"Write" and Wrong: An Analysis of the Linguistic Differences in Men's and Women's First-Year Technical and Engineering Writing

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The field of engineering is an extensive one, one that covers sets and subsets of differing engineering disciplines. Despite this, the writing within the field takes on similar patterns across these disciplines. Because engineering has always been a male-dominated field, these patterns and standards of engineering writing were initially created and implemented by men. In recent times, however, the field of engineering has become more diverse as a larger number of women have pursued a degree in the field and entered the workforce. This raises a number of questions. How are these writing standards challenged and altered with the introduction of more women in the field? Do women take a different approach to analyzing subjects and putting them into words, and if so, is this alternate approach beneficial?

In their article, "Disrupting Masculinities," Wendy Bastalich and her research team describe a prior study by Judith McIlwee and J. Gregg Robinson which argues that "men's preferred style is based on early childhood learning, which disadvantages women who lack a mechanical background and familiarity with technology" (387). Could this preferred style manifest itself in the physical writing of the field? Research suggests that, yes, women might take a different approach to technical writing than men do. Because engineering writing standards affect everything from engineering education to publishing in peer-reviewed engineering journals, this standard set by men may be inhibiting progress in the field as a whole.

Review of the Literature

Engineering as a Gendered Field

Despite the steps that have been taken to attract and retain more women in the field of engineering, there remains a masculine working environment which makes it difficult for women to feel like they belong (Bastalich et al.; Foor and Walden; Schuster; White et al.). This idea is inherent in all the sources I have read that research women in engineering. Indeed, it appears to be the core belief that such research is based upon, but the way it manifests itself differs. It is not just the common conception of sexist male engineers believing their female coworkers to be incapable. It is in the fact that genderless or gender-neutral subjects in technical writing contexts mean male subjects (White 15), and that the audience for such writing is generally depicted as male as well (Schuster 383). It is in the fact as well that "[this] myth of the gender neutral workplace is pervasive even in […] research journals" (White 15).

This bias, though subtle, begins influencing female engineering students early on in their education. When one reaches the workforce, the masculine environment becomes more obvious. Cindy Foor and Susan Walden explain, "Women who wish to answer the call for increased participation in engineering experience a cultural space enmeshed in a web of conflicting threads of possibility and frustration" (42). This "cultural space" is supported and defined further when Bastalich et al. claim, "Academic work that emphasizes the need to change the engineering culture in order to attract and retain more women demonstrates that engineering is dominated by a masculine cultural style and sets of institutional practices that are hostile to women" (387). Bastalich et al. go on to conclude that "the problem with engineering is that the workplace culture polices a narrow set of masculine norms and is intolerant of diversity" (397). This appears to be a common theme in the existing literature, interwoven in the context of the topic and the writing if not outright stated as it was in Bastalich et al's article.

Feminist Theory

In order to gain an understanding of the issues surrounding women engineers, it is highly beneficial to conduct studies from a perspective of feminist theory (Beddoes; Beddoes and Borrego; Foor and Walden; Sullivan and Moore). Examining women in the masculine environment of engineering through a more traditional lens would cause one to miss some of the more subtle interactions between the two. Unlike in traditional pedagogy, personal experiences and emotions are valued in feminist pedagogy (White 15). As Foor and Walden explain, "By recognizing the dynamic relations between culture and social action, feminists pointed the way to scrutiny and explanation and rejection of the distinction between subject and object implicit in structuralist thought" (45), in which every system has a structure, and that structure determines the position of each element within the system. Feminist theory is not commonplace in engineering studies. In fact, "many feminist approaches would be counted as alternative—in part because they focus on collaborative relationships" (Sullivan and Moore 337).

The effect of this can be seen in Kacey Beddoes's argument that "examinations of feminist methodologies remain almost wholly absent from engineering education literature" (107). However, these approaches are necessary, as the study of women in engineering centers more around human interaction than the technical work that is associated with the field. Kacey Beddoes and Maura Borrego describe five differing types of feminist thought, naming liberal feminist theory, standpoint feminist theory, intersectional feminist theory, interactional feminist theory, and finally masculinity studies. They describe how each applies to research on gender and engineering, but in particular claim, "Interactional theories could point to everyday behaviors and interactions that are problematic and produce new explanations as to *how and why* masculine biases persist in engineering education" (286). They refer to engineering education, but what one learns in school gets transferred into the workforce as well.

Engineering Education

In order to institute a change within the field of engineering, one must first make a change to the methodologies used to teach engineering education (Beddoes; Beddoes and Borrego; Laeser et al.; Foor and Walden). No one is born an engineer. Each engineer currently in the workforce went through an education program to be where they are now. Therefore, it makes sense that they would learn not only the technical skills they need but also the social structures and practices of the field

(Foor and Walden 46). Foor explains, "Engineering education, as a hierarchical social community, reinforces these relationships in the production and reproduction of acceptable gendered identities" (46). This furthers the divide between the field's female and male members, beginning to do so early on in the engineers' careers. As discussed earlier, Kate White and her research team argue that feminist pedagogy values personal experiences and emotions (15); however, Beddoes and Borrego state that "norms of engineering education dictate that in order to make credible claims, [they] must present a rigorous accounting of [their] categorization results and procedures [of their study]" (290).

Beddoes expounds on this point in her own research article, stating, "Expectations for engineering education research have largely been determined by research norms and epistemologies from engineering" (114). She states that because engineering education is a relatively new field, it relies on "quantitative and positivist" research that "often exclude[s] characteristic features of feminist research" (114). In the same article, she mentions a study she had done earlier, where "participants identified challenges and barriers to conducting and publishing research that engaged feminist methodologies in engineering education contexts, namely, resistance to qualitative methods and an insufficient number of qualified reviewers" (113). Despite these challenges that face the implementation of feminist theory in engineering education, Melissa Laeser and her team confirm in their study of gender composition and teamwork that "engineering educators may not be able to rely upon the general research that has been completed concerning gender interactions to inform their classroom decision making with respect to teamwork" (54). The research done on this matter points to room for improvement in methods of engineering education.

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In this day and age, with an increasing number of women entering technical fields such as engineering, the discussion of feminist study in these fields has never been more important. A common theme among existing feminist studies is that the masculine environment of engineering is hostile towards women, although some rhetors disagree on the cause of this environment. Some have suggested possible solutions to the issue, ranging from implementing more feminist methodologies in research to altering the way engineering education is conducted in schools; however, it has not yet been investigated as to whether the current standards of engineering and technical writing help to perpetuate the disadvantage women face in technical fields. In this paper, I will discuss the linguistic differences that I found in examining men's and women's college first-year engineering and technical writing.

Methods

In order to conduct this research, I collected various samples of technical and engineering writing. These samples included lab reports from a materials science class at the Rensselaer Polytechnic Institute (RPI) and the final engineering reports from the University of Central Florida (UCF)'s first-semester Mars rover project.

In order to obtain the lab reports from RPI, I asked a friend who attended school there if she could help with this research. She volunteered the lab reports that she and a couple of male friends had written and uploaded them into a shared Google Doc. Of the six lab reports they each provided me, I used two from each of them for my research, resulting in a total of six documents. The first was a lab report on the synthesis of polymers, while the second was a report on the breaking patterns of differently-treated pieces of glass.

When I first started the research, I originally posted to the UCF Class of 2019 Facebook page and asked for samples of the Mars rover report; however, that attempt garnered no response. Instead, I asked some of the people I knew who were also in the UCF engineering program if I could analyze their papers. I was unable to obtain reports from all-female and all-male teams, so I settled for looking at reports from majority female and majority male teams, each with a 3-to-1 composition. Each team was composed entirely of first-year engineering students such as myself. Because I had to ask people I knew for the papers, I did not have the completely unbiased advantage of anonymity; however, I am confident that bias was not an issue in this research.

In order to analyze the data, I first read over the documents as a whole in order to make qualitative observations about the differences between them. I recorded these observations in Microsoft Word, organizing my thoughts by the sections of the papers I was looking at. I then went through the documents again more carefully, coding for the following items:

- Hedging
- Graphs
- Tables
- Pictures
- Diagrams
- Hard numbers
- Equations
- Extended background
- Present tense
- Past tense
- First person
- Third person

Using colored pencils, I highlighted each occurrence of the different categories with its own color. While I was only able to use some of this information to any quantitative degree, the colors allowed me to see the composition of the documents better and made it easier for me to compare them.

Of the eleven categories I coded for, I picked eight that I could reasonably assign quantitative data to and sorted them into a Microsoft Excel spreadsheet [see Figure 1]. Those categories were ‘hedging words,’ ‘first person,’ ‘tables,’ ‘graphs,’ ‘diagrams,’ ‘pictures,’ ‘hard numbers,’ and ‘equations.’ The remaining code categories that I did not use quantitatively allowed me to get a better outlook on the overall composition of the documents in the form of verb tense usage and the contexts in which the authors placed the reports. In addition, I made note in the spreadsheet of how many words were in each document. I tallied up the number of occurrences in each document and over all the documents I obtained. I then calculated the average number of times each term appeared in the documents and both the total and average percentage that those terms appeared in relation to the word counts of the documents. Because tables, graphs, diagrams, and pictures were not included in the word count, percentages were not found for these categories. Instead, I only calculated the average number of times they appeared in the men’s documents and the women’s documents.

MALE REPORT RESULTS

	Hedging Words	First Person	Tables	Graphs	Diagrams	Pictures	Hard Numbers	Equations	Number of Words
Male 1 Lab 1	3	4	0	0	3	0	15	3	2349
Male 1 Lab 2	1	10	2	5	1	0	16	1	1230
Male 2 Lab 1	1	4	0	0	4	0	12	3	1843
Male 2 Lab 2	4	4	2	5	0	4	5	3	1720
Male 3 Report 1	5	26	1	1	0	0	9	0	2503
Total:	**9.5**	**37**	**3**	**6**	**4**	**2**	**33**	**5**	**6074**
Average:	3.17	12.33	1	2	1.33	0.67	11	1.67	2024.67
Total Percent:	0.156%	0.609%	- - -	- - -	- - -	- - -	0.543%	0.082%	- - -
Avg Percent:	0.139%	0.494%	- - -	- - -	- - -	- - -	0.648%	0.109%	- - -

FEMALE REPORT RESULTS

	Hedging Words	First Person	Tables	Graphs	Diagrams	Pictures	Hard Numbers	Equations	Number of Words
Female 1 Lab 1	4	0	0	0	0	0	10	0	1418
Female 1 Lab 2	5	0	1	0	0	1	8	1	1300
Female 2 Report 1	3	6	2	1	2	4	41	3	1787
Total:	**12**	**6**	**3**	**1**	**2**	**5**	**59**	**4**	**4505**
Average:	4	2	1	0.33	0.67	1.67	19.67	1.33	1501.67
Total Percent:	0.266%	0.133%	- - -	- - -	- - -	- - -	1.310%	0.089%	- - -
Avg Percent:	0.278%	0.112%	- - -	- - -	- - -	- - -	1.205%	0.082%	- - -

COMPARISON

	Hedging Words	First Person	Tables	Graphs	Diagrams	Pictures	Hard Numbers	Equations	Number of Words
Men	0.139%	0.494%	1	2	1.33	0.67	0.648%	0.109%	2024.67
Women	0.278%	0.112%	1	0.33	0.67	1.67	1.205%	0.082%	1501.67

Figure 1: Tables of quantitative coding analysis

Because I had two different samples of the lab reports written by men, I had to factor this into my average calculations. Had I not done so, my data would have been inaccurate due to having more samples from men than women. In order to account for this, I set Excel to calculate the average number of occurrences of each category for the two lab reports individually, then used those averages in the final averages for each category.

It is necessary to note that I did not have a large data pool to work with. For the men, I had four documents written by two individual men and one document written by a team of three men and one woman for a total of five documents. For the women, I had two documents written by one woman and one document written by a team of three women and one man, for a total of three documents. Any and all conclusions I drew from this data were not absolutely conclusive due to the fact that I did not have enough data to prove anything substantial. Had I had more time, I would have expanded my data pool to include documents from other projects and other schools. I would have also continued with my original plan to analyze documents from all-female and all-male teams instead of making the concessions I did. In addition, because I had difficulty finding the documents in the first place, I was unable to conduct the post-analysis interviews I had originally planned on doing. These interviews would have given more insight into the writing process of each individual in addition to the final product.

Results

From the numerical data I collected, I found that women used hedging words more often than men, with an average percentage of hedging words–words along the same vein as 'could,' 'possibly,' and 'might'– totaling 0.278% of the word count to the men's 0.139%. Men, on the other hand, wrote in the first person more often than women did, with an average percentage of personal pronouns totaling 0.494% of the word count to the women's percentage of 0.112%.

Both men and women had an average count of one table per document. The men used six times as many graphs and twice as many diagrams in their papers (two graphs per document to women's 0.33 graphs per document and 1.33 diagrams per document to women's 0.67 diagrams per document). The women were 2.5 times more likely to include pictures (1.67 pictures per document to men's 0.67 pictures per document).

Women used hard numbers (numerical data written using Arabic numerals) more often than men, with an average percentage of numbers to a total word count of 1.205% in comparison to the men's 0.648%. Meanwhile, the men included more equations in their papers, with an average percentage of 0.109% of the total word count to the women's 0.082%. On average, the men's papers were 1.35 times longer than the women's papers. The men's papers on average were 2,025 words while the women's were, on average, 1,502 words.

There were some qualitative observations to make note of as well. While coding for present and past tense, I found that the women's reports did not vary as wildly between tenses as the men's reports did. The women's papers also generally stayed within the context of the assignment they were writing about, whether it be a lab or a project. The men were more likely to research and include extended background information and place their reports in the context of the science or the situation around which they were writing. In addition, I noticed fewer grammatical errors in the women's papers than in the men's.

Discussion

The finding that women use more hedging words than men concurs with prior research on the topic. Ken Hyland describes *hedges* as "devices which withhold complete commitment to a proposition, allowing information to be presented as an opinion rather than fact" (199). Prior literature on the subject states that women in technical fields are less confident about their work and more likely to phrase things as suggestions, which is reflected in their writing. This may also explain why women are less likely to use personal pronouns in their writing. Hyland states that "the presence or absence of explicit author reference is a conscious choice by writers to adopt a particular stance and disciplinary-situated authorial identity" (200). By using the personal pronouns, the men place their authorial identity in themselves. This exhibits a sense of self-confidence that the women seem to lack. Instead of putting that confidence in themselves, they appear to place it in their work by removing themselves from the equation. This is further supported by the finding that the women included more hard numbers in their papers than the men did, while the men included more equations and formulas. People see numbers as authoritative. By including these numbers in their writing, women may be hoping to establish themselves as credible in the field, while the men might be allowing their readers to assume the math was done correctly.

Another area of contention may be the length of the women's writing. In each document I analyzed, the women were concise and to the point, explaining what they needed to in the context of the assignment. While women have the stereotype of being wordier than men, I found the exact opposite to be true in their technical writing. The men all included extra information that went above and beyond the assignment itself. I am unsure whether or not this applies to writing in the professional field, but, if it does, then women must learn when to include more detailed information and what to include within it. There are some advantages to brevity, however. It makes for a much easier, much more understandable read, so perhaps it would be prudent to consider simplifying the complicated technical jargon where possible. The observation that the women's grammar held fewer errors than the men's might simply be an effect of having such a small sample size; however, the stereotype that "engineers cannot write" suggests that it might be worth looking further into this aspect as well.

While I did not have the opportunity to thoroughly examine the writing standards for publication in engineering journals, I did notice while reviewing the literature that tables, graphs, and diagrams were far more prevalent in the journal articles than pictures. This may be one of the aspects that women need to sacrifice and change in order to be published in reputable engineering journals. While diagrams may look cleaner and more professional by the current standards in place, pictures offer details such as texture that would not be conveyed otherwise. A critical analysis of these differences between men's and women's technical writing is likely the first step toward dispelling the "myth of the gender neutral workplace," at least in how it applies to research journals (White 15). This would open engineering research journals to new research and possibilities that are currently not up to the masculine "gender neutral" standards of journals today.

Conclusion

The study I conducted was not expansive enough to provide sufficient evidence to fully support any claim about the linguistic differences between men's and women's technical writing due to limited resources; however, what I did find suggests that there is more research to be done on this topic. This study should be repeated with a more in-depth analysis by someone with a greater sample selection from a larger data pool than I had to work with. These findings suggest that women may go about technical writing slightly differently than men. If this is indeed the case, then the standard of engineering writing should be examined and revised to account for those alternate methods that may provide new insight into the genre of technical writing. This would make engineering and other technical fields a more welcoming environment for a more diverse group of people.

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