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Selling policy short? Faculty perspectives on the role of policy in addressing women’s underrepresentation in engineering education

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ABSTRACT
Despite a nearly 40-year history of research initiatives and interventions to recruit and retain women engineering students, women remain significantly underrepresented in engineering. Given the lack of progress, it seems clear that new lenses on the problem of underrepresentation warrant further attention. Higher education policies are one area that has received comparatively scant attention from researchers and administrators in regard to underrepresentation in undergraduate engineering programs. This interview-based research article explores how policy featured in engineering professors’ discussions about gender and underrepresentation in engineering. It shows that, while there is widespread awareness of workplace policies related to the careers of female engineers and engineering professors, policies related to underrepresentation in undergraduate engineering education programs are marginalized. The article concludes with seven examples of student-related policies that warrant further exploration in regard to women’s participation in engineering programs.

KEYWORDS
Engineering education; underrepresentation; women; policy; retention; admissions

Introduction
Despite a nearly 40-year history of research initiatives and interventions to recruit and retain women and other minority engineering students, those groups remain significantly underrepresented in engineering (NSF 2013). Even more troubling is the fact that, in recent years, enrollments of female engineering students have actually declined from gains made in the 1980s and 1990s (Grose 2006; NSF 2013). For instance, in the United States in 1991, women earned 15.5% of engineering bachelor’s degrees; in 2002 that number had risen to 20.9%; but by 2010, it had fallen back to 18.4% (NSF 2013). The numbers of underrepresented minority women are even more staggering: they earn only 3.9% of doctoral degrees, 7.9% of master’s degrees, and 10.6% of bachelor’s degrees in engineering. Also of note is the fact that most of the gains made in enrollments of female engineering students have been at the graduate level, not at the undergraduate level. At all levels, engineering is considered a ‘low participation field’ compared to other science fields (NSF 2013). These numbers indicate that the significant amounts of time, energy, resources, and research devoted to increasing the participation of women in engineering have largely not succeeded in broadening participation to the extent intended.

Women’s underrepresentation in engineering education has seldom been approached through a policy lens. Typically, it is treated as a matter of culture, role models, identity, self-efficacy, socialization, or simply a lack of knowledge about the field. Certainly, each of those factors contributes
to the problem. However, given the lack of progress, it also seems clear that other lenses on the problem of underrepresentation warrant further attention. For instance, what roles might higher education policies play in perpetuating underrepresentation? Conversely, how might higher education policies be used to increase women’s participation in engineering? While it is now more common to consider policy questions in relation to female faculty members and engineering workplace policies, exploration of such policy questions has largely not trickled down to the student level.

This article explores how policy was engaged in discussions with 39 engineering professors in the United States. The interviews explored many aspects of gender and engineering education. The specific research question addressed in this analysis is: To what extent and in what ways do engineering professors think that policies are related to underrepresentation? The aim in posing and answering these questions is to bring under-explored perspectives into the body of research on women in engineering. The discussion will also explore ways in which higher education policies could be used to increase the number of women in engineering.

**Literature review**

There is a very small amount of research on policy and underrepresentation in engineering education. After searching literature specifically on admissions policies, Holloway et al. (2014) found that there were very few studies that had investigated the relationship between admission policies and women’s underrepresentation in engineering. More specifically, they found a ‘significant lack of research’ in three key areas (277). The first was how common metrics, such as high school grade point average (GPA) and standardized test scores, may produce gender biases in admissions. The second was how the types of factors, such as cognitive, affective or attitudinal, used in admissions decisions may produce gender biases. The third was ‘the role of systematic research to inform policy creation or modification’ (277). They concluded that, ‘the lack of scholarly work on engineering admissions promotes keeping these processes and policies unchanged rather than modifying them in an informed way’ (277). In their review of the literature, they found only two studies that had examined relationships between admissions policies and underrepresentation in engineering: Margolis and Fisher (2003) and Leonard and Jiang (1999). However, if the scope is broadened beyond engineering, studies can be found that have explored admissions policies and broadening participation in higher education in Sweden and the UK (e.g. Berggren 2007; Hoare and Johnston 2011).

Holloway et al.’s own (2014) study on admissions policies found a statistically significant gender bias in admissions at a university in the United States. Policy changes were implemented to address the bias, and subsequent analysis revealed that the policy changes had mitigated the bias. After finding that applications from women increased 46% but admissions only 23% over a five-year period, the authors investigated and ultimately worked with administrators to change admissions policies. The changes included reducing weight given to standardized math test scores, while increasing weight given to: (1) verbal/written standardized test scores, (2) the number of semesters of math, science, and English taken in high school, (3) leadership, major indecision, and academic motivation, and (4) social relevance of engineering. These changes resulted in increases of female applicants admitted to engineering and enrolled in engineering. The first year the changes were implemented, the percentage of women enrolled in engineering was 26%, when it had been 21% the previous year, and the number of women enrolled in the first-year engineering program rose by 28%. The study explores several possible explanations for biases in admission processes, including admission counselors’ unconscious biases, and the lack of an explicit policy on how much weight should be given to mathematics standardized test scores. The authors hypothesized that, in the absence of an official policy, counselors were placing high value on the mathematics scores and that this was part of the problem.

Another example of a way in which admissions policies could serve as a site of intervention comes from researchers studying students who have switched to engineering after enrolling in
college and first selecting a different major (Brawner, Orr, and Ohland 2014). Studying these ‘accidental engineers’ revealed that all of them attended institutions that did not have first-year engineering programs. In other words, when sophomore students can matriculate directly into engineering rather than having to pass through a first-year engineering program, it allows students to enter engineering who otherwise would not have been able to or may have been discouraged from entering an engineering major. Although it was based on a small sample of students, the study supported prior findings that the requirements of first-year programs discourage students from transferring into engineering (Orr et al. 2012).

Separate from admissions policies, McLoughlin (2009) has suggested that current recruitment and retention policies could be changed to support increased numbers of women engineering students. In her research, she found that by focusing efforts on a previously ignored group – what she calls ‘Non-traditional engineering organized (NEO)’ students – more women can be recruited and retained in engineering programs. NEO students are those who have high overall GPAs in high school but do not have a ‘concentrated background’ in Science, Technology, Engineering and Math (STEM)-related classes and do not consider their strengths to lie in science and math. Despite their high school preparation, however, NEO female students were just as happy in their engineering programs (indicating that they were likely to persist) as female students who had taken more STEM-related courses in high school and considered their strengths to lie in science and math. McLoughlin suggests that universities change their recruitment policies to target and visit all advanced placement (AP) classes, not only science and math classes, as is currently the common practice. She also suggests that retention policies aimed at supporting NEO students, in particular by making sure they are aware of differences in grading practices between engineering and non-engineering coursework, would be helpful. Recent research also suggests that loan repayment policies could increase retention of women students (Yang and Grauer 2016).

These studies provide evidence that when we choose to critically examine policy, we find gender biases in unexpected places. Policies assumed to be gender-neutral, such as admissions, are found to be problematic when researchers choose to ask critical questions about them. The scant amount of research on the effects of higher education policies on underrepresentation in engineering education is a reflection not of policy’s insignificance, but rather of the choices researchers have made to problematize female students rather than features of engineering education, such as policy (Beddoes, forthcoming; Faulkner 2009; Mills, Ayre, and Gill 2010; Riley 2008).

**Methods**

**Methodology**

The methodology guiding this study distinguishes it from the vast majority of STEM diversity research. Borrowing language from Nader (1974), this project enacts a methodology of ‘studying up.’ Studying up means to study people in positions of higher social status or power, or institutions more generally (Nader 1974; Sprague 2005). Studying up stands in contrast to ‘studying down,’ which is the tendency in social science to study – and often locate problems within – groups and individuals in positions of lower social status and power (Nader 1974; Sprague 2005). In engineering education research, this tendency manifests in research on self-efficacy, identity, and ‘marketing’ of engineering, for example. Faulkner (2009) has referred to such efforts as ‘deficit model’ approaches. The tendency to problematize women students in engineering education research on gender has been critiqued but continues to dominate the research and intervention landscape (Beddoes, forthcoming; Mills, Ayre, and Gill 2010; Pawley 2013; Riley 2008; Slaton 2011). As the dominant mode of inquiry, it has led to gaps in our understandings of the roles that faculty,
administrators, institutional structures, policies, and majority students, among other factors, play in underrepresentation.

Participants and recruitment

In 2014 and 2015, in-depth interviews were conducted with 39 engineering professors at three different institutions in different parts of the United States. As summarized in Table 1, the interviewees represented a mix of tenured and tenure-track professors only, and the full range of engineering disciplines that exist at each of the three institutions included in the study. All participants teach or have taught engineering courses. Several interviewees also held administrative positions. On an open-ended, demographic form given at the end of the interviews, seven identified as Asian or Asian/white, two identified as black, two identified as Indian, and the rest as white. There were 10 different nationalities listed.

Eleven participants were from Institution 1, which was a large, doctoral-granting research university. The response rate for Institution 1 was 28%. Fourteen participants were from Institution 2, which was a primarily undergraduate institution offering some Masters degrees, but no Doctoral degrees. The response rate from Institution 2 was 40%. Fourteen participants were from Institution 3, which was a large, prestigious, doctoral-granting research institution. The response rate for Institution 3 was 17%. None of these institutions is the author’s home institution. All institutions were public, four-year universities. None were Ivy League colleges, historically black colleges, tribal colleges, or two-year colleges.

Recruitment was done through a combination of maximum variation sampling and purposeful random sampling (Patton 1990), and recruitment efforts for this project have been discussed in detail elsewhere (Beddoes 2015b). Public, departmental websites were used to randomly generate names. Yet, within the parameters of random sampling, purposeful steps were taken to recruit a full range of engineering disciplines, career levels, and, ideally, an equal number of men and women. The goal was to recruit interviewees who were randomly selected in order to avoid a participant pool who all had involvement with ‘women in engineering’ initiatives. However, the random sampling process did of course enroll some participants with involvement in ‘women in engineering’ initiatives and these people were not excluded. Institutional Review Board (human subjects research ethics) approval was obtained prior to contacting any potential participants. A personalized email was sent to all potential participants explaining the study and offering them a $20 gift certificate to Amazon.com for participating. They were invited to reply by phone or email if they were interested in scheduling an interview.

Table 1. Overview of participants.

<table>
<thead>
<tr>
<th>Group</th>
<th>No. of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Career level</td>
<td></td>
</tr>
<tr>
<td>Full professor</td>
<td>15</td>
</tr>
<tr>
<td>Assistant professor</td>
<td>13</td>
</tr>
<tr>
<td>Associate professor</td>
<td>11</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>21</td>
</tr>
<tr>
<td>Women</td>
<td>18</td>
</tr>
<tr>
<td>Discipline</td>
<td></td>
</tr>
<tr>
<td>Electrical/Computer</td>
<td>7</td>
</tr>
<tr>
<td>Civil/Environmental/Construction</td>
<td>6</td>
</tr>
<tr>
<td>Industrial/Operations/Manufacturing</td>
<td>5</td>
</tr>
<tr>
<td>Chemical/Biological</td>
<td>5</td>
</tr>
<tr>
<td>Mechanical</td>
<td>5</td>
</tr>
<tr>
<td>Aerospace</td>
<td>3</td>
</tr>
<tr>
<td>Nuclear</td>
<td>3</td>
</tr>
<tr>
<td>Materials</td>
<td>3</td>
</tr>
<tr>
<td>Biomedical</td>
<td>1</td>
</tr>
<tr>
<td>Other*</td>
<td>1</td>
</tr>
</tbody>
</table>

*A small unique discipline, not identified to protect participant’s identity.
Data collection and analysis

The semi-structured interviews averaged 60 minutes in length and were audio-recorded and then transcribed. They took place in professors’ offices with closed doors, except for two that were conducted via Skype and one that was conducted in a faculty lounge that was empty aside from the interviewer and interviewee. The interview protocol was designed to cover a wide range of topics that have been identified in prior literature as contributing to the gendering of engineering and/or women’s underrepresentation in engineering. The overarching aim of the interviews was to better understand what and how engineering faculty members think about gender in engineering, women’s underrepresentation in engineering, and how they make decisions around gender in their classes. Policy was one of several topics explored in the interview protocol. Others included course content, learning environment, teaching practices, and beliefs about students.

The interviews began with asking participants why they thought women were underrepresented in engineering and what changes could be made to increase the numbers of women in engineering. The interviews ended by asking if there was anything that had not been covered that participants thought was important for understanding gender in engineering or women’s underrepresentation in engineering. When participants did discuss policy on their own (without me asking about it specifically), it was in response to these two initial questions and that closing question. When time allowed, participants who had not already mentioned policy were asked about policy toward the end of the interview. They were asked if there were any ways in which policies, either at the university, college, or departmental level, could be considered gendered or contribute to underrepresentation, or if there were any ways in which policy could be used to increase the numbers of women in engineering. The interviews also covered content (subject matter) and assessment (grading), which could be considered policy issues, but these are beyond the scope of this paper and will be explored as separate topics elsewhere.

For this analysis, transcripts underwent initial coding (Charmaz 2006) for all instances of a discussion related to policy. Those sections of the interviews were then analyzed with open and axial coding to identify emergent themes (Corbin and Strauss 2008). This open coding approach was most appropriate given the novelty of the research questions being explored. Such grounded theory methods are appropriate for studies in which no pre-existing theory is used to guide the coding. They allow new themes to emerge from the data rather than it being analyzed through the lens of a pre-existing framework (Miles and Huberman 1994). This analysis builds on preliminary findings published previously (Beddoes 2015a).

Findings and discussion

Policies for female faculty members

Only 19 participants discussed policy in any way: 13 of those instances were related to workplace policies. Six of those 13 were about female faculty members, with 3 focusing on family-friendly policies, such as parental leave, childcare, and stopping the tenure clock. The other three focused on policies related to recruiting and hiring more women applicants and how faculty members are evaluated once they are hired. The following quotations are representative of discussions about family-friendly policies:

I think one of the easiest things to address would be the policies and culture around maternity leave. I think is the easiest thing to address. In Sweden it’s like night and day to here with regard to maternity leave. Not only is it really well funded and it’s also funded by the government. Essentially, the employer has little incentive to be crappy about it. But the cultures around it are just drastically different. I mean Swedish culture and American culture are very different in a variety of ways. There is no sense of loss of opportunity, of whatever, around child bearing in Sweden. I don’t know how you do that here. I don’t know how you change that here. The easiest start is to just change it financially. You just make it not financially burdensome to have kids. And then
maybe the culture changes around that? I don’t know … Other policies … [long pause] I can’t think of any that are inherently gendered. I don’t know. [Female assistant professor]

Women are not sure or feel this [engineering] is an appropriate career choice, for example, if you wanted to combine it with family. Women may feel the standard faculty person is a mid-50s white male … I think it has to do with whether you can visualize yourself doing something, going back to role models, whether you feel you’re good enough to be able to do that, and I think at the faculty level to become more specific about that, I think it has a lot to do with the pressures, for example, of the first six years to tenure, where most women after a long time in grad school to get their PhD, post-doc experience, may eventually feel that it’s time to start a family, and they may feel that they’re almost not allowed to because of this additional pressure. It’s almost like everybody’s sort of telling them, “Wait a little bit longer. Wait a little bit longer. Get to that next stage. Get to that next stage.” [Male assistant professor]

Another way in which policy discussions turned toward female faculty was regarding evaluation. One participant discussed faculty evaluation when asked about policy:

I think at the faculty level, there are certainly policies that will limit women at the faculty level in the way that we process teaching evaluations, for example, and the way we give teaching awards based on those teaching evaluations. I think those don’t reward female faculty members, which then downstream from that don’t keep women in academia. [Female associate professor]

In addition to family-friendly policies and evaluation, two participants discussed how hiring policies in academia can be used to increase the numbers of female professors hired into engineering.

The issues, concerns, and phenomena identified in these discussions are not new or unique to this study. They constitute common themes in the literature on the challenges female faculty members face (Beddoes and Pawley 2014; Moody 2004; Nikunen 2012; Raddon 2002; Ylijoki 2013). What is of significance here is that these are the policies that were most often discussed in a study that was not about female faculty members. While concerns about policies that negatively affect female faculty are no doubt important, it was striking that this was the most common policy-related topic in interviews where the questions had all otherwise focused on students and undergraduate engineering education, not the careers of female faculty members. The number of participants who answered about industry policies, rather than student-related policies, was similarly noteworthy. I turn now to those discussions.

**Policies in industry**

The seven remaining workplace policy discussions were about industry workplace policies, specifically family-friendly or work–life balance policies. These discussions centered around engineering being a ‘demanding’ and ‘serious’ job not compatible for women who want to raise children, and how the presence or absence of ‘family-friendly’ policies can help or hurt, respectively. Below are three representative quotations:

Companies that hire engineers don’t tend to be very good at people taking long-term leaves of absence and women tend to be the ones who stay home with children so do those things. So I’m not sure how many high school students consider that when they’re choosing a career, so I don’t think that influences the initial influx necessarily, but I think it certainly influences later on. You can do lots of things with an engineering degree, and being an engineer tends to restrict you to have to be at that job continuously. There’s not a lot of flexibility … [Male full professor]

I think it is still socially more acceptable for a woman to have maybe a softer career the ways people might imagine that still maybe staying at home, and being an engineer is a pretty demanding job. It requires going to work 8:00 a.m. to 5:00 p.m. or whatever it is, and maybe that’s not as easy to have the work/life balance. I think that’s one reason there’s still that how do we have this partnership between the spouses to care for the kids if the women aren’t taking on these more time consuming jobs. [Female assistant professor]

I think what happens is that once they [women] start families they kind of get left behind or they stop working for a while, things like that. So I think it would really help if we would create a little more flexibility for both the men and the females. I think the U.S. still is a society where taking care of children is mainly the women’s jobs. That has
changed. Like in Northern Europe, that’s no longer the case. The males also take maternity leaves, things like that. In many ways engineering should be the perfect field to have a family, because you don’t have to always work 100 percent of the time. You can work part-time and still be productive on smaller projects. So if we could have that becoming more of a common practice, if they would see the flexibility, if they would see that they can do both, I think that’s the biggest hindrance. [Female assistant professor]

Again, these are not new issues; a large body of literature exists on work–life balance issues. But the point to note here is that workplace policies (as opposed to student-related policies) constituted a large part of all policy discussions. It is also interesting to note that participants contrasted the United States with Northern Europe and Scandinavia. While it is true that Northern European and Scandinavian countries generally have more family-friendly policies, they do not in fact have significantly more female engineers (Hatfield 2014). That fact would seem to undermine the perceived connection between family-friendly policies and underrepresentation. This is not to say that such policies are not needed, and could have an important role to play, but it highlights the problem with focusing only on workplace policies as causes of and solutions to underrepresentation.

**Student-related policies**

*Views that student policies could be related to underrepresentation*

Only six participants discussed policies related to students, and two of those were contending that current policies help underrepresented students. One participant identified a way in which undergraduate admissions policies could be considered gendered. Admissions at his university were based solely on a point system, wherein applicants receive a certain number of points for GPA and a certain number of points for national standardized college entrance exam score – with one exception. Applicants receive extra points for military service, which the interviewee said could be considered a gendered policy because it is more likely to benefit men, as they are more likely than women to have served in the military. Another participant discussed how graduate school admissions decisions are subject to implicit biases, even if admission policies are ostensibly unbiased.

Two participants identified interesting ways in which policies could be used to increase the number of women in engineering education. One spoke about the possibility of requiring gender training for new faculty, and/or as part of annual evaluations. The other spoke about adding accountability for mentoring and retention of underrepresented students into tenure and promotion criteria. These unconventional but potentially powerful policy changes are discussed further in the Conclusion section.

On the other hand, two participants said that admissions policies actually help minority students. (It was common in the interviews for participants to discuss other types of minority students in addition to women). They said that while it might not be a policy per se, there is an ‘emphasis to keep an eye’ out for diverse applicants and a ‘well intentioned desire’ to increase the numbers of minority students enrolled. In other words, they think current admissions practices help rather than hurt female students. In fact, admissions are one area where we do have evidence of systemic gender biases – and not in favor of women. As noted in the Literature Review above, Holloway et al. (2014) found that admission policies at the university they studied were biased and that changing the policies increased the numbers of female students enrolled in engineering.

*Views that student policies are unrelated to underrepresentation*

Thus, while four participants identified ways in which student-related policies could either contribute to or be a solution to underrepresentation, the rest said that student-related policies were unrelated to underrepresentation or said that they did not know. For example, the following were responses to the questions about whether policy does or could play a role in underrepresentation:

I just don’t know. You’d have to start with the admission process, and I just trust that our administrators know what they’re doing and that they are conscious of those things. And I think they are, as far as I can tell, at least for underrepresented minorities, in general. And again, I don’t know what is done. So I know there are
programs and such things for women, and specifically I don’t know what exists and what doesn’t. But for all underrepresented groups I believe there are support programs or programs that are meant to address some of these issues. I’m not familiar with them and so I can’t speak to whether they’re helpful or not. So as far as I can tell, there are policies in place to try to address all these issues. And again, it’s one of those things that I don’t know enough about that I will have to leave it up to others who really know what they’re doing to address this. [Male assistant professor]

No, I don’t think so in engineering – not that I am super-familiar with all of our policies, but in general in terms of acceptance, we accept everyone. We have very low acceptance criteria, so I don’t think we’re filtering out anyone preferentially … Typically only GPA [grade point average] is the only cut-off there, and that GPA varies by the number of students we can accommodate. Is GPA the right metric? That’s certainly a good question. It’s the GPA of certain core engineering classes, so it’s not just everything, but that is the current policy. I don’t think that it’s particularly gendered, but again, it goes back to your question of are our metrics of assessment gendered, and so then those things would be related, if they are. But I’ve not seen anything that seems biased in a gendered way – really, biased in any way. I’d like to think I would call it out if I did. But of the policies I’m familiar with, which are not very many, I haven’t identified anything that’s gender-biased, no. [Female assistant professor]

That’s an excellent question. My knee-jerk reaction is that if there are bias issues, they’re not policy bias issues; that our policies don’t really differentiate any particular types of people, so if there are biases, it’s cultural or individual faculty biases that might come in … So I think those sorts of things [policy] are not really a problem. [Male full professor]

At the undergrad [level], I can’t think of any [policies that are a problem]. [Male assistant professor]

Sometimes, the speed and certainty with which this response was given were a striking contrast to other questions in the interviews. As we have seen, there may be several explanations for lack of attention paid to policy. Some see the problems as too deeply rooted in ‘culture’ for policy to be of any use. Others assumed that if there were any problems at a policy level, someone else would know about them and fix them – surely, everything must be okay or it would have been fixed already. It is also a reflection of the tendency to externalize the causes of underrepresentation outside of the university, which occurred throughout the interviews (Beddoes and Panther 2016). Whatever the reason, it was clear that student-related policies were marginalized in the discourses that surround underrepresentation. Certainly, policy will not be the only answer, but there could be much to gain by starting to see it as a bigger piece of the puzzle.

**Discussion: situating these findings in the broader research landscape**

The marginalization of student-related policies makes sense in the context of the broader scholarship landscape. The fact that most discussion of policy focused on workplace policies rather than student policies is a reflection of the current and historical research and intervention landscape in two regards. First, it reflects the fact that policy has been explored almost exclusively in relation to female faculty and workplace policies. A large body of scholarship now exists on gender and workplace policies. In academia specifically, initiatives such as the U.S. National Science Foundation’s ADVANCE programs have been instrumental in raising awareness and funding such research (NSF 2016). It appears that research on gender biases in hiring, evaluation, and family leave policies or work–life balance policies has succeeded in raising awareness among faculty that workplace policies can either support or hinder gender equality.

Second, the marginalization of student policies reflects the fact that research on gender in engineering education has for the most part problematized female students, as opposed to institutional structures, faculty, or policies (Beddoes, forthcoming; Faulkner 2009; Mills, Ayre, and Gill 2010; Pawley 2013; Riley 2008). When self-efficacy and identity theory dominate the research landscape, critical questions about policy are less likely to be asked because the focus is on individual students. This tendency to ‘study down’ (Beddoes, forthcoming) normalizes institutions and helps to explain the lack of research problematizing student policies.

What researchers choose to study and the questions they choose to ask determine what we will have knowledge of and what we will not have knowledge of. To date, very few questions have been
asked about the role of policy in underrepresentation at the student level, but that does not necessarily mean that those policies are unproblematic. What then could be gained from turning the policy lens to student policies in the same way it has been turned on female faculty and workplace policies? Perhaps if the same amount of attention had been given to student-related policies over the last 30 years, my participants would have had more to say about them as well. Holloway et al.’s (2014) study is a striking case in point of a problematic policy that remained hidden until someone thought to question it.

Implications for policy

The interviews reveal that policy and culture are seen as separate, and policy is not readily thought of as a tool for addressing gender biases in undergraduate engineering education or women’s underrepresentation in engineering. Most often, policy was dismissed as a cause of or solution to underrepresentation. To the extent that policy did feature in the interviews, it was primarily related to female faculty, rather than students. The lack of focus on policy reflects a broader trend in the interviews whereby participants externalized the problem of underrepresentation as located not in undergraduate education. On the one hand, the small amount of attention paid to policy related to students is understandable. In many ways, policies are inadequate for addressing problems rooted in culture. On the other hand, to ignore, dismiss, or actively refuse to engage with policy as one piece to the solution of underrepresentation seems limiting and shortsighted.

There is much room for expanding and deepening how we think about the role of policy and taking a critical approach to questioning current policies as they relate to students. Beginning to think of policy and culture as two sides of the same coin wherein policies represent institutionalized culture or values would be an important step. If increasing recruitment and retention of women engineering students and improving their experiences in engineering education really are a priority, then there are policy changes that could be made. Blackman and Woods (2004) argue that policy is a combination of resources, evidence, and values. Although they are referring specifically to public policy, it is worth bringing increased attention to the relationships between policy and values (or ‘culture’ as participants labeled it) in engineering education, and asking what values our current policies support.

Certainly, policy change alone is not the answer. Indeed, there is historical evidence that policies and values are intertwined in ways that can undermine diversity efforts. Slaton’s historical studies of race and engineering education policy clearly show this (Slaton 2010). Thus, any policy changes that are made with the intent of increasing diversity in engineering should entail concomitant consideration of how the policies are related to and interact with the cultures and value systems into which they are introduced. Nonetheless, such challenges should not lead us to write off policy as a tool for greater equality in engineering education.

In order to support increased engagement with student policies, I offer seven examples intended to highlight a range of ways we could begin to make policy a larger part of the conversation. These examples are drawn from prior literature on the topic, findings from the interviews, and insights from other faculty members. Further research and intervention around each of these types of policies could provide important new insights into how policy can be used as a tool to promote the enrollment and retention of women in engineering.

Freshman admissions policies: The study on admissions policies mentioned above provides a compelling example of the unseen role that admissions policies can play in contributing to underrepresentation (Holloway et al. 2014). This study is a striking case in point of a problematic policy that remained hidden until someone thought to question it. Just because something has not been investigated, does not mean it is not a problem. What other policies are assumed to be fair but have simply not been investigated critically?

First-year programs and transferring into engineering: Another example of a way in which admissions policies could serve as a site of intervention comes from the research on the requirements of first-year engineering programs (Brawner, Orr, and Ohland 2014; Orr et al. 2012). These
requirements could hinder transfer into engineering, particularly by underrepresented groups who may not have had exposure to engineering prior to college. Alternative ways of entering engineering programs should be explored.

**Recruitment policies:** Prior research also provides evidence that expanding recruitment efforts beyond AP science and math courses can lead to the enrollment of female students who otherwise may not have enrolled in engineering programs (McLoughlin 2009). The effectiveness of similar strategies at other institutions should be explored.

**Attrition policies:** Attrition from engineering programs represents yet another site of potential policy intervention. Currently, most engineering programs have no policy in place to gather vital information from students about why they are leaving the program. Instituting such a requirement would produce knowledge about aspects of local cultures and practices that lead to attrition. Such institutional research would likely be most effective if it went beyond quantitative surveys with prescribed answers and allowed students who were leaving to actually speak openly, telling their stories about why they were leaving. One of my faculty participants discussed the need for such information gathering, although in a part of the interview not about policy explicitly.

**Full-time enrollment policies:** Yet another example concerns enrollment requirements. It has been suggested in conversation about this topic (by Alice Pawley, for example) that requiring full-time enrollment in engineering programs is a policy that negatively affects some students, such as working mothers, more than traditional and majority students. In that sense, it is a policy that is raced, classed, and gendered. Part-time enrollment options would allow students to major in engineering who otherwise could not, owing to work obligations, childcare responsibilities, financial cost, or other family obligations.

The final two examples are more faculty-directed and likely much more controversial than the prior five. However, resistance to such ideas is not an indicator of their lack of merit.

**Tenure and promotion criteria:** Policy change could be implemented for faculty tenure and promotion requirements. While likely to be met with kneejerk dismissal, it is possible to imagine tenure and promotion to require evidence of contribution to recruiting and retaining female students. As discussed briefly above, one professor did broach this idea in their interview, saying that it was the only way more women would be retained in engineering. Currently, recruitment and retention of female students does not feature in criteria for tenure and promotion at any institution I am aware of. That is a policy choice that inadvertently serves to promote the status quo. It may be wildly unpopular and personally risky to institute a policy requiring evidence of contribution to recruiting or retaining female engineering students in order to receive tenure, but that is not the same thing as saying it cannot be done.

**Hiring policies:** Likewise, it might seem far-fetched to suggest only hiring faculty who have taken or agree to take gender studies courses or trainings, but given the overproduction of PhDs and the large number of applications routinely received for open positions, it would be possible to do so if hiring committees valued knowledge from such courses. Another option would be to institutionalize incentives for yearly participation in such programs.

While these examples are certainly not exhaustive, the aim in presenting them is to prompt critical reflection about how current policies promote or mitigate biases and inequalities in undergraduate engineering education. Programs such as ADVANCE (NSF 2016) have contributed to our understandings of the ways in which university policies can negatively affect female faculty members, and we know now that biases permeate that system. The findings presented in this article show that these understandings have gained foothold in professors’ discourses of underrepresentation. But we now need to turn that lens to exploring policy issues that directly affect students.

**Conclusion**

The contribution of this article has been to highlight one way in which studying up could advance both the current state of engineering education and any field that struggles with issues of
underrepresentation. By adding critical examinations of policy to the research landscape, we move beyond the narrow focus on problematizing women that has been the dominant mode of inquiry. Any of the seven types of policies delineated in the Conclusion section presents avenues for future research. For instance, do recruitment and retention of women students increase at other institutions if admissions, first-year program requirements, or recruitment efforts change? Or, what longitudinal effects could be identified from requiring in-depth gender training for faculty members? There are no doubt many other policy research horizons that have yet to be identified. Again, examining policy is not the only type of studying up that is needed. As I have argued, it could be a step in that direction. This article joins a growing list of others conducting research that moves away from studying down (e.g. Cech, Waidzunas, and Farrell 2016; McClelland and Holland 2015; Pawley 2013; Walden et al. 2016) that may represent the beginning of a shift ‘up’ in the research landscape.

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References


Hatfield, Stefano. 2014. "Where are All the Female Engineers?" The Independent, June 29.


