



"Engineering beats you up": Problems with relying on the bell curve

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“Engineering beats you up”: Problems with left-of-center grading Research Paper

Abstract

This research calls attention to the negative impacts of *left-of-center* grading on female engineering students. We define *left-of-center* grading as a specific norm-referenced (i.e., curved) grading practice where the exam median grade is below 50%. We interviewed 83 engineering students, faculty, and professionals about their perceptions of *left-of-center* grading. Our results indicate that *left-of-center* grading is common in the engineering curriculum, with all but three participants reporting direct experience with the practice, and that female students are significantly more likely than their male peers to find the practice discouraging. While many participants stated that left-of-center grading motivates and challenges students, they overall cited more cons than pros to the practice, noting that it makes students question their competency, causes stress and frustration, and focuses student attention on the system rather than on their own learning. Many participants equated the practice with teachers who do not care about their students. More research is needed to understand how engineering faculty can encourage healthy competition, challenge students, and ward off grade inflation without engaging in practices that discourage otherwise successful students.

1. Introduction

We'll have like a 30 percent average [on exams]....When you take the exam, it makes you feel horrible. You come out of there like, “I answered a fifth of that right, at most.” It's sort of like, “Well, gee, what did I learn? What did I spend all of last night studying? I come in here, and it just goes horribly wrong.” You feel—yeah, **you feel like you didn't master the material, you didn't learn it, you kinda, you feel like you dropped the ball** (*Female Hispanic student, Research I private university, Bioengineering*)

Almost all my classes [have exam averages below 50]. The class average would be a 40, but in actuality, I guess we would get a B or something... **I feel like if the entire average is a 40, then obviously the professor's doing something wrong, or that he's not teaching the way he should be, if our entire class doesn't understand it.** (*Female Asian student, non-Research private university, Mechanical Engineering*)

The quotations above reflect a common experience for engineering students: norm-referenced grading (or grading on a curve). Norm-referenced grading has often been linked to problems of retention in engineering and other STEM fields. In their widely cited study on why undergraduates leave the sciences, Seymour and Hewitt attribute norm-referenced grading to creating a competitive atmosphere where students are pitted against one another—an atmosphere that alienates many otherwise capable students[1]. Individual engineering faculty have likewise spoken out against the practice for fostering a competitive atmosphere that discourages students from developing the collaboration competencies ABET now requires [2, 3]. The popular press also links norm-referenced grading to STEM retention, with *US NEWS and World Report* claiming that “Nearly half of all students who begin studying for a STEM degree switch majors [...]. ‘Weed-out’ classes, curve grading and a lack of faculty involvement are to blame” [4].

Educational research is likewise critical of norm-referenced grading. Covington describes a study in which undergraduate psychology students in a “mastery” group, where grades were based on clearly defined criteria, had substantially higher test scores and confidence levels than students graded on a curve where there was competition for high grades. Covington claims that the absolute standards created a sense of fair play that resulted in students in the mastery group studying harder than those in the competitive group [5]. Other researchers have found that the competitive atmosphere of norm-referenced grading encourages maladaptive learning strategies such as failure to seek help, cheating, and avoidance of new learning challenges [6]. In reviewing this research, *The Handbook of College Science Teaching* concludes that the practice of grading on a curve is problematic and should be avoided [7].

Yet, despite this criticism, the practice of norm-referenced grading remains prevalent in STEM education [7]. The most common arguments given in support of norm-referenced grading is that it helps prevent grade inflation by limiting the number of high grades [8, 9]. Many faculty moreover believe that such grading policies will motivate students to push themselves because true excellence is rewarded, although such claims have been questioned by educational researchers [5].

Rewarding true excellence and limiting grade inflation are worthwhile goals and norm-referenced grading can help instructors reserve high grades for the truly deserving. Yet, not all forms of “curving” or adjusting grades are the same. Imagine a large class in which an instructor gives a challenging exam: the best score is in the low 90s with a few scores in the 80s and the majority of students scoring in the low 70s. The instructor may adjust grades so that a student who scored a 70 now receives a C+ . Now imagine an instructor who continually gives exams where the best score is near 50 and most students score in the 30s and low 40s. This instructor adjusts grades so that a student who scored 40 now receives a B. This second instructor may have an identical grade distribution to the first, awarding comparable numbers of As, Bs, and Cs. But we argue that these two practices send very different messages.

This essay examines the latter practice, which we term *left-of-center* grading to distinguish it from other forms of norm-referenced grading. *Left-of-center* grading refers to a pedagogical philosophy where an instructor deliberately creates an exam with a median grade below (i.e., left) of 50%. *Left-of-center* grading refers to a deliberate pedagogical strategy and should not be confused with an instructor who accidentally creates an exam that is too hard.

We became interested in *left-of-center* grading through an unrelated project on gender and communication in engineering. During the course of our interviews, we frequently heard complaints about tests with medians as low as 20. Curious, we began systematically asking our interview subjects about the pros and cons of this grading practice.

Since adding this question to our protocol, we have interviewed a total of 83 engineering undergraduates, professional engineers and faculty. Our study adds to research examining competitive grading practices in engineering in that we focus our insight on a very specific grading practice (e.g., *left-of-center* grading) and we include the perspectives of individuals who have had successful, long-term careers as engineering professionals or faculty. These individuals certainly have the wherewithal to succeed as an engineer and their voices cannot be as easily

dismissed as representing the viewpoints of those who are not “cut out” for the engineering profession.

Our research also specifically examines the impact of *left-of-center* grading on women versus men. Women tend to leave engineering at higher rates and with higher GPA's than their male counterparts and often cite poor teaching, intimidation, and loss of confidence among their reasons for leaving [10, 11]. Research also suggests that women are more likely to have a mastery orientation (e.g. a focus on learning rather than outward appearances) to course material that is at odds with the performance-based, competitive orientation fostered by norm-referenced grading [12]. It is reasonable to hypothesize then that women may find *left-of-center* grading more frustrating and confidence-shaking than men. Our study focuses on the perceptions of this vulnerable population to a grading practice our interviewees claim is common in the engineering curriculum.

2. Methods

2.1 Participants:

Eighty-three participants were interviewed for this project, including 27 faculty (16 female; 11 male), 24 professionals (19 female; 5 male), and 32 students (19 female; 13 male). The high proportion of female participants is due to the original purpose of our interviews, which was to study gender and communication in engineering. 57% of our participants were White, 20% African American, 16% Hispanic, 4% Asian, and 4% Native American. Over half of the students were seniors (n=19) with the rest juniors (n=8) and sophomores (n=5) from a range of public and private Research I and Research II universities.

Participants came from a range of engineering disciplines, with the most heavily represented fields being Mechanical (n=20), Civil (n=16), Chemical (n=15), and Electrical (n=9). All participants were native English speakers or spoke English as well as (or better than) their native language.

All professionals and all but two faculty had at least five years of experience, with a median of 17 years of experience for both groups. All professionals and faculty had received their degrees from American or British universities. Professionals worked in a variety of sectors, including small private companies, large public corporations, and government. Faculty taught at a variety of public and private Research I and Research II universities.

2.2 Procedures:

As part of a much longer interview protocol, we described the practice of faculty who routinely create exams where the highest score is 50% or lower. All but one student (a sophomore) and two faculty had direct experience with the practice. We then asked participants to reflect on the pros and cons of this practice and asked them about their personal feelings about *left-of-center* grading. Faculty participants were also asked to comment on their own philosophies of exam creation and grading. Participants received an honorarium for participating in the interviews and all IRB procedures at participating institutions were followed (IRB: HS12-318).

2.3 Analysis:

Interviews were analyzed using MaxQDA qualitative software. Each participant's response to the questions about *left-of-center* grading was coded as definitely perceiving the practice as a problem, not seeing it as a problem, or having mixed feelings about it. We then coded the reasons they provided, identifying trends in the responses.

Since the interviews were open-ended, the numbers we report reflect topics that naturally emerged from the conversation. These numbers are therefore not as high as they would be if participants had specifically been asked to comment on all of the topics. In other words, the fact that an interviewee did not mention a particular concern or issue does not mean that they do not share that concern.

3. Results

3.1 Students' and Professionals' Perceptions

Table 1 shows that female students and professionals were significantly more likely than their male counterparts to perceive problems with exceptionally low test grades that were then substantially curved, $\chi^2(2) = 8.72, p < .05$. Over half of the women interviewed indicated being bothered by this practice, compared to less than 20% of the men.

Professionals of both genders were more likely to have mixed attitudes about *left-of-center* grading practices than students. However, female professionals were still more bothered by this practice than their male colleagues, with nearly half recounting substantive negative reactions, even years after leaving school.

Although our results are too small to make meaningful comparisons among ethnic groups, we did find that Hispanic women were the group most bothered by *left-of-center* grading, with over 70% ($n=5/7$) reporting that this practice has more cons than pros.

Table 1: Proportion of students seeing *left-of-center* grading as a problem

<i>Gender</i>	<i>Definitely problem</i>	<i>Mixed</i>	<i>Not a problem</i>
Female			
Students ($n=19$)	63% ($n=12$)	16% ($n=3$)	21% ($n=4$)
Professionals ($n=19$)	47% ($n=9$)	37% ($n=7$)	16% ($n=3$)
All ($n=38$)	55% ($n=21$)	26% ($n=10$)	18% ($n=7$)
Male			
Students ($n=13$)	15% ($n=2$)	23% ($n=3$)	62% ($n=8$)
Professionals ($n=5$)	20% ($n=1$)	60% ($n=3$)	20% ($n=1$)
All ($n=18$)	17% ($n=3$)	33% ($n=6$)	50% ($n=9$)

3.2 Faculty perceptions

The faculty data is more challenging to interpret. When we asked faculty if they had ever experienced this grading practice, they often answered whether they had *taught* a class with this grading practice. Not only did faculty naturally gravitate to a discussion of their teaching

practices rather than their experiences as a student, they may also have felt vulnerable by discussing their practices.

Table 2 shows that nearly 60% of the faculty we interviewed found *left-of-center* grading to be a problematic pedagogical practice, and only a small minority (n=3) reported using this practice themselves. In contrast to the male students and professionals, male faculty were surprisingly opposed the practice, with 73% describing it as a problem. This result likely reflects a selection bias in our sample: the men we interviewed were individuals who volunteered for a study on gender and communication in engineering, and consequently may not be representative of their peers. Tellingly, some of the male faculty we interviewed stated that they began their teaching careers employing *left-of-center* grading, but revised their practice after seeing how troubling it was to some of their students.

Table 2: Proportion of faculty seeing *left-of-center* grading as a valid pedagogical practice

<i>Gender</i>	<i>As pedagogical practice</i>			<i>Use themselves*</i>	
	<i>Problematic</i>	<i>Mixed/unclear</i>	<i>Not a problem</i>	<i>Yes</i>	<i>No</i>
Female (n=16)	50% (n=8)	25% (n=4)	25% (n=4)	14% (n=2)	86% (n=12)
Male (n=11)	73% (n=8)	18% (n=2)	9% (n=1)	9% (n=1)	91% (n=10)
All (n=27)	59%(n=16)	22%(n=6)	19% (n=5)	12%(n=3)	88%(n=22)

* Two faculty (both female) did not answer this question

3.3 The cons: Problems cited with *left-of-center* grading

3.3.1 *Left-of-center* grading makes students question their competency

Overall, 30% of the students and professionals we interviewed complained that *left-of-center* grading sends a message of failure, even when the final grade after the instructor's curve is acceptable. These individuals express a strong belief that exams should reflect what they have learned in a course and were bewildered by the thought that a grade significantly below 50 could signify success:

If you fail every exam, you pass with a C. I was like, "That makes no sense. **How do you pass a class and not understand any material?**" (*Female White student*)

No matter how hard you study you're still—the exam tells you that you're still only understanding 20 percent of the material, which is frustrating. It's not necessarily about grades, because you can get a 40 percent and still get an A, so it's not really about the grade, but.... **you feel like you're failing even if you get an A on the exam.** (*Female Native American student*)

I also feel like I'm not really learning anything because if that grade is on a curve, then okay, maybe I'll get an A or B. If I get an A, I still feel like I haven't learned anything. If I need to use this material in another class then **how does it really help me if I got an A but didn't learn anything?** (*Female Asian student*)

You don't feel like you learned it. I mean you get 50 percent on a test, and you get an A, I mean **that's horrible because there were so many others that you didn't get right.**

(Female African American professional)

I ended up with over a 3.6 GPA, so I obviously didn't do that bad, but there were a lot of tests that I would end up like leaving in tears, frustrated...It makes you feel like, **"Why am I in engineering school? I don't understand what I'm doing. I'm not learning anything."** *(Female White professional)*

To me if I made a 30, **even if the 30 is the highest grade in the class, I still failed.** I think it's very demoralizing *(Female White professional)*

You know, it was always very frightening the first time you got a 62 on a test, and you found out you still got an A, and you go, **"But that's just wrong! I mean why would you give us a test that nobody's ever gonna pass?"** Yeah, it is very frustrating. *(Female White professional)*

Even if it's curved, I—"Did I learn anything if I made a 16?" *(Male African American professional)*

These students and professionals find *left-of-center* grading antithetical to a sense of mastery of the material. Common words to describe this practice included "frustrating" (used 31 times in the student and professional interviews); "discouraging" (used 14 times); and "demoralizing" (used 10 times) with some describing the practice as "traumatic," "humiliating," and a "nightmare."

These students evidence a mastery orientation to learning: they expect tests to measure what they have learned and internalize the messages of failure that these low grades appear to suggest. Many of the engineering faculty we interviewed agreed with students that tests should reflect a mastery of the material:

I can't imagine why anybody would think that that was a good plan for giving tests. I teach statistics. **How can a 30 be representative of the knowledge that you're supposed to learn?** *(Female White faculty)*

I don't know why it exists. I disagree with it because **even a smart student who does well with a 50, I just think it's—there's no feeling of satisfaction that you've learned something.** *(Male White faculty)*

You don't want to see that everybody doesn't know half the material that you taught... If your average is 50, then you need to change how you're teaching or what you're testing. You can still spread the students fine without cutting half of them down. *(Female White faculty)*

3.3.2 Students do not know their grades in the course until the end

The frustration many students experience with *left-of-center* grading can be greatly compounded when instructors do not fully share details of their grading system with students. In fact, several students told us that *left-of-center* grading is fine only if the instructor tells them early whether or not grades will be curved. Approximately 15% of the students and professionals we interviewed

told us about situations where they had been in the dark about what their grades were in a particular class, with some not knowing if their grades would be curved at all.

My freshman year, I freaked out because **you don't know that it's all a curve**. You just don't realize. You think, "I'm at a 50. I'm gonna fail this class." It made me feel terrible freshman year. (*Female White professional*)

It is very frustrating. It is because **you don't know what your grade's gonna be**... You never knew where that was going to fall. (*Female White professional*)

"Why do you give us bad grades and then boost 'em?" **You feel bad for the whole year, and then you feel good one day, when you get your grades**. That doesn't seem to make sense. (*Male Hispanic Student*)

This lack of information about grading policies clearly causes stress and can lead to ill-informed decisions about whether to drop a class or stay enrolled. In fact, many students who did not mind *left-of-center* grading specified that the practice was only acceptable if instructors are up front about their grading practices. As one student explained, grades can be a mystery for students in the middle of the bell-curve who do not know until the end of the semester whether the professor will curve a little (allowing most students to barely pass the course) or will curve a lot. One professional even told us of a class that he dropped due to low grades only to realize later that if he had stayed, he would likely have received a B. Such lack of transparency about grades may inadvertently privilege students who have well-developed networks that can provide them with information about a given instructor's grading practices.

3.3.3 Left-of-center grading encourages a focus on the system rather than the self

Educational research suggests that norm-referenced grading encourages students to focus on arbitrary rewards rather than the personal satisfaction of learning [5, 6]. If students' grades are based solely upon performance relative to others, then working to lower others' performance is as likely a path to success as working to improve oneself. This point is reinforced by the case of a class at Johns Hopkins' university in which all of the students refused to take an exam, earning zeros, which translated into As for the entire class [13]. We see evidence of a similarly externally oriented mindset in several of our interviews:

[After describing how one of her classmates turned in a blank final] We were just like "Holy cow!" **The curve for that was quite high to make up for it** (*Female Asian student*).

The incentive then is to have a big party the night before the test **so that nobody will study**. (*Female White faculty*).

If the exam is so tricky that even people that studied are only getting 50 percent, **there might be someone who gets lucky** and might also get near a 50 percent, cuz basically nobody got it. (*Male African-American Faculty*)

Many students who did well attributed their successes to other's poor performances rather than their own competence. They saw their good grades as arbitrary (and undeserved) outcomes of the system:

Sometime it feels like I don't know if they're teaching it correctly or if I'm not doing enough work. My reaction is usually—I usually feel like I just don't know anything, and I'm just going through the motions, and **my grades are fair just because of a curve** (*Female Hispanic student*)

The pros—I guess you can get good grades for it....**if you're lucky** (*Female Asian student*)

The pros [of *left-of-center* grading] are you end up getting **a grade that you probably don't deserve**. (*Male African American professional*).

These student quotes coincide with other education research finding that when rewards are very scarce, failure tends to be interpreted as personal incompetence and success as a result of chance or good fortune [5].

According to the individuals we interviewed, some faculty encouraged this focus on the system by explicitly valuing a normal distribution over student learning:

There were professors who would come in and say that. It's like, "I don't care if all of you get 100. Some of you will get B's and some of you will get C's and some of you will get A's." **We're like, "Time out. What if we all get it right?" "Nope, that's how I grade."** (*Female White professional*)

Another student told us of a team project on which her instructor clearly indicated that the group's work was "definitely A material," only to receive a B because their grade of 90.5 fell below the normal distribution cutoff for an A. The instructor told the group he was surprised by their grade but was worried about administrative repercussions for awarding too many As.

3.3.4 Left-of-center grading is equated with uncaring teaching

Over 20% of our participants explicitly equated persistent *left-of-center* grading with poor teaching practices, interpreting across-the-board low grades as evidence that an instructor does not care:

He's just been teaching for so long, **he doesn't even care about the students** as a person or if we're willing to succeed or fail. It's like, "Oh, well. I've been doing this for 50 years it doesn't really matter to me. You're just another student." (*Female Asian student*)

Basically, if the entire class is getting a 50 that means that the teacher isn't teaching it or the students aren't understanding it. That's the biggest problem with it: **there's an underlying issue and instead they just pass you**. (*Male White students*)

Others attributed more insidious motives to instructors:

The reason they make it hard, **I think part of it is ego**. When they say that they have the hardest class, I certainly think that that plays a factor. (*Male Hispanic student*)

Some professors just have the attitude of I'm gonna show everybody that they don't know anything, **or I know more than they do.** (*Male White Professional*)

Some professors love making exams that are too hard, because **it makes them feel smart**, which is ridiculous. (*Female White Faculty*)

3.4 The pros: Benefits cited with *left-of-center* grading

3.4.1 *Left-of-center grading distinguishes among students*

Those participants who defended *left-of-center* grading challenged the assumption that test grades should reflect a student's mastery of course content. For these individuals, the purpose of an exam is to distinguish among students, and low scores on an exam simply reflect the difficulty of the exam, not the competency of the individual taking it:

The numbers matter only in relation to how you did in relation to others....The number really doesn't matter very much. **It just means that of what was put down on this paper, you were able to do 55% of it....I think students put an inherent judgment in that number which isn't there.** (*Female White faculty*)

Exam grades, first of all, don't reflect what you've learned. A lotta professors realize that exams aren't students' best way of showing what they know. That's why, in certain classes, they're trying to tweak it so it's not really so exam-centric. (*Female African American student*)

As long as I don't—like, I don't really care if I get a 50, if everyone got a 50. Then that means I'm not doing anything bad. It just means the test was hard. If there are some times where, if I got a really good grade, like if I got a 90, that doesn't mean I learned the material any better. **It just means the test was easier.** (*Male Hispanic student*)

For such individuals, exam grades are a sorting mechanism rather than an attempt to measure student learning.

3.4.2 *Low grades motivate students*

The most frequent comment in favor of *left-of-center* grading was that it motivates students: over 20% of students and professionals mentioned motivation as a “pro”

Since I came to [University X], I had to learn how to develop my study skills and learn material properly, which it was a **great learning experience just because I was seeing so many low grades on my assignments and was just very frustrated with it and wanted to get better.** (*Male African American student*)

It leaves more room for improvement, and **if there is more room for improvement, people will, probably, improve more** (*Male Hispanic Student*)

I mean you have to really lift yourself up after making a 30 on a test. It actually can sometimes **fuel you to do better the next time** (*Female African American professional*)

It's sort of a **wakeup call** to sort of pay more attention in class, (*Male White Professional*)

Yet, consistent with other research demonstrating that scare rewards can be de-motivating [5], many of our participants found *left-of-center* grading made studying seem pointless:

It was very demoralizing to get 30s out of 100 for three years, every single test, every class. What that does is it kinda gives you this feeling of **it doesn't matter how hard you try. You're always gonna get around the same score.** (*Male Hispanic student*)

Some students I think are motivated by it, but other students are like: "Okay, so next time I realize that the A cutoff ended up being at 49%, **so I don't need to plan on trying to get a 100%. I'm just aiming for 49% next time.**" (*Female White faculty*)

3.4.3 Left-of-center grading challenges students, allowing the best to distinguish themselves

Over 25% of our participants noted that a major benefit of *left-of-center* grading is that it provides a challenge to students and distinguishes the great from the good.

We want to give you the opportunity to not only learn the material, but to **really demonstrate your ability on these exams.** (*Female White Faculty*)

You really get a sense of, you know, not just what you've taught them, **but how far they're able to take what you've taught them.** (*Female African American Faculty*)

I feel like courses that are designed with problems that are... almost too hard for the students to do is actually a good way to teach because...**it really sees how those students are able to frame a problem in their head and try and approach it from an interesting way...** If you do end up getting a really high grade, it means you really did really understand the material very well. You actually earned it as opposed to, oh, everyone gets sorta this range. (*Male Hispanic Student*)

However, even while relatively high numbers of interviewees acknowledge the pedagogical rationale behind challenging students, many were quick to point out that other—perhaps more productive—ways exist to provide this challenge:

The reasons I think professors make exams like these is to really question the students' ability to take what they taught in lecture and critically apply it to something else, which is really, really awesome. I haven't quite figured out why they make it this hard. **You can do that without making a freshman-level class have graduate-level questions on it.** (*Female African American Student*)

I mean, the pros, it seems to me that, like I said, the professor did that to sort of stretch—you've learned all this, and if you have a really good, in-depth understanding of it, you can figure out how this fits into what you've learned. It makes you think rather than just regurgitating things. I guess that would be the pros. **But to me, that should have been homework, and not my test!** (*Female White Professional*)

3.4.4 Left-of-center grading teaches students to cope with stress and failure

Over 10% of the student and professionals stated that one benefit of *left-of-center* grading is that it teaches students to cope with failure and stress:

Everyone before me has gone through that. You've gone through it and **it's actually character building** because say you take one of these tests and you come out with making a 30. I mean you have to really lift yourself up after making a 30 on a test (*Female African American Professional*)

What they are doing is throwing all this information at you **to see if you can cope with the situation**. It's almost kind of like getting you to a train of thought where, you know, if you walk in some...if you got a job or whatever, and you come in there and you got overwhelmed they want you to be able to adapt and make the best of what you can do with what you're given. So I feel like that's almost a really good thing, a learning experience, as well. (*Male African American Student*)

Some participants also noted that the stress of *left-of-center* exams fosters team-building as students bond over shared misery and begin to study together.

4. Discussion

Our findings contribute to a growing body of research criticizing norm-referenced grading. First, our research provides compelling evidence that an extreme form of norm-referenced grading, which we term *left-of-center* grading, disproportionately affects female students. Significantly more women than men described the practice as having more pros than cons, with many using words such as “demoralizing,” “discouraging,” and “traumatic” to describe the practice. This finding is consistent with research showing that women are more likely to adopt mastery goals towards learning while men are more concerned with others' perceptions of their academic status [14-17]. In fact, many of our participants predicted this difference in their interviews, saying that they felt that women were more discouraged by *left-of-center* grading than men.

We hope that the fact that most of our participants have had successful careers as professional engineers or engineering faculty will lend to the persuasiveness of their concerns. Clearly these are individuals who are capable of succeeding in the profession; their perspectives cannot easily be dismissed as reflecting the viewpoints of those who should be weeded out of the profession. Moreover, hindsight did not give our participants more insights into the benefits of the practice: professionals well-removed from their schooling were as critical of *left-of-center* grading as students still working on their degrees.

Surprisingly, given other research suggesting that norm-referenced grading discourages collaboration [1-3], we did not find participants specifically linking *left-of-center* grading to an

overall competitive climate. In fact, several participants suggested the practice encouraged bonding over shared distress. Instead, participants tended to criticize the practice because it made them feel like failures, even when their final grades suggested they had been successful. These individuals wanted confirmation that they were mastering the material their professors deemed necessary to an engineering career.

Our participants also perceived *left-of-center* grading as evidence of faculty, and to a lesser extent, a culture, that does not care. As one participant told us:

This guy gets horrible reviews every semester, [he's] got to, and yet, he's still got a job. Obviously, they don't care about that. Just forget that...you're not going to change him.
(*Female White Professional*)

And another participant stated

Engineering just has a notion of beating up on people (*Female White Professional*)

Although our study does not directly link left-of-center grading to attrition issues (all of our participants persisted in engineering), commonly cited issues for why women leave engineering include perceptions of poor teaching, lack of confidence, and a sense that one does not belong [1, 10, 11] . Our findings suggest that *left-of-center* grading may contribute to these feelings and discourage women from persisting in engineering.

Our research is limited by the selection bias of our sample—particularly by the fact that we only interviewed three faculty who use *left-of-center* grading themselves. Moreover, the faculty we did interview all volunteered for a study on interpersonal communication in engineering and thus may not be representative of the broader engineering faculty population. Future research should also survey faculty directly to find out the extent to which *left-of-center* grading is deliberately employed since most of our knowledge of the practice is filtered through student perceptions. We also need research that can better understand the motivations of faculty who use the practice. Understanding these motivations can help researchers come up with viable alternatives to *left-of-center* grading.

5. Acknowledgements

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