticipatory professional behavior as they begin to master professional competencies, gain comfort with uncertainty, identify with valued symbols, enact expected norms, espouse professional truisms and learn to project a confident, capable image to others.¹⁰,¹¹,¹⁷,¹⁸,¹¹

Socialization includes, then, assimilating the profession’s “myths,” or the symbols, norms, and truisms of engineering. Building on the centrality of scientific method, engineering embodies a commitment to meritocracy: an anchoring point of engineering’s “folk wisdom” is that individuals who work hard and have the appropriate skills in math and science will be well-positioned to enter the engineering academy and, building on this foundation, to acquire the technical knowledge and skill set required for success in the profession.²²

Meritocracies are also assumed to operate objectively and without bias toward one or another group (e.g., women, racial/ethnic minorities, or lesbian, gay and bisexual individuals [LGB]), rendering them sites that are culturally apolitical. The apolitical space of engineering defers to objectivity and value-neutrality that, moreover, complement core values of scientific positivism.⁵,¹³ Those who do not “cut the mustard” or who fail to “make it” only have themselves to blame, either because of a lack of ability, commitment, or fit.

In its commitment to science, technique, and merit, then, engineering partitions “political” issues such as gender equality to the realm of the social and, therefore, off-limits. The apolitical culture of engineering embodies, then, a de-gendered space where issues that may be of social concern to women in science are de-valued and marginalized.¹³ As Kanter reminds us, moreover, the contrast effect of the presence of women, particularly if they challenge the apolitical status quo, may have the unintended effect of exaggerating the cultural assumptions of the dominant group.⁸ For example, women who bring social questions of equality in engineering to the table are likely to confront dominant cultural paradigms rendering the question, if not the bearer of the question, irrelevant. Whether women interpret such experiences through a political (as, for example, an experience of collective silencing) or an apolitical lens depends on the extent to which they themselves embrace the cultural values of the dominant group.

Women, then, confront a set of paradoxical pulls: women both stand out as tokens and are de-gendered or rendered seemingly invisible as women. How then do women conceptualize their status? What are the norms, values, and truisms that they draw upon to navigate the space of engineering education?
Before exploring how these young women conceptualize their status, it is important to note that two dimensions of the sites of this inquiry that are themselves theoretically important: the institutions’ (1) approach to engineering education and (2) commitment to gender parity. In engineering education, the pedagogical debate revolves around the sequencing of “learning” and “doing” engineering and is succinctly articulated in MIT’s emblematic motto: mens et manus, mind and hands. Pedagogical models focus on the sequence of training minds and hands. Engineering education at MIT and UMass begins with the premise that one must learn (science) before one can do (engineering), “learn then do.” Smith and Olin, by contrast, begin with the premise that it is best to “do and learn” (science and engineering) at the same time. Although both MIT and UMass have long-standing efforts in place to encourage women to complete degree programs in engineering, Smith and Olin, at least theoretically, enjoy a distinct advantage in this regard. Smith, a women-only, elite, liberal arts college, introduced its engineering program in 2000. The Picker Engineering Program at Smith College is the first, and only, program in the United States where the student body is exclusively women. Olin College of Engineering admitted its first class in 2002 with a strong commitment to gender balance among its student body and faculty. On both pedagogical and contextual grounds, it is reasonable to expect that women will enjoy a friendlier environment to pursue engineering at Olin and Smith compared to MIT and UMass.

Methodology

We asked a panel of participants in our study to tell us about their engineering education as they lived the experience. Rather than interviewing students at various stages and asking them retrospective questions, in this study students were given a blank slate to tell us the experiences of becoming an engineer that they find important and meaningful.

We randomly selected a sample of students at each site (MIT, Olin, Smith, and UMass) and asked each of them to write at least two entries per month about what they were experiencing. As appropriate, we oversampled for women and minorities. Because the proportion of racial/ethnic minority students is very small, in this article we focus only on gender differences.

In reading through the diary entries, we were struck by three threads running through their submissions. First, we noted that our respondents often prefaced their comments and critiques of the engineering profession with “I am not a feminist, but….” Second, our close reading of their diary entries also disclosed questioning about engineering’s “real” commitments. Third, our reading revealed that these young women, despite this questioning, were quite comfortable with many of the foundational assumptions of engineering and science. The pattern of these themes provides the foundation for the findings explored in this article.

Coding diaries: All diary entries were coded using Atlas.ti. After the first semester of diary submissions, Seron and Silbey independently read each diary entry and inductively developed a codebook to capture the range of topics discussed by students. As a result of this process the codebook contains approximately 120 codes. Codes need not be mutually exclusive and multiple codes are used on the same piece of text.

Table 1 reports the number of diary submissions by year of the study. There is a relatively small
sample of diary submissions that was submitted in year 5; these submissions are from students who joined the study in year 2 (Smith and Olin) and from others who requested the opportunity to continue submitting entries because they found it helpful. Table 2 shows the number of diary writers by school:

<table>
<thead>
<tr>
<th>Year of study</th>
<th>Total number of submissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1</td>
<td>615</td>
</tr>
<tr>
<td>Year 2</td>
<td>941</td>
</tr>
<tr>
<td>Year 3</td>
<td>1167</td>
</tr>
<tr>
<td>Year 4</td>
<td>476</td>
</tr>
<tr>
<td>TOTAL</td>
<td>3199</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>School</th>
<th>Number of diary writers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Olin</td>
<td>9</td>
</tr>
<tr>
<td>MIT</td>
<td>8</td>
</tr>
<tr>
<td>Smith</td>
<td>12</td>
</tr>
<tr>
<td>UMass</td>
<td>12</td>
</tr>
<tr>
<td>TOTAL</td>
<td>41</td>
</tr>
</tbody>
</table>

**Codes:** For the purposes of this examination, we selected four codes that capture students’ thinking about the experiences associated with professional socialization on the one hand and their reactions to it on the other. Table 3 shows the codes and their respective definitions.

<table>
<thead>
<tr>
<th>Code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineer</td>
<td>(1) Any explicit discussion of engineering per se; (2) definition of; (3) profession of; (4) why engineering and me; (5) doubts about; (5) and social responsibility.</td>
</tr>
<tr>
<td>Future</td>
<td>(1) jobs; (2) graduate school; (3) children; (4) marriage) (5) looking ahead; (6) making money.</td>
</tr>
<tr>
<td>Identity</td>
<td>(1) explicit discussion of discovery of social identity; (2) crises of identity (can be related to race, class, gender).</td>
</tr>
<tr>
<td>Jobs</td>
<td>(1) references to employment now or in the future; (2) concerns about; (3) getting a job for the summer; (4) internships; (5) resume; (6) making money; (7) careers.</td>
</tr>
</tbody>
</table>

**Inter-coder reliability.** As Table 1 reveals, we were dealing with an enormous sample of diary submissions; resources did not permit us to have each entry coded by two individuals for purposes of inter-coder reliability. Yet, we were concerned about the consistency of coding across coders. To address concerns about inter-coder reliability, we developed a process that combines independent coding with collaborative evaluation and recoding. Teams of three to four undergraduate students, under the supervision of Seron, Silbey and a graduate student, coded diary entries by semester. In addition to each student’s weekly allocation of diaries to be coded, each member of the team coded one, common diary entry. At weekly team meetings, each assistant reported his or her codes for the commonly coded diary entry. This process provided an opportunity to discuss interpretations of codes and to examine why a specific code was, or was not, used on that entry by any member of the team. Borrowing from techniques developed to code qualitative data for quantitative analysis, these reports were used to calculate inter-coder reliability scores for different codes by weekly, commonly coded entries. With this information we could improve the meanings of the codes, thus their analytic utility, as well as the consistency across coders. As a result of this process, some of the original codes were eliminated or collapsed with others, and other codes were added. On average, we achieve about 75-80% agreement across coders. While this score is not as high as one would like for conversion to quantitative data, the goal here is quite different. Interpretation is a fundamental and inevitable aspect of
analyzing qualitative data. Thus, it is to be expected that coders will identify somewhat different interpretations of the text. The challenge, then, is to find an appropriate balance between difference and common pattern. The team meetings were designed to do just that, i.e., to insure that assistants had a common understanding of the codes, could reach a shared understanding of meanings, yet leave room for unexpected insights.

**Findings**

The young women who share their experience of engineering education begin with the recognition that they are a minority and, further, that they do not identify with a feminist orientation. Implicitly, many of our informants begin with “lay” myths about engineering. As they progress through their engineering programs, their experiences raise questions about the core values of engineering. For some, these questions lead to critiques of engineering and its organizing values. Through their diary entries we learn that many question whether engineering is in fact committed to meaningful social change and humanitarian work; in their experiences at work sites during internships, they reflect on whether engineering tasks are often too mundane where one only has the opportunity to focus on a small, technical problem of a larger and often uninteresting project; others describe a workplace dominated by men who display a tendency to be dismissive toward (particularly young) women. These young women also express a concern about whether the profession is so all-consuming that little time is left for family and children, while others question whether they want to be a part of a field that seems to valorize social ineptness.

Professional socialization entails a process of putting aside one’s lay myths: through classes, work with peers, internships, and jobs, the neophyte comes to identify with the profession’s claims about itself. As we demonstrate below, the critiques expressed by these young women do not, however, lead them to question the profession’s myth about itself and its commitment to scientific values organized around individualistic and meritocratic achievement.

**Tokens:** Whether at Smith, Olin, MIT or UMass, these women are well aware of their minority status in the profession writ large. At UMass, a woman need only walk into a first semester class to realize that she is part of a very small proportion of the engineering student body (see e.g., U29). But, her peers at Smith are equally aware of their minority status within this discipline:

> The response from most people, when I say that I’m an intended engineering major is one of respect and a bit of awe. People tend to believe that engineering is hard work and I’m not sure if I receive more fascination from people because I’m a woman going into engineering and it might be seen as more natural for a man to enter the field. I don’t really think this is the case, as I’ve had feminist women congratulate me on going into engineering. (S2).

This comment foreshadows a second, and equally, robust viewpoint among these engineers in the making: they do not see themselves as feminists. To place this in a broader context, we turn to findings from our student surveys. In years 2 and 5, we asked all of our respondents to rate their agreement on a five-point scale from strongly agree to strongly disagree with the statement “I consider myself a feminist.” In both years 2 and 5, women in engineering are significantly less
likely to report that they consider themselves to be a feminist than their female counterparts in all other majors. Interestingly, by year 5, women who stayed the course in an engineering major are more likely to identify as a feminist (3.14) compared to their beliefs in the second year (2.87); in other words, various experiences in school seem to have engendered a slightly stronger identification with a feminist perspective. Interestingly, there is also no significant difference among women in engineering majors at each of our sites; while we might expect that women at Olin and Smith, in particular, might be more likely to identify as feminists than their counterparts at MIT and UMass, the findings do not bear this out. As we further explore women’s orientation toward engineering, the findings reported from the survey make clear that ambivalence around a feminist identity is an anchoring and shared experience.

Critiques of the mission of engineering: Social change through engineering? While these young women are, on balance, ambivalent about ideas associated with feminist thinking, many do develop a critique of engineering. In this discussion we focus on the perspectives of women, but our broader analysis of these data suggest that women tend to bring higher expectations than men of engineering as an agent of social change, have experiences that lead them to question those expectations, and, hence, tend to be more critical compared to their male counterparts. Many of these young women begin their education envisioning engineering as a professional path for social change. Two women at Smith (S1, S3), for example, express a desire to use their engineering skills to improve the situations of their countries of origin in Africa and Latin America. After deciding that engineering is not the best route to her goal, one student opts for a major in economics (S1) while her classmate stays the course but wonders whether she will be positioned to realize her desire to influence progressive social change.

These concerns to use engineering to improve society are, moreover, not unique to students from developing countries. A student at MIT, corroborating the hopes of a number of others, would like to use her engineering skill in “some type of humanitarian work;” she goes on to observe that she finds that, for the most part, the men are so much more “competitive” around engineering projects than the women (M21). A counterpart at Olin compares her expectations to those of her boyfriend and writes,

We are so different - I enjoy doing community work, while he develops his mind. He’s a true engineer; I am only a person who really enjoys science, math, and building things. This is the most convenient career that I could take - but I don’t fit exactly into the description. I don’t want to work in a cubicle, a replaceable cog in the company. I want to make a difference - innovate, use my mind, create. I don’t want to paint a new look onto something old and call it my own; I don’t want to regurgitate something that has already been done. I want to do something and call it my own. (O26)

The Smith website, echoing the commitments of Olin, describes a goal to educate “engineers who address human needs through invention, resources and technology” (http://www.science.smith.edu/departments/Engin/; retrieved 10/22/10). Despite their commitments, these students raise concerns about whether the real goals of engineering professionalism are in fact much narrower such that they will not be able to “innovate” or “create,” in the ways described by our Olin informant above.
Critiques of the engineering workplace: “Boring,” mundane work, inequity, and work-life balance: Beginning with summer jobs, women are exposed to the world of engineering work—an experience that often results in some unintended consequences. Any number of the women describe their jobs as “boring” in part because they are not given assignments that are sufficiently meaty or because they spend long stretches of time without anything to do (O11, O18). Others begin to wonder if engineering is really what they want to do, or whether, as one student puts it, there is a certain “mundaneness” about working in industry as an engineer (M21). Hoping to gain a firsthand exposure to the ways in which engineers are engaged in creative problem solving, many find that their on-the-job experience does not comport with expectations. An Olin student writes, in some frustration,

I'm going to try and convince them to take me over the semester [for another job placement], that way I can figure out if they give me useful work and if I like it; if not I'm going to try and find another position for the summer. I really want to go to work and work my ass off and do useful stuff, not bitch work. I need to find meaning in work, and fulfillment, and I certainly am not feeling that at . . . (O27)

In addition to finding the work boring, respondents raise questions about gender inequity. For example, an Olin student expresses concern that an organization where she had a summer job saw itself as a “progressive,” “green” design firm, but only hired its first woman in a professional position during her summer employment (O20). Others describe experiences of not being taken seriously in their internship, which they attribute to their gender. A woman at UMass who is highly committed to engineering writes:

But, one thing that really bugs me about being an intern and a young girl is that the people whom I work with don’t take me seriously. Not everyone does this, but a fair amount of the older men in my working environment do this. They’ll treat me like I know nothing, and I am only working at Raytheon because my dad works there. What they don’t know is that I have a 3.7 GPA and am practically acing all of my engineering classes. . . . Anyways, I just can’t stand it when men look at me as being a dumb blond; I mean they end up treating me with no respect. They never give me the time of day and just ignore what I have to say, especially since I am a young woman. But, don’t get me wrong, there are [also] absolutely amazing people working at [organization]. . . . The majority of people do give me respect, I have made so many friends and I can’t be happier where I am working. There are just some people who you can’t avoid; they are everywhere and always look down on [women]. I never used to really care, but now when it interferes with my profession it just irritates me. I find myself to be succeeding much more than the majority of males in mechanical engineering at school. So, anyways, it’s just bothersome. But I am still happy! (U37).

Many of these young women also question whether engineering is a profession that will provide the space and time to find a balance between work and family. A woman at Smith asks, “Is an engineer allowed to be in love, be attracted to anyone, or better still, even have the time to engage in such wonderful human relationships?” (S03). Her counterpart at MIT echoes the concerns of her peers when she writes,
All my life, I’ve been encouraged to not let being a female limit what I do; women like Sally Ride and Marie Curie were held up as role models and I was always told to pursue what I like and what I want. No one ever told me that I should grow up and be a good mother, it was always, “What profession do you want to go into when you grow up?” But somehow, in the last couple of years (maybe even in high school as well), I got the idea into my head that I will eventually become a mother (and a wife), and when I do, family, not necessarily work, will be my first priority. . . . My mom, while very much a career woman, always worked on the values that family was very important, and that a woman had a certain share of responsibility in taking care of a family. My grandmother also, once told me that when I cook dinner for my husband, I should do all the chopping and prep work before he gets home, so that he only has to see me do the artful part, the actual cooking, and not the grunt work. Of course, this might be outdated by a generation or two, but in an odd “Desperate Housewives” kind of way, I agree with this. (M21).

Echoing many of her peers, M21 embraces contradictory meanings about herself as an engineer in the making and as a woman on the brink of marriage and motherhood. We have shown in other research, however, that such family concerns do not affect women’s persistence in an engineering major, or plans to remain in engineering in the future.10

Foreshadowing themes we explore below, M21 sees herself as and identifies with exceptional women: modeling herself on these exceptional women, she takes it for granted that she brings the talent, intellect, and commitment to play hardball in a man’s world. Yet, when she thinks about having her own family, even with her “career woman” mother as a role model, M21 seems to assume that her family will, of necessity, come first and be all consuming; after all, she has not forgotten her grandmother’s advice to have dinner under control so that she may give her undivided attention her husband when he comes home from work.

In popular culture, engineers are sometimes described as “nerds”—a group that tends to be stereotyped as socially inept. Some women question whether they want to be a part of this group. A woman at MIT finds that

So many of the guys and girls here come from a high school where they were the village dork. It sounds bad but it’s true. . . . In addition, I have found MIT guys to be totally not my taste. They are bad dressers, not too physically attractive, and lacking in the personality department. Some may argue that I am being too opinionated and too judgmental. But then explain this: every girl that I have talked to agrees with me. They can attest to the fact that MIT probably has the country’s most unwanted men. (M16).

These young women begin with the recognition that they are a minority, experience disparaging comments and slights attributed to their gender, but it does not follow that their status leads them to see themselves as feminists. Indeed, our findings are quite the contrary: both our survey findings and diary entries underscore that these women are quite decidedly “not feminists.” Nonetheless, they do have critiques of engineering: they question whether it is “boring” and “mundane” when they expected the opportunity to invent and innovate in a way they define as socially meaningful; they entered college thinking that they could do it all, but begin to question whether it will be possible to find a meaningful balance between work and personal
commitments; and, they expected to encounter peers who they can respect and relate to, but begin to wonder if engineers are, in fact, the peers with whom they can relate.

*Comporting: Essentialism, exceptionalism, and meritocracy:* Their experiences, questions, and critiques are couched in a broader set of values anchored by an acceptance of gender essentialism, exceptionalism and meritocracy. For the most part, these women assume that there is, indeed, a biological, or essential, difference between men and women. They explain their own abilities in math and science as exceptional, or different from the norm for women (as we saw above with M21). And, it follows, they hold to the view that success is up to the individual and her willingness to persist in the face of whatever challenges come along. As we shall see, many of them question whether they have sufficient confidence, or “self-confidence,” to make it in engineering, but even this questioning is couched in essentialist terms and solutions.

Over the course of data collection we occasionally emailed the group of diarists and asked them to comment on an event in the news. A particular event during year 2 of data stood out: In January 2004, then President of Harvard University, Lawrence Summers, presented remarks at a National Bureau of Economic Research (NBER) Conference on Diversifying the Science and Engineering Workforce. Summers prefaced his remarks by stating that he sought to be provocative—and, in that he succeeded both at the conference and in the aftermath of media coverage. For our purposes here, we quote one, summary point from his remarks to recall his argument:

> So my best guess, to provoke you, of what's behind all of this [discrepancy in the retention patterns of men and women in high end science and engineering fields] is that the largest phenomenon, by far, is the general clash between people's legitimate family desires and employers' current desire for high power and high intensity, that in the special case of science and engineering, there are issues of intrinsic aptitude, and particularly of the variability of aptitude, and that those considerations are reinforced by what are in fact lesser factors involving socialization and continuing discrimination. I would like nothing better than to be proved wrong, because I would like nothing better than for these problems to be addressable simply by everybody understanding what they are, and working very hard to address them.


Summers’ statements provided the unique opportunity to ask these women to respond to commonly held explanations for women’s minority status in engineering. These reactions were patterned in three ways. First, if not surprising, they embedded their critiques in the context of noting that they are “not a feminist, but.” Second, while one woman reported that she did not care what he said (06), for the most part, our respondents took exception to Summers’ argument. Third, in taking exception, they nonetheless expressed quite traditional and stereotypical views about the differences between men and women by way of their ability in math and science, the ways in which they are “different,” the “appropriate,” if gendered, roles of childrearing, and their unquestioning expectation that one can achieve anything if one works hard enough. For example, an Olin student writes:
Living and breathing engineering at this school meant that I knew about [Summers’ speech] right away….I never actually read the contents of the speech until today, though - it wasn’t released when the whole female engineering community was in a fervor, and it certainly left my mind shortly afterwards - there were many more things that were more important to me than what the president of Harvard had to say about women in engineering (such as being a woman in engineering).

After reading [the speech], I think that President Summers covered his tracks by stating that these were his hypotheses… Maybe this was his point - he states in his first paragraph that he wishes to provoke a response. Maybe we all started to think more about females in engineering and the obstacles that we had to overcome to come this far because of his speech and that was his intention. Maybe many research studies will sprout from his speech that were started to try to prove him wrong.

Regardless of what he hoped to accomplish, it made me think. . . .Where did I see my career as an engineer going? Do I plan on spending eighty hours a week on a job? I do want a family, I know, and kids - but how will that affect my career? I am so academic-oriented now, will I become so career-oriented later that I will never actually marry and have kids? Will I sacrifice my career for my children? Where do I see my career - as an engineer, as management, as a freelancer? What in the world do I want in my life? I have no answers right now. (O20)

Note the absence of a critique of a field that requires 80-hour work-weeks, or of a gendered division of labor that might require such a “sacrifice.” A counterpart at MIT described the speech as pretty “lame,” noting that she is not “really political,” but had this to say:

What Lawrence Summers said was probably a dumb political move; I’d have to agree. But personally (and I lead a very self-centered life), I don’t think it matters. I know I’m good at what I do, and I’m always pretty competitive and aggressive. I don’t like to walk around with a chip on my shoulder because I’m female, because I have gotten so many other advantages in my life that I’m way better off than most people. There, is, however, still a lot of male/female comparing [that] I don’t think really needs to happen. But I think it’s a thing that will change with time, which is already starting. (M21)

This student’s reaction is to point to her own hard work and experiences. Another student elaborates on how patterns of under-representation may be due to individual “choice” more than discriminatory selection:

One of my male friends even organized a panel at MIT to discuss the impediments women face when entering the work force. While I admired his efforts, I felt no need to attend this panel. In my mind, a woman will succeed if she wants to succeed. Maybe this is an overly idealized thought, but I’m going to live by it.

Having actually read Summers’ remarks now, my ideals and opinions remain mostly unaltered. While I do think he made some valid points, I also think he overanalyzed many things. In his opening section, he brought women, Jews, and white men into this issue of misrepresentation in different fields. I can’t really understand why he thought this necessary. Maybe Jews don’t dominate the agricultural fields because they don’t
want to. In my opinion, it doesn’t really matter why they wouldn’t want to. I would just accept that they don’t. If Jews were actively trying to acquire jobs as farmers and were being shot down by the higher-ups, then we’d have an issue to address: selectivity in the discriminating sense. This very issue led to the affirmative action policies of college admission boards. Should such a policy be introduced to work fields such that every workplace would be comprised of fifty percent females and fifty percent males? Maybe. I think such a policy would be advantageous and pleasing to many. In my own opinion, however, I think it isn’t right… I feel that the best person should get the job, regardless. I don’t really approve of affirmative action because being a white girl I feared that I would be rejected because the admittance of a less-qualified African American male was necessary to meet some quota. Being female, I will be the subject of such affirmative action policies in the work field… I would always wonder if my employers really found me to be qualified. I do not want to be a pity hire.

Returning to Summers remarks directly, he kept commenting that women just aren’t socially equipped with the stamina to have a dominant stance in any work field; women were raised as nurturers, not workers. My problem with such remarks is that it shouldn’t matter how a woman is raised. I plan on having a life and a career. Will I have to focus on the career before getting my life together? Probably. I’m willing to accept that though. I don’t think men have to put such holds on their lives, if only because men don’t give birth to lives. Women do. When we decide to have a family, we make the decision to have two full-time careers. Maybe some women can’t handle it and consequently take a few years off. This should not be held against them. Without mothers, the world would be a very sad place. Summers should be praising women for keeping the world together, not criticizing them for a lack of vocational vigor. (M20)

Again we see the ways in which M20’s comments illustrate a bevy of contradictory meanings. M20 makes clear that whether a woman succeeds is a matter of choice—a belief that she holds inviolate; it follows that the first question we should ask when we observe a pattern of exclusion (e.g., Jews’ absence from agriculture), is whether that group wants to do the task (i.e. agriculture)—a variant on individual choices. It should come as little surprise, then, that M20 does not want to be judged through a lens of affirmative action. Yet, M20 finds Summers’ comments offensive when he turns to a discussion of women’s stamina to “do” science when, in fact, she expects that she (no doubt like her peers) will simply have “two full-time careers”—something that should be “praised.” In making this final point, M20 leaves uncriticized that childrearing and all that it entails is, essentially, a woman’s responsibility.

One woman does, however, reflect on the ways in which gender roles are socially shaped and describes her reaction this way:

Ok so going back to what the president of Harvard said, about how maybe women do have fewer innate abilities regarding ability to understand engineering -- it’s true to an extent, I would say. Women are less encouraged to be focused in math and science during high school; there are still cracks made about how women belong in the kitchen, in the softer sciences, English, etc. Yes, still, even though this is 2005. So yeah, the only reason why women aren’t as innately prepared for engineering as men is because we’re
not told from the beginning that engineering is the field in which the smartest, most intelligent of our gender go into. We are taught that having children is great, that maybe college would be good to have, but only so you can help your children -- mostly your sons -- when they are in school themselves. My parents raised me very differently, maybe that was because they didn't have any sons. (O27).

Embedded in their critiques of Summers’ argument, these women raise familiar, if contradictory, perspectives, ranging from an essentialist assumption that work-family balance is a woman’s issue (O20), to an individualistic and instrumental approach to leveraging gender for success while also noting their exceptional status (M21; U26), to assuming that success is meritocratic, grounded in individual choices, and comes to those who work hard (M20). There’s no need for women to carry a “chip” on their shoulder (M21); and all of this talk raises the specter of affirmative action and the possibility of “quotas” (M20) and “pity hires” (M20). Yet, laced through some of their comments, there is a theme of the ways in which gender roles are socially constructed, suggesting that these respondents often hold simultaneous and paradoxical values.

Underlying themes of essentialism, exceptionalism, and meritocracy are not, however, limited to their discussions of Summers’ talk. In fact, they are embedded throughout the diary entries. A student at Olin describes her reaction to learning about the ways in which minorities and women, compared to white men, respond to negative signals in engineering:

The research I am doing talks about how women and minorities in engineering will place all the blame internally when they do badly in engineering, while white males tend to blame external factors -- teachers, teaching assistants, having a bad day, etc. Also, white males are given more opportunities than are any other race or gender mix; they make up the majority of engineering, is it any wonder? I hardly think that there’s a reason to be all crazily feminist though; I think the answer to getting women and minorities to increase retention in engineering is just to wage a long battle in which slowly but surely progress is made. And then one day the world will look around and see that there are as many women and minority engineers as there are white male engineers, and one more thing will have been made better through the actions of many people working tirelessly for many years. (O27).

A number of assumptions are embedded in this quote. First, she seems to assume that it’s no surprise that men enjoy the luxury of blaming others for their shortcomings whereas those of a minority status internalize their experiences, but her solution seems to be that women and minorities should tough it out and move on. Second, there is an implicit assumption that change will move in a progressive direction, in keeping with central notions of scientific claims. Third, of course, one does not need to be a “crazy” feminist to “get” that this research is persuasive.

These women are exceptional achievers and they have been recognized for their accomplishments through admittance to and persistence in demanding programs of study. The “system” has, in many respects, served them well. It is not surprising, then, that they hold tightly to a world-view organized around meritocracy. A woman at MIT illustrates this in her reflections on a class discussion about affirmative action:
The professor outlined the reasons that affirmative action policies were first developed, and the arguments for and against their continuing use. Being a minority and a woman, I have given a lot of thought to what I think of affirmative action, and why I think that it is out of date, and shouldn’t be used anymore, and I was pleasantly surprised to find every single one of my main points to be ones that the professor brought up in the lecture. It didn’t necessarily validate my beliefs, but it is nice to know that other people who’ve given a lot of thought to the matter have come up with some of the same flaws that I had. (M24)

Toward the end of her fourth year, a MIT classmate describes her reaction to a study that demonstrates the persistent discrepancy in earnings between men and women, net of experience, education and other factors.

Am I going to be a part of the statistic? For one reason or another, I'm generally immune to statistics; I hold the belief that I live my life and set my goals and achieve or don't achieve based on my own merit. But for whatever reason, this finally got through to me, this perception that there is some external trend that exists that I am subjected to, that I have no power to change or resist. I guess I'm just a control freak, and I'm certainly used to having control over my own life, and so I don't know how to respond to this. I don't know. This is certainly one of the most inconclusive or unresolved entries I've ever written, but I guess that reflects my position on the matter. Who knows. (M21).

Many of her peers describe doubts about themselves that tend to focus on self-confidence. Following a “women’s discussion” at Olin, a woman writes that she “realize[d] that I need to be more confident and say what I know is true and not just think it in my head or say ‘I think, I believe.’ Hopefully, I can be more confident!” (O11). An Olin classmate also recognizes that many of her female classmates do not enjoy the same self-confidence as her male counterparts and, further, that research shows that women tend to react differently to negative feedback by internalizing doubts about one’s ability. But, she proposes a different tack:

Don't be afraid to start your problem set because you know you won't be able to finish it. Don't let the boys on your team overshadow you because “they know what they're talking about. You need to fake it ‘til you make it!” And it's true -- that has been my phrase of choice lately. Fake it ‘til I make it -- you can make yourself believe anything. Isn't that really what confidence and self-confidence is all about, believing in yourself whether or not you have legitimate reason to? And women, despite thinking we don't, have as much, if not more, reason to believe in ourselves [than men do]... (O27)

The Society for Women Engineers (SWE) is, for many of our informants, an important anchoring point in their education that underscore the dominant values of engineering science. Our diary entries suggest that the vast majority of our writers have had some exposure to SWE often beginning in their first year of college. For example, Smith and UMass students describe trips to Cambridge to meet women who are pursuing graduate degrees or on the faculty in STEM fields at MIT and Harvard. “Fake it ‘til you make it” often comes up in the context of discussions about SWE. Through participation in SWE activities, these women also describe how they learn to “try on” engineering (and professional) personas, including networking and
negotiating skills. For example, after returning from a SWE conference, an Olin student describes how she was told that professionals write thank you emails:

We had a SWE meeting today. We talked about the conference and strategies for networking. It had never occurred to me to send follow up e-mails to everyone that I met at a conference or meeting or event. Apparently that works very heavily in your favor though. The person you met remembers you and sometimes they offer you things. I’ll have to make sure to do that in the future. I also need to make some business cards at some point. (O18).

Or, after attending a seminar on the “Cost of Not Negotiating;” with a Gilligan-esque motif, a classmate notes,

It was talking about what you need to do when you are going for a job. Both with money and with job benefits and opportunities. It was interesting to learn how women negotiate differently than men and sometimes do not ask for what they deserve. We play a game where we had to negotiate splitting $10 between two people, but you could not split it in half. It was a weird position to be in because you are negotiating with your friends, but it was a good experience to be willing to put yourself out there. (O11).

SWE activities are designed to encourage young women to recognize that they are capable of effective and meaningful careers in engineering. As the conferences and activities of SWE imply, it may be necessary to take the time to re-enforce one’s self-confidence, to “learn” what the “boys” seem to know by way of “faking it,” negotiating and networking. On balance, participation in SWE is a positive extracurricular activity for many of our diarists. But, these findings suggest, participation in SWE does not challenge their fundamental orientation organized around essentialism, exceptionalism, or meritocracy. SWE’s role is to work with women to “Aspire, Advance, Achieve at Every Stage of your Career:”

The Society of Women Engineers (SWE) is a not-for-profit educational and service organization that empowers women to succeed and advance in the field of engineering, and to be recognized for their life-changing contributions as engineers and leaders. Founded in 1950, SWE is the driving force that establishes engineering as a highly desirable career for women through an exciting array of training and development programs, networking opportunities, scholarships, outreach and advocacy activities, and much more.


At the end of the day, these young women recognize that they may be tokens in a male-dominated field—and, that many of them are more or less ready to take it on, if on the terms and conditions they are handed:

So yes. I do belong here. I will graduate as a woman engineer and when I go out into the world I will kick ass. . . . But the difference between women and men in engineering is that while men are all for themselves, we women know that what we do today directly
impacts the women engineers of tomorrow, and so I'm not just one woman -- I am all women. There, that's all I have to say about that. (O27)

Discussion and Conclusion

The sites for this study include two new programs committed, among other things, to overcoming gender inequity in engineering. Situated on an elite, women-only liberal college campus, the Picker Engineering Program at Smith College is committed to both transforming the way engineers learn their craft and preparing women to be leaders in their field. The Franklin L. Olin College of Engineering is a new, entrepreneurial venture in engineering education where students get their hands “dirty” in the lab and then figure out the science and physics of the problem; cohorts at Olin approach gender parity. The founding faculty at both sites begin with the premise that engineering requires equal doses of expertise and craft—and, better to learn by doing at the get-go. The findings reported here do not, however, reveal that the Smith and Olin women describe notably different orientations, experiences, or goals than their counterparts at MIT and UMass. Indeed, this pattern is echoed in other analyses of our diaries\textsuperscript{27} and surveys.\textsuperscript{9,10}

Across four diverse sites of engineering education, these young women embody multiple meanings about what it takes to stay the course in engineering. They tend to begin their education with a somewhat more ambivalent commitment to feminist values than their peers in other parts of the university and, echoing their commitments to careers in science and engineering, take for granted that the world rewards meritocratic achievement one individual at a time. Their diary entries also disclose a shared, gender essentialist assumption, particularly around appropriate roles on the home front. While their writings demonstrate recognition of (and pride in) their exceptional abilities in math and science, they nonetheless tend toward essentialism around differences in men’s and women’s strengths (e.g., men are more competitive) and weaknesses (e.g., women are less self-confident). And, while their writings are reflective, probing, funny, and thoughtful, they rarely spring from a political lens; steeped in the values of science, they more often than not valorize their apolitical stance in the world. Thus, these young women may find former President Summers’ remarks offensive, but not a call to action beyond building an individualistic pedigree to challenge his claims by example.

Whether or not these young women stick with engineering, they have nonetheless done exceptionally well in a field that is stereotypically masculine and, by the numbers, remains disproportionately male. They have weathered the hurdles of persisting in math and science through high school,\textsuperscript{12,28} been admitted to challenging academic programs and most will graduate with a degree in engineering. At each step, they are a numerical minority, token success stories; when they question their confidence to be tokens in this world, the solutions they try on are steeped in individualism as, for example, they learn to “fake it ‘til they make it.” At SWE events, tokenism may turn to moments of solidarity among women, often across generational boundaries, which, we’ve shown, re-enforce the dominant values of engineering itself. The longevity of women’s minority status in engineering and the continued efforts to overcome that status has, taken together, produced its own, institutionalized sub-culture of tokenism in engineering. What Kanter hypothesized was a transitional stage with women’s entry into the professional labor force has, in the case of engineering at least, become embedded in that culture, if on engineering’s terms, values and assumptions.\textsuperscript{8}
An anchoring point of this sub-culture is revealed in our organizing theme “I am not a feminist, but….” Beginning with the premise “I am not a feminist,” we have seen that these young women take for granted the values of engineering culture, including its positivist claims to science, technique, and merit in a world without politics. As these young women navigate engineering culture, “but….” reveals their starting point for critique. Any one of these critiques—its mundaneness, its nerdiness, its apolitical commitment to social change—are ripe avenues for taking the next step to question the underlying premises and values of engineering that might provide transformative insight. But, as we know from endless studies of social movements, transformation is, of necessity, a collective and a political undertaking. At that moment, our findings show, these young women remain deeply committed to individualism and meritocracy that, it should not be forgotten, has served them remarkably well. This, then, is a story of how a marginalized group’s critiques—many of which derive from their experiences as a minority—get folded into the dominant culture about what it takes to achieve professional success while the critique itself seems to fade from view.

Whether these young women decide to persist or exit from engineering, the norms, values, and symbols of engineering remain safely and deeply intact. Should they persist, they will do so, our findings suggest, most likely accepting the organizing principles of their chosen profession. Or, should they decide to exit, the challenge they might pose is safely removed from view.

Endnotes

1. Women are significantly more likely to leave engineering compared to their male counterparts, net of grade point average. Indeed, evidence suggests that women leave, on average, with higher GPAs than their male counterparts.2
2. Although women are under-represented in the higher ranks of law and medicine, and in some subfields therein, these fields have reached gender parity at the credential-acquisition stage (i.e. medical school and law school).29,30
3. This pattern is identified in Stover’s study of law students.19 Our findings suggest a similar pattern. For example students in their first year entries often discussed that they did not know what engineers “really” do, but did understand that it required talent in math and science.
5. This debate is typical not only of engineering education but of law schools and medical schools as well.28,31,32
vi. Our reading of the men’s diaries certainly reveals some disillusionment with engineering as a consequence of work experiences, but their observations of this experience are different along a number of trajectories, a theme that we will return to in subsequent work. (Also see Seron et al.27)

References