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# Professors' Discourses on Why Underrepresentation Matters

Kacey Beddoes  
University of Massachusetts Lowell  
kacey\_beddoes@uml.edu

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## CONTEXT

While much scholarship has explored the causes of women's underrepresentation in engineering, very little has explored why certain groups of stakeholders care about underrepresentation in the first place. Arguments for increasing the numbers of women in science and engineering tend to fall into several clearly identifiable and recurring discourses, including equity or social justice, workforce concerns, legal concerns, "access and legitimacy" concerns, and economic competitiveness concerns. However, nearly all prior research on this topic has been based on written documents. In that sense, sources are 'closed' to further inquiry about authors' thoughts or motivations. What happens, then, when such questions are posed in interviews in which participants are asked to explain or justify the discourses they engage about why underrepresentation matters?

## PURPOSE

The research question addressed in this paper is: Do engineering professors believe that women's underrepresentation in engineering is a problem that needs to be fixed, and, if so, why does it matter?

## APPROACH

In-depth interviews were conducted with 39 engineering professors at three different institutions in the United States. Among other questions, participants were asked if they thought underrepresentation was a problem, and if so, why. Responses to that question underwent open, and then axial, coding, resulting in three categories of discourses.

## RESULTS

By far the most common discourse, with 35 participants mobilising some version of it, was the idea that increasing the numbers of women in engineering would lead to 'better engineering' in some way. However, follow up questions revealed that this discourse is in need of further interrogation. The other two discourses engaged were a social justice discourse, and that underrepresentation actually is not a problem that needs to be fixed.

## CONCLUSIONS

The discourse of 'better engineering' warrants further critical reflection. The finding that some participants do not understand why underrepresentation matters can provide insight to those working on change efforts by highlighting issues that they should address in their work.

## KEYWORDS

Staff, Professors, Underrepresentation, Discourse

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## Introduction

Rationales for increasing the numbers of women in science and engineering tend to fall into several clearly identifiable and recurring discourses, including equity or social justice, workforce concerns, legal concerns, "access and legitimacy" concerns, and economic competitiveness concerns (Beddoes, 2011; Lucena, 2005; Pfatteicher & Tongue, 2002; Slaton, 2010; Thomas & Ely, 1996). At various times, legal, economic, and social justice discourses have each been engaged, with economic competitiveness ones being more common than social justice ones. The various discourses mobilised led to different outcomes and had different levels of "success," indicating that the way in which underrepresentation is problematized shapes the solutions enacted and what they accomplish (Slaton, 2010).

The body of scholarship summarised above is based on written documents. In that sense, the sources are "closed" to further inquiry about authors' thoughts or motivations. What happens, then, when engineers are asked about these issues in person? To answer that question, engineering professors were asked if they thought women's underrepresentation in engineering was a problem, and if so, why. This paper presents findings from those interviews.

## Methods

Semi-structured interviews were conducted with 39 engineering professors at three different public institutions in different parts of the United States (18 women and 21 men) in 2014 and 2015. The interviews averaged 60 minutes in length and were audio-recorded and transcribed. They were conducted in-person, except for two that were conducted via Skype. Interviewees were a mix of Assistant, Associate, and Full professors and from all major engineering disciplines. Several interviewees also held administrative positions. Seven identified as Asian or Asian/white, two identified as Black, two identified as Indian, and the remaining twenty-eight as White. Ten different nationalities were represented. 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, 2015).

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 professors think about gender in engineering, women's underrepresentation in engineering, and how they make decisions around gender in their teaching. This paper presents findings from one question posed at the beginning of the interviews. Participants were asked if they believed underrepresentation was a problem, and if so, for whom it was a problem, or in other words, *Why does it matter that women are underrepresented in engineering?* All responses to that question were analysed with an open coding approach (Charmaz, 2006) through which the three primary themes identified in this paper emerged. Many participants mobilised more than one discourse, which is reflected in the numbers given at the beginning of each subsection below. In recognition of the diversity of participants, they are identified with numbers in this paper, so as to avoid any implication of cultural or national origins that pseudonyms can imply. Quotations were edited to remove false starts, stammers, and "crutches of speech," such as "like" and "um." Words in square brackets were added for clarity.

# Findings

## Better Engineering

The most common discourse, with 35 participants mobilising some version of it, was the idea that increasing the numbers of women in engineering would lead to better engineering in some way. For the purposes of this paper, five versions of this idea were subsumed within the “better engineering” category:

- 1) engineers should be representative of the people they serve;
- 2) diversity brings more creative and innovative design ideas;
- 3) we want the best brains working on engineering problems;
- 4) having more women on teams leads to better environments or team dynamics, and
- 5) economic competitiveness.

These ideas are similar to what has been called elsewhere “access and legitimacy” (Thomas & Ely, 1996), “economic competitiveness,” “professional service and representativeness,” and “women’s attributes” (Beddoes, 2011). Each of these is a somewhat different perspective warranting its own analysis in future work, but, given space allotted, they are categorised as “better engineering” herein. The following response from P5 is representative of many answers in this category:

*Fifty percent of the population that we design, build, and maintain things for are women, but 80 percent of the engineering, well actually more than that in many cases, are men designing things the way that they perceive them. That’s going to be a natural bias towards designing things more male-oriented than for the population as a whole.*

What is most interesting about the “better engineering” discourses however, and what has not been revealed in prior research based on document analysis, is what happened when participants were asked follow-up questions. The first follow-up question was if they could give me examples of how women in engineering have or would lead to better engineering. For various reasons and given the nature of semi-structured interviews, not every participant was asked these follow-ups. But of those who were, not one participant could provide an example. When asked this question, one of three things would happen: 1) They would say they had no examples; 2) they would give a response that did not actually provide an example of what they had just said; or 3) they would “backpedal” and start talking about something else entirely. Providing a sense of these responses is difficult here given space constraints, but the following exchange with P33 is one example. She does not provide examples of women in engineering but instead shifts to discussing interdisciplinarity:

*Interviewer: Could you talk a little bit more about examples you’ve seen of how diversity breeds creativity or innovation?*

*Interviewee: I’ll give you examples of things to think about in the lab. My students, we spend upwards of five years working together on a project. Right about the third year, we’re all thinking the same because they’re all thinking like me because I’m training them, and that becomes difficult for us to see solutions to problems that we run into in the lab. We think everything is perfectly fine until we go to a conference or we talk to another colleague, who is completely outside our realm, who goes, “But why that?” So, that’s an easy example of how you see diversity of thought bringing creative solutions to a problem. Things that we couldn’t think about based on our expertise, somebody just outside of our field can look at it and say, “Well, this sounds like this.” And we go, “Oh, my God. You’re right.” So, that’s an example that you see in scientific research.*

In a similar way, P21 shifted her discussion to examples from finance rather than engineering:

*I can't think of a specific example. I've never worked outside academia. I've always been in science, science and engineering, like academic. I think the example from the financial sector that I just mentioned, that's one where diversity works. I have heard from rehab design teams, when you're trying to design a technology that you should be a little diverse, but I don't have any specific examples.*

The other follow-up issue I attempted to get participants to talk about was if they thought “diversity” was able to be expressed or manifest in current engineering cultures or classrooms. Prior literature suggests that it often will not be. While a couple of participants said “No,” most participants to whom this was asked did not understand the question.

## **Social Justice or Equity**

The second most common discourse, with 15 participants mobilising it, was essentially a “social justice” or equity discourse. Only one participant actually used the term “social justice” when answering this question, but several types of responses conveyed ideas that can most succinctly be categorised as social justice arguments. Within this category of social justice, there were two distinct lines of reasoning. The first was essentially that everyone should be free to choose the best career for him or herself without being influenced by gender stereotypes or biases. As P1 explained:

*I think it matters in a sense that it's important to live in a world where people feel like they can pursue whatever career path makes sense to them. And so if there are barriers that are preventing women from entering engineering based on the culture that makes them feel unwelcome or other issues like that, that's a big deal.*

P11 expressed the same idea, saying:

*I don't think all women have to be engineers, but I think they have to have been given the chance to decide for themselves and not to be turned away from it due to things like, “Oh, I don't want to be viewed in a certain way,” or that they had bad experiences from a math teacher or from certain interactions.*

The second line of social justice reasoning was that engineering is a highly paid profession and excluding women from highly paid occupations is unjust. For example, P17 said:

*I think that women need access to choices and professions where you can make a solid living for their own independence and their own choices in life. I think that engineering, for whatever reason, pays very well and has some career satisfaction in it for people if it fits them.*

While she did not think it was the most important reason, part of P18's response was that “engineering is fun and creative but also very financially rewarding as well, and if we're excluding large swaths of a population, fifty percent, from these activities, then it has certain ramifications. The financial ones are pretty clear.” The one participant who used the term “social justice”, P24, said:

*There's sort of a...for want of a better phrase, I guess I'll say a kind of moral or social justice kind of issue...It's a, relatively speaking, lucrative profession – there are some that are more lucrative – but everybody should have a shot at it, so there's all of those aspects.*

However, P24 then went on to say that she thinks economic competitiveness arguments are more compelling to engineers than social justice arguments are:

*In some sense, the same thing from a different perspective is if I want to do the best job of providing a skilled workforce for the United States, I don't want to say, “Okay, I'm going to exclude 50 percent or 70 percent of my talent pool from the group I'm trying to train.” That just doesn't make any sense...And okay, well, if you're not adequately and effectively educating*

*your entire population, you're going to suffer economically. I like those arguments, because it separates out any kind of amorphous social justice kind of arguments. It's just business, you know? If you're not really utilising your talent pool, somebody else is going to beat you...If I'm arguing an issue like that, I find the quantitative arguments are better at defeating perspectives on what's morally correct.*

Whether or not quantitative, “business” arguments are in fact more compelling is a question that warrants further research.

## **Underrepresentation Is Not a Problem that Needs to be Fixed**

After social justice, the third most common response was that it actually does not matter that women are underrepresented in engineering, or that participants were not sure if or why it matters. Fourteen participants expressed some version of this idea. More specifically, the versions of this idea were:

- 1) If choices are made on a level playing field, then underrepresentation is not a problem;
- 2) Diversity of thought matters but that is not related to underrepresentation of women;
- 3) I am not sure that it does matter; and
- 4) The world does not need more women doing what engineers do.

Four was a unique perspective expressed by only one participant.

Some participants said that underrepresentation is only a problem if choices are not made on a level playing field. For instance, P6 and P13 related their responses back to the social justice discourse, explaining that once people are free to make choices within an equal playing field, then it actually does not matter if far fewer women than men choose engineering:

*P6: If it matters, I think it matters for my daughter, for example, not to say that “No, I can’t do it [engineering] because there isn’t one [a female engineer] or because women don’t do that [engineering]. So I think from that side it does matter. I think after we’re old enough and we’re all here, I don’t think it really does [matter].*

*P13: I actually often have that question as well. Why are we so concerned? We need everybody in society to take on different roles, and if some women want to do engineering, let them do engineering, but a majority don’t. So what? They’re going to do other wonderful things. So I often wonder why we push this, and I think for me I just want to make that opportunity available for women, not to say you have to be an engineer, but to make it an option.*

Other participants said that diversity of thought is important for engineering, but that diversity does not necessarily come from bringing more women into engineering. As P34 put it, “I think gender is a poor proxy for diversity of thought.” These explanations were similar to the “better engineering” discourse then, except the difference was that these participants did not think better engineering would necessarily come from women.

P23’s response reveals how some participants struggled to answer the question, interspersing some reasons while simultaneously questioning whether or not underrepresentation does in fact matter:

*These are good questions, because as you say in your consent form, it helps me to think about what my actual position is. As I say, I haven’t really thought about things so much. So is it [underrepresentation] a problem? I’m hesitant to just say “Yes” outright...I don’t know the answer is necessarily “Yes.” I mean, it’s certainly good to have a diversity of opinion. And it’s always good for women to know that they have that opportunity. But if, for example, it was suggested that women chose not to pursue this in general, if once all the other factors were taken out there was still some bias, would that necessarily be negative for engineering, the*

*actual engineering itself? I don't know. The engineering culture probably would be beneficial to have women in. But in terms of actually getting things done, it wouldn't necessarily, in principle be. I don't know. That's a difficult question to answer.*

P35 was more certain that it does not matter:

*I don't necessarily think it's a problem. I'm trying to search for why it would be a problem. I can't see why it would be a problem necessarily. Maybe – I have all these caveats – maybe that's the man thinking or something. I don't know. But I just don't see it as a problem and I do believe individuals should do what they feel like is going to be fulfilling to them.*

While not espousing this idea themselves, two participants mentioned that they often hear colleagues saying underrepresentation does not matter.

P10 was an outlier who was critical of engineering and its role in the world, specifically its ties to the military-industrial complex. He said that we probably do not want more women (or people in general) participating in that system:

*I actually have some questions about why would you want to change it [underrepresentation]. So is that something that's valuable to the female students that'll go off and do it, is that a good thing to direct their lives towards participating in that system? Or is it maybe better to have them for themselves go off and do something different than solve problems using science and technology, which is how I define engineering. So I'm not sure if it [increasing the numbers of women in engineering] is what needs to be done or what anybody wants to be done. I'm not sure.*

This participant was the only one who expressed such fundamentally critical views about engineering. Before moving on, it may be worth remembering here that these are the people who cared enough to take the time out of their schedules to participate in an interview about gender, so the fact that so many within the sample population did not necessarily think underrepresentation was a problem was surprising.

## **Discussion and Conclusion**

The first finding to note was that the discourse most often mobilised – better engineering – was done so without there being evidence or examples to support it, and without recognition of the ways in which minority voices are often not heard in engineering. We can call the idea that simply adding women, or other minorities, to engineering somehow changes engineering the “myth of bodily diversity.” As one of my participants put it, “gender is a poor proxy for diversity of thought.” A facile belief in bodily diversity necessarily leading to “better” engineering is a problem because those who study engineering cultures, both in education and practice settings, continually find engineering to be dominated by masculine cultures in numerous ways (Faulkner, 2009; Mills, Ayre, & Gill, 2010; Mills, Franzway, Gill, & Sharp, 2014; Riley, 2008; Tonso, 2007), and we know from teams research that women’s voices and ideas are often ignored, or not “heard” (Beddoes & Panther, 2017, In Press; Meadows et al., 2015). Such realities are obscured in the “better engineering” discourse when it does not account for cultures and practices in male-dominated environments.

A second finding of note was the prevalence of social justice discourses. Other researchers have observed a decrease in the use of social justice arguments since the 1980s (Etzkowitz, Fuchs, Gupta, Kemelgor, & Ranga, 2008; Lucena, 2005; Roberts & Ayre, 2002; Slaton, 2010). Their prevalence in this study is noteworthy then in contrast to engineering education publications, where social justice arguments are scarce (Beddoes, 2011). The findings also suggest that social justice arguments may be more compelling to at least some engineers than is often assumed, despite the fact that they have lost ground in favour of economic competitiveness arguments. As noted, however, one participant did believe that social justice

arguments are not compelling to the engineering community and that she strategically chooses not to use them for that reason.

A third finding of note was that almost the same number of participants who engaged a social justice discourse said that the lack of women in engineering was not a problem in need of correction. Given that this was a population who chose to take time out of their schedules to participate in an interview about gender and engineering, it is reasonable to assume that the percentage of those who do not think underrepresentation is a problem is much higher among the entire population of engineering professors. Before changes to make engineering education more inclusive gain widespread support, it would seem that much work first needs to be done to convince more professors that underrepresentation is a problem.

Asking engineers if and why they think underrepresentation is a problem allowed deeper insight than has been gleaned from document analysis alone. It revealed that although variants of the “better engineering” discourse were readily mobilised, follow-up questions were met with an inability to provide examples or evidence for that discourse. Furthermore, it seems scant attention is given to thinking critically about the ways engineering cultures may inhibit diversity. On the other hand, social justice discourses emerged as more prevalent than may have been expected based on prior document analyses. Many participants were also willing to say that they do not understand why anyone should care about underrepresentation, or, more strongly, that they actually do not think it is a problem. Further research into how engineers think about women and gender in engineering may present one important way forward for those who do wish to increase women’s representation in engineering. Deeper understandings of the relationships between framings of a problem and interventions designed to address it can shed light on these trends.

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