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Are Engineering Schools Masculine and Authoritarian? The Mission Statements Say Yes

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After reading the mission statements of 20 engineering and liberal arts schools, business students recorded their impressions of a hypothetical successful student at each institution. Based only on institutional mission statements, engineering students were deemed significantly more likely to be dominant, forceful, and masculine and significantly less likely to defend their beliefs, or to be soft spoken, eager to soothe feelings, feminine, or likable. Additionally, for male subjects, the higher their own level of authoritarianism, the more likely they were to indicate that a successful student at an engineering institution was someone like themselves. Authoritarianism had no such predictive value for female subjects. Our results may illustrate why engineering schools might be having trouble attracting a more diverse group of students: a culture of masculinity and hierarchy may be so deeply entrenched that it is evident even to causal observers.

Keywords: stereotypes, engineering, authoritarianism, mission statements, women

In light of the scientific community's interest in attracting students to science, mathematics, and engineering fields (Hennessy, Hockfield, & Tilghman, 2005), the ongoing discussion regarding the participation of women in science and engineering (Amancio, 2005; Bell, Spencer, Iserman, & Logel, 2003; Bystydzienski & Bird, 2006; Chesler & Chesler, 2002; Chubin, May, & Babco, 2005; Eisenhart & Finkel, 1998; Frehill, 2004; Gallaher & Pearson, 2000), and the continued low enrollment of women in engineering fields in particular (cr70NSF, 2006), we believe it is important to examine how potential students perceive the culture of engineering institutions. While administrators at engineering institutions officially welcome greater diversity among their students and faculty, the institutional culture may influence the messages the institution sends, making these messages likely to attract people similar to those who are already there. In this study we examine reactions to one discrete piece of institutional communication: the mission statement.

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The Nature-Nurture Debate

In the United States, while more bachelor's degrees in science and engineering overall (including the social sciences) are awarded to women than to men (NSF, 2006), women earn only 20% of undergraduate bachelor's degrees in engineering. Within engineering, the highest percentages of women are found in environmental (42.1%) and biomedical (40.4%) engineering, while female representation is lower in mechanical engineering (13.2% of bachelor's degrees), electrical engineering (14.8%), and computer science (18%) (Bell et al., 2003; Gibbons, 2003).

Although some controversy lingers as to whether women on average have less technical aptitude than men (Bell et al., 2003), the rapid progress made by women in technical fields in recent decades confirms how important cultural barriers have been to women's scientific and technical achievement (Catsambis, 1995; Clewell & Campbell, 2002; Greenfield, 1997; Monastersky, 2005). Much of the difference that is observed appears to be explained by test-related artifacts (Bell et al., 2003; Johns, Schmader, & Martens, 2005; McGlone & Aronson, 2006; Toppo, 2003). In fact, a recent report from the National Academy of Sciences concluded that the literature did not support the existence of any biologically based gender difference in aptitude or performance; rather, the report concludes that it is bias, rather than lack of aptitude or interest, that accounts for the lower representation of women in science careers (NAS, 2006).

So what exactly are these cultural barriers? From childhood, girls receive the message that science and engineering are for boys. Parents and counselors tend to believe that boys are better at science than girls, and that science education is more important for boys than for girls (Andre, Whigham, Hendrickson, & Chambers, 1999; Evetts, 1993). Children parrot these assumptions at an early age (Jones, Howe, & Rua, 2000; Simpkins, Davis-Kean, & Eccles, 2006). This is especially significant for girls, as parents appear to have an earlier and greater impact on girls' participation in math and science than on that of boys (Jacobs, Davis-Kean, Bleeker, Eccles, & Malanchuk, 2005; Simpkins et al., 2006). As girls go from elementary to secondary school, there is a drop in the percentage who are interested in science and related fields. Girls stop seeing themselves as scientists or science students (Lee, 2002).

Women and Engineering Culture

Engineering has traditionally been viewed as a masculine occupation (Faulkner, 2000; Frehill, 2004). Among female students, engineering sees a low rate of initial enrollment as well as a high rate of attrition (Bystydzienski & Bird, 2006), even though the qualifications and performance of those who leave are not different from those who stay (Bell et al., 2003; Seymour & Hewitt, 1997). Once in an engineering program, female students perceive the learning environment in engineering schools as chilly and inhospitable to women (Baker, 2002; Bell et al., 2003), and, as outsiders, they remain socially isolated (Fisher & Margolis, 2002).

According to the *situated learning* perspective (Lave & Wenger, 1991), learning is a social as well as a cognitive phenomenon; learning does not just take place inside discrete, individual minds operating alone. Learning requires participation in tasks, relationships, and networks so that the learner forms a new identity—for example, as an engineer. Women, who are often excluded from the knowledge and connections that come with informal interaction, are consequently excluded from the full experience of learning and remain peripheral to the engineering community (Eisenhart & Finkel, 1998). Not only does experiential learning take place within school and work, it is a significant contributor to scientific expertise outside of these contexts (Lottero-Perdue & Brickhouse, 2002). This perspective highlights the importance of an institution's culture in attracting and retaining students.

As engineering undergraduates, in addition to dealing with outsider status, talented women may be overtly dissuaded by their professors from pursuing graduate work, while family members worry that a woman with an engineering degree may be seen as less attractive or marriageable (Ambrose, Lazarus, & Nair, 1998). Once women in science and engineering do enter the workplace, whether in the commercial sector or in academia, they experience lower pay and benefits, are more dissatisfied with workplace condition and culture, and are far more likely to experience harassment and discrimination than their male counterparts (Lawler, 2003; Roberts & Ayre, 2002).

Relative to their male counterparts, women's confidence in their engineering ability decreases as they progress through the program, disproportionate to their test scores or grades (Marra & Bogue, 2006). The low percentage of women faculty in these fields may also contribute to attrition of female students; there is a positive relationship between retention of female students and the percentage of science and mathematics classes taught by female faculty. This relationship is more significant when there are few female students (Robst, Keil, & Russo, 1998). This is consistent with the finding among organizations in general that people prefer to work and spend time with others they see as similar to themselves (Brief et al., 2005), which can lead to dissatisfaction and attrition among those who differ from the norm (Mannix & Neale, 2005; Schneider, 1987). When, in addition to the dissuaders that women have been experiencing since childhood, women also perceive that they are a poor fit with the culture of an engineering program, they may either avoid that program to begin with, or join and then leave.

Can Engineering Culture Be changed?

Changing societal expectations is a tall order, but what about changing institutional culture? It is appears that hostile institutional culture plays a part in driving women away from an otherwise attractive field of study, so one may wonder why the answer is not simply to transform the culture to make it more inclusive. The reason is that under normal circumstances, it is nearly impossible to make significant changes. Organizational culture has high inertia, and will budge only in response to clear, consistent, and highly coordinated actions at all levels of management, or to highly threatening circumstances (Ravasi & Schultz, 2006; Robbins, 2003). When organizations do transform, the culture itself exerts a powerful influence on *how* this change occurs (Ravasi & Schultz, 2006).

The problem of organizational change is nontrivial but not intractable. Efforts to make science and engineering more inclusive have met with some success (Bianchini, Whitney, Breton, & Hilton-Brown, 2002; Chesler & Chesler, 2002; Dingel, 2006; O'Halloran, 2005). These efforts need to be institution-wide, however. Individual instructors, however committed, cannot change organizational culture. After observing a group of university instructors already committed to inclusive science education, one team of researchers commented, "We are once again reminded that instructors' commitment coupled with professional development opportunities are not enough to achieve substantial and lasting change," and emphasized the significance of "institutional constraints encountered by participants outside of seminar walls" (Bianchini et al., 2002). We believe that the stubbornness of organizational culture contributes to the continuing underrepresentation of women in engineering schools; try as some might to send out positive messages about diversity, female students may be picking up subtle but pervasive manifestations of organizational culture, and concluding that they will not fit in.

The Gendered Organization

Researchers have used the idea of the "gendered organization" (Acker, 1990; Martin & Collinson, 2002) to analyze the organizational culture of engineering institutions (Britton, 2000; Chubin et al., 2005; Faulkner, 2000; Frehill, 2004). Masculine-gendered organizations both reflect and perpetuate gender inequality (Acker, 2006). To reinforce this inequality, it is not necessary to single out women for shabby treatment. Inequality can be reinforced through more subtle means, such as hierarchical structure and expectations of employees.

In a gendered organization, "gender-neutral" concepts are, in practice, not neutral at all, and end up perpetuating existing gender inequities (Acker, 1990). For example, employees in such an organization may be expected to allocate their time as if they had a nonemployed partner at home (traditionally a prerogative of affluent men). They may be required to work in situations where women are likely to feel uncomfortable, such as going on a customer visit that requires taking public transportation at night. In engineering culture, men and women alike are expected to appreciate "humor" that frequently has a crude and misogynistic bent (Eisenhart & Finkel, 1998). And while official organizational policy may not distinguish between men and women, women's exclusion from informal networks can present a significant obstacle to professional success (K. S. Davis, 2001).

The construction of science as "rigorous" and "elite" is so pervasive and inflexible that it can hobble innovation in the science classroom (Carlone, 2003). Science and engineering jobs are assumed to rightfully belong to men, and women are at best "a tolerated minority" (Amancio, 2005); discussions of women entering engineering have often used a metaphor of "invasion" (Bix, 2006). As women and certain men are excluded from power, women and men conform to the existing culture lest they become further marginalized (Miller, 2004). Just as DNA is found in every cell of a living organism, this gendering can be found in different facets of an organization—its stories, its symbols, its language.

The perspective of the gendered organization brings out two useful points: Gendering is pervasive, and it can be subtle. The pervasiveness of gendering allows us to analyze just one "thin slice" (Ambady, Krabbenhoft, & Hogan, 2006) of culture—its language, as evidenced in its mission statement or equivalent. Gendering can also be implicit; we posit that a mission statement can convey that some will be a better fit than others, without mentioning sex or gender explicitly, and that our study participants will be able to infer this.

Most official communications from engineering schools appear to be gender-neutral. Few administrators would declare in print today, as did Penn State's engineering dean in 1955, that women are not suited to engineering, and that teaching them is wasted effort (Bix, 2006). Still, language that appears superficially neutral may be anything but. For example, referring to mathematical and interpersonal skills as "hard" and "soft" respectively reinforces the idea that mathematical skills are connected to intellectual rigor as well as to masculinity and virility, while interpersonal skills are less important, and related to weakness and impotence. That "hard" is a synonym for "difficult" may further reinforce the higher respect accorded to mathematical skills. Even something as benign-sounding as referring to engineering students as the "cream of the crop" reinforces the status quo and implies that the way things are now is the way they should remain. After all, if engineers are currently the "best" students, then the most qualified people have *already* made it in. There is pride in being *ex*clusive, not *in*clusive. Anyone else who tries to come in must be an outsider, not the cream of the crop, someone who doesn't really belong—and naturally engineering must be defended against these unqualified invaders, or risk losing its prestige (Burack & Franks, 2006).

Hypotheses

We use the liberal arts as a baseline with which to compare engineering. Compared to the liberal arts, the engineering fields are more predominantly male (Ramsay & Letherby, 2006) and are perceived as masculine (Bell et al., 2003; Miller, 2004; Wilson, 2002).

If the culture of an institution is sufficiently strong, that is to say, deeply held and widely shared (Robbins, 2003), we believe that its values will be evident in its mission statement.

Our first hypothesis pertains to the overall impression of gender conveyed in the mission statement: Based on mission statements alone, we propose that participants will rate hypothetical successful engineering students are more "masculine" than successful liberal arts students. While mission statements generally do not mention sex or gender explicitly, we propose that engineering mission statements will convey a message that "masculine" students are more likely to be successful.

Because masculinity is considered a desirable and characteristic trait of men (Auster & Ohm, 2000; Evans & Davies, 2000), we posit that men would be more likely to see themselves succeeding in engineering institutions, and would be more likely to select "someone like me" as one of the characteristics of successful students at these institutions. This is an indicator of perceived fit; a high level of fit with an organization and with other organization members predicts higher satisfaction and commitment (Brief et al., 2005; Kristof-Brown, Zimmerman, & Johnson, 2005; Mannix & Neale, 2005; Schneider, 1987). Our second hypothesis is that male participants will be more likely to evaluate a successful student at engineering schools as being similar to themselves than will female participants.

Our third hypothesis pertains to the authoritarianism of the participants themselves. Authoritarianism is a world view that embraces hierarchy, denigrates out groups, and resists change (Adorno, Frenkel-Brunswik, Levinson, & Sanford, 1950). Authoritarianism has been found to be associated with negative attitudes toward feminism and equal rights for women (Sarup, 1976), hostile sexism and sexual harassment (Begany & Milburn, 2002), and unethical decision making when influenced by a dominant leader (Son Hing, Bobocel, Zanna, & McBride, 2007). Engineering students and practitioners have been found to be higher in authoritarianism than students in other disciplines (Athanasiou, 1971; Future Directions for Engineering Education, 1973; Gallaher & Pearson, 2000; Harrison, Tomblen, & Jackson, 1955; Rubinstein, 1997; Weller & Nadler, 1975; Wilson, 2002). Consistent with authoritarianism's hostile sexism, engineering school culture has been found to be hostile to women (Chesler & Chesler, 2002; Elaine, 1995; Gallaher & Pearson, 2000; NAS, 2006; O'Halloran, 2005; Roberts & Ayre, 2002) and resistant to diversity (Burack & Franks, 2006). Because of the association between authoritarianism and engineering culture, we hypothesize that participants high in authoritarianism will be more likely than low-authoritarians to see themselves as successful engineering students.

Method

We used college rankings from US News and World Report, selecting the top 10 undergraduate engineering programs and the top 10 undergraduate liberal arts institutions for analysis. We used U.S. News & World Report rankings solely as a delineator of category, not of quality—if a school is listed among the top 10 for undergraduate engineering in U.S. News and World Report, we conclude that it can be counted as an engineering institution. Some of the institutions (e.g., Swarthmore and Harvey Mudd) offer both liberal arts and engineering courses of study. In all cases, we took the USN&WP rankings as the final word on category, as high ranking of a particular program indicates that the institution devotes significant resources to this program and places high importance on it.

We started with the mission statements listed by US News and World Report's website. We double checked the statements on institutional websites. In one case (Carleton) we contacted the institution directly to confirm that the statement on their website could be considered a mission statement. The intent was to get a thin slice (Ambady, Krabbenhoft, & Hogan, 2006) of institutional communication for participants to evaluate.

People are adept at making inferences from a very small amount of information; they can make surprisingly accurate snap judgments about the personality traits and future job performance of others based on a thin slice of observation lasting from a few seconds to five minutes (Ambady et al., 2006; Benjamin & Shapiro, 2006). Higher education mission statements reflect the various values and orientations of different institutions (J. H. Davis, Ruhe, Lee, & Rajadhyaksha, 2006; de Pillis & de Pillis, 2005; Morphew & Hartley, 2006), and the mission statement can therefore serve as a useful thin slice of organizational culture.

Participants were 47 male and 56 female undergraduates enrolled in three sections of introductory business courses at a public university. We recruited students from business classes because business is distinct from liberal arts and engineering, and requires both qualitative and quantitative skills. Participation was voluntary. There was no majority racial or ethnic group in our sample. The ethnic composition of the sample was: Multiracial – 40; Caucasian – 39; Japanese – 9; Other – 4; Pacific Islander – 3; Chinese – 3; and Native American, African American, Filipino, Southeast Asian, South Asian – 1 each. There were 10 additional students enrolled in these sections who did not complete the study.

The participants in our study read 20 mission statements, from the 10 top undergraduate liberal arts colleges and the 10 top engineering programs in U.S. News & World Report's, 2005 rankings ("Best Liberal Arts Colleges," 2004; "Best Undergraduate Engineering Programs," 2006). Nine of the 10 engineering schools had "engineer" or "engineering" in the mission statement, and four of the 10 had the name of the institution in the mission statement. Eight of the 10 liberal arts mission statements contained the name of the institution. Participants were not given any other information about the institutions.

After reading each statement participants selected the descriptors they felt applied to a successful student at each institution: "A successful student at this institution is________." Participants could select all that applied among: Masculine, Forceful, Dominant, Feminine, Eager to Soothe Feelings, Soft Spoken, Defends Beliefs, and Likable. "Forceful" and "dominant" are considered to be masculine descriptors, "eager to soothe feelings" and "soft spoken" are feminine descriptors, and "likable" and "defends beliefs" have been rated as neither masculine nor feminine (Hoffman & Borders, 2001). To test whether a participant felt he or she would be a good fit with the institution, we also asked the participant to indicate whether s/he agreed with the statement, "A successful student at this institution is someone like me."

Participants also completed Robert Lane's widely used (Hicks, 1974; Larsen & LeRoux, 1984) four-item authoritarianism scale (Lane, 1955). This measure has retained its validity and usefulness for over 50 years (Christie, 1991). While there are measures of authoritarianism that are more up-to-date (Altemeyer, 2004), the brevity and simple vocabulary of Lane's measure helped to ensure ease of comprehension and a high rate of completion.

Results

Hypothesis 1 posits that engineering mission statements will convey a message that successful students are more likely to be "masculine," even though they do not mention sex or gender explicitly. Table 1 shows that engineering students are presumed to be significantly more masculine and less feminine than liberal arts students. Averaging results within engineering

Table 1
Characteristics Attributed to Successful Students at Engineering and Liberal Arts Schools (T-Tests)

Type of descriptor	Descriptor	Engineering Average	Engineering Average, omit Air Force, Army, and Navy academies	Liberal Arts Average	Significance: Engineering vs. Liberal Arts	Significance: Engineering without military academies vs. Liberal Arts
Feminine	Eager to Soothe Feelings	.1874	.2275	.3359	**.000**	**.003**
Feminine	Feminine	.1350	.1526	.3398	**.000**	**.000**
Feminine	Soft Spoken	.1612	.2039	.2660	**.012**	.080
Masculine	Dominant	.5505	.4924	.3825	**.005**	**.034**
Masculine	Forceful	.4272	.3454	.2660	**.009**	.057
Masculine	Masculine	.4243	.3093	.2155	**.009**	**.023**
Neutral	Defends Beliefs	.3019	.2649	.3738	**.036**	**.001**
Neutral	Likeable	.3466	.4119	.4806	**.009**	.061
Neutral	Someone Like Me	.1029	.1221	.1447	.073	.281

Note. Bold type indicates $p < .05$.

schools and within liberal arts institutions, the hypothetical student at the average engineering school was rated significantly higher than the hypothetical liberal arts student on the masculine descriptors (dominant, forceful, and masculine) and significantly lower on the feminine descriptors (feminine, eager to soothe feelings, and soft spoken). Because three of the top engineering institutions were military, we conducted our analyses both with and without these institutions included. Excluding the military institutions moved "soft spoken" and "forceful" to statistical insignificance, but otherwise the results were the same. The hypothetical student at a liberal arts institution was also considered significantly more likable and more inclined to defend his or her beliefs than was the hypothetical engineering student. The gap between engineering and liberal arts in "defends beliefs" widened when the military institutions were removed.

Values range from 0 to 1, with higher values indicating more participants who agree that successful students at these schools possess this trait. For example, the proportion of participants who thought a successful student at an engineering school was likable was, on average, .3466, or just over 34%. By contrast, 48% of participants indicated that a hypothetical liberal arts student was likable. A p value below .05 is statistically significant.

Hypothesis 2 posits that male participants will be more likely than female participants to indicate that a successful engineering student is someone like themselves. There were only two institutions that showed a significant difference: Women were more likely to indicate that the hypothetical successful Wellesley student was "someone like me", while men were more likely to identify with a successful student at the U.S. Naval Academy. The other 18 institutions did not show a significant difference. Hypothesis 2, therefore, was not supported.

This appears to be inconsistent with women engineering students' lower self-efficacy relative to their male counterparts. The present study, however, only measures initial impressions based on a brief mission statement. In practice, as women progress through engineering programs their self efficacy decreases over time, relative to their actual performance (Marra & Bogue, 2006). Our results do not support the notion that women avoid engineering because they lack self-efficacy; instead, it appears that the culture of engineering erodes the confidence of the women who participate in it.

Our third hypothesis posits that individuals high in authoritarianism are more likely to select "someone like me" as one of the characteristics of successful students at engineering schools. Regression results in Table 2 indicate that for men, number of engineering schools (out of 10) where a successful hypothetical student was "like me" was predicted by both the participant's authoritarianism level and by the number of liberal arts institutions selected. Beta is a standardized measure of the strength of the relationship between two variables. For Table 2, the independent variable "Authoritarianism" has a beta weight of .329, which means that

Table 2
For Men, Authoritarianism Positively Predicts Number of Engineering Schools Where a Successful Student is "Someone Like Me" (Linear Regression)

	Men	Women
Authoritarianism	Beta = .329, Sig. = .006	ns
Number of liberal arts schools selected	Beta = .553, Sig. = .000	Beta = .326, Sig. = .016

Note. ns = nonsignificant.

when other independents are held constant, increasing authoritarianism score by one standard deviation increases the number of engineering schools selected by .329 of a standard deviation. For women, the only significant predictor of engineering schools selected was number of liberal arts institutions selected; authoritarianism was not a factor for women. The relationship between number of liberal arts schools and number of engineering schools selected may indicate that affinity for liberal arts institutions is based on a more general academic interest or self-efficacy.

Men averaged 3.33 on the 5 point authoritarianism scale, while women averaged 3.16. This difference did not reach statistical significance. Table 3 illustrates that authoritarianism was not a significant predictor of affinity for liberal arts institutions.

Further confirming the relationship between authoritarianism and affinity for engineering schools is the fact that for *every* engineering school, men who indicated that a successful student was "someone like me" had higher authoritarianism scores, on average, than the men who did not select this option. By contrast, 5 of the 10 liberal arts schools were selected by men with higher authoritarianism scores, and 5 were selected by men with lower scores. Table 4 lists all the institutions for which the difference in authoritarianism scores reached statistical significance.

Discussion

On average, hypothetical successful students at engineering institutions were rated significantly more masculine, and significantly less feminine, than were successful students at liberal arts institutions. Successful liberal arts students were also judged to be significantly more likable and more inclined to stand up for their beliefs. In addition, authoritarian male students were significantly more attracted to the engineering institutions.

It is not surprising that authoritarianism and masculinity are associated with engineering. This relationship has been noted for decades (Athanasiou, 1971; Future Directions for Engineering Education, 1973; Gallaher & Pearson, 2000; Harrison, Tomblen, & Jackson, 1955; Rubinstein, 1997; Weller & Nadler, 1975; Wilson, 2002). What is remarkable is that a non expert audience can infer this relationship based only on a very thin slice of organizational culture. It is not immediately obvious *how* some mission statements convey masculinity and authoritarianism. Why do those men who indicate they would succeed at Harvey Mudd College have an average authoritarianism score of 4.5 out of 5, significantly higher than the score of 3.24 among men who did not select Harvey Mudd? Harvey Mudd College "seeks to educate engineers, scientists, and mathematicians, well versed in all of these areas and in the humanities

Table 3
Authoritarianism Does Not Predict Number of Liberal Arts Schools Where a Successful Student is "Someone Like Me" (Linear Regression)

	Men	Women
Authoritarianism	ns	ns
Number of engineering schools selected	Beta = .666, Sig. = .000	Beta = .341, Sig. = .016

Note. ns = nonsignificant.

Table 4
Authoritarianism Scores of Students Who Indicated That a Hypothetical Successful Student at Each Student Was "Someone Like Me," Versus Those Who Did Not (ANOVA)

College	Type of program	Average authoritarianism of men who agreed that "a successful student here is someone like me"	Average authoritarianism score of men who did not agree	Sig. (men)	Average authoritarianism of women who agreed that "a successful student here is someone like me"	Average authoritarianism score of women who did not agree	Sig. (women)
Harvey Mudd	Engineering	4.25 (n = 4)	3.24 (n = 43)	.009	2.83 (n = 3)	3.18 (n = 52)	.385
Carnegie Mellon	Engineering	4.13 (n = 4)	3.26 (n = 43)	.025	3.19 (n = 9)	3.15 (n = 46)	.862
Amherst	Liberal Arts	4.03 (n = 7)	3.20 (n = 40)	.005	3.13 (n = 10)	3.17 (n = 45)	.859
Cooper Union	Engineering	4.00 (n = 7)	3.21 (n = 40)	.009	2.89 (n = 9)	3.21 (n = 46)	.182
Cal Poly	Engineering	3.96 (n = 6)	3.24 (n = 41)	.026	3.15 (n = 10)	3.16 (n = 45)	.962
Bowdoin	Liberal Arts	3.81 (n = 8)	3.23 (n = 39)	.044	3.03 (n = 15)	3.21 (n = 40)	.392

Note. Authoritarianism is measured on a scale of 1 to 5, with 5 being the most authoritarian.

and the social sciences so that they may assume leadership in their fields with a clear understanding of the impact of their work on society-"(HMC, 2007).

Could it be that the very presence of the word "engineer" triggers an authoritarian stereotype? Among the nine mission statements that do contain "engineer" (only the U.S. Air Force Academy mission statement does not contain some variant of the word), there was great variance in participants' assumptions about a hypothetical successful student. For example, the U.S. Military Academy's mission statement mentions engineering three times: "To educate and inspire cadets in civil engineering, mechanical engineering, and engineering mechanics such that each of these cadets is a commissioned leader of character who is committed to Duty, Honor, Country; a career in the United States Army; and a lifetime of service to the nation." The average authoritarianism of men who indicated that successful U.S. Military Academy students were "someone like me" was 3.50 out of 5. This was not significantly different from the score of men who did not select the U.S. Military Academy, 3.32 out of 5. The variance in responses to the mission statements must be due to something other than the mention of "engineer" or "engineering".

While investigating how observers make inferences from mission statements is an interesting direction for future research, our main purpose is not to find the best way to "spin" a mission statement. We believe that the mission statement is only an indicator of the values and culture of the organization. Our interest is in what the mission statement or other thin slice of organizational culture unintentionally reveals.

Limitations and Future Directions

Because our sample was so ethnically diverse—"multiracial" was our largest category, and included over 30 different combinations—comparing ethnic groups yielded no significant differences. This may indicate that people of all backgrounds believe themselves to be equally suited to engineering—or it may mean that our sample was too small to yield any meaningful findings. In order to maximize participation, we also did not inquire into nonvisible aspects of diversity that participants might be reluctant to disclose. Future research would add to the present findings by using a much larger sample in order to be able to include other measures of diversity in addition to gender.

Implications for Practitioners

Changing the culture of engineering schools may be challenging, but it is imperative. The projected dearth of engineers and scientists in the United States is an economic and national security issue (Chubin, May, & Babco, 2005). Policymakers recognize the urgency of broadening the pool of potential scientists and engineers to include women (Hennessy et al., 2005).

We propose stepping away from the simplistic goal of getting "more women" or "more diversity" in engineering (only to have the "diverse" students leave), and reexamining from the ground up the subtle yet deeply ingrained and relentless ways in which traditional engineering culture pushes out those who may not fit in.

Changing engineering culture requires years-long effort with commitment at all levels of the organization (Brainard & Carlin, 1998; Fisher & Margolis, 2002). In 1995, Carnegie Mellon initiated a program of research and action to understand students' engagement in the field of computer science and to address gender imbalance. CMU's effort, which includes revising admissions standards to focus on relevant skills, monitoring student attrition, and remediating bright but inexperienced students, has led to an increase in women's enrollment and a drop in women's attrition, with no apparent negative effects on program quality or participation of male students (Blum & Frieze, 2005; Fisher & Margolis, 2002; Gilbert, 2002).

In contrast to the success of Carnegie Mellon's computer science department, their larger campuswide attempts at improving multiple aspects of diversity have mixed results despite a decade of coordinated effort ("The State of Diversity at Carnegie Mellon University Annual Report", 2007). It may be that the drastic, culture-changing efforts of the Computer Science department are difficult to replicate on a large scale. In addition, the CS department had a very clear goal: to increase participation by those students—mainly female students—who were promising computer scientists, but whose interest in computers took a different form from that of the stereotypical male "gamer geek". Measuring success in this case is straightforward. More generalized, campuswide diversity initiatives may suffer from vague, unmeasurable, or conflicting goals.

The question remains: Why have only certain engineering fields resisted the entry of women? Not only have other historically homogeneous areas such as veterinary medicine and law attracted greater numbers of women, but the subspecialties of biomedical and environmental engineering see over 40% of bachelor's degrees earned by women. We propose that the difference may lie in authoritarianism within the culture. We suspect that among subfields of engineering we might find differing levels of authoritarianism, which may help to explain variance in the extent to which "outsiders" are allowed in. Future study in this area should take authoritarianism into account. Scholars in psychology and political science have pointed out the strong effect of authoritarianism and related constructs such as Social Dominance Orientation on decision making (Altemeyer, 2003, 2004; Pratto, Sidanius, Stallworth, & Malle, 1994; Pye, 1990). We believe that authoritarianism is a long-overlooked feature of organizational culture.

A successful diversity effort may have to follow the principle of thinking globally and acting locally—there must be institutionwide, high-level support for diversity programs, as the barriers to women in engineering are systemic (Bystydzienski & Bird, 2006; Gallaher & Pearson, 2000; Hennessy et al., 2005; NSF, 2006; Rosser, 2006) and can only be broken down by efforts that involve entire organizations from the top down. Isolated attempts to impose equal opportunity can be met with formidable and adaptable resistance (Bagilhole, 2002). At the same time, Carnegie Mellon's experience indicates that efforts at culture change may need to be implemented idiosyncratically within discrete academic units, and must have clear, measurable goals. Changing the mission statement is not the answer; doing the hard work of analyzing and then changing the culture piece by piece, on the other hand, may result in a changed culture, a changed mission and eventually a transformed presentation to the outside world. Certain small changes can have a large impact: having engineering schools' publicity materials display a 1:1 gender balance may increase the interest and engagement of both female and male math and engineering students, and greatly increase women's sense of belonging without affecting that of men (Murphy, Steele, & Gross, 2007). Nevertheless, instituting cultural change is a difficult, long-term process. This is particularly true in engineering institutions, which are notoriously prone to inertia (Florman, 1993). For policymakers and administrators seeking to change the culture of engineering schools, our results confirm the magnitude of the challenge they face.

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