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# Self-Perpetuating Stereotype Threat: How Anonymous Posting May Undercut Efforts to Address Gender Stereotypes in Computing

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## Extended Abstract

The use of anonymity in online forums, particularly in class settings, has been found to have positive effects such as allowing students—especially those likely to experience imposter syndrome—to feel more comfortable asking questions [Sankar et al.(2015)]; as a result, women have been found to post anonymously more than men [Flanagin et al.(2002)]. However, in a study of an undergraduate computer science class, we found that while anonymity may allow women to feel more comfortable posting in a male-dominated field, it also concealed opportunities for them to learn that they belonged in the class. Our study used a dataset from six semesters of interactions in a course forum associated with a CS1 class, focusing on those students who self-reported a gender during their start-of-course survey (fewer than 1% of students identified as non-binary or declined to answer, and so this analysis focuses on only those that selected male or female as their identified gender).

We proposed four hypotheses: (a) women elect to post anonymously more often than men; (b) as a result of (a), the gender distribution of class interaction on the forum appears significantly different than it actually is; (c) these trends persist systematically across the majority of students rather than being skewed only by a small number of particularly active students; (d) as a result of these trends, there are existing interactions that miss the opportunity to combat the very stereotypes that lead to anonymous posting in the first place. If these hypotheses are true, we further hypothesize anonymous posting misses an opportunity to address stereotypes in computing, a phenomenon that has similarly been observed in other domains [Birch(2022)].

To test these hypotheses, we conducted four studies on this dataset. In the first study, we examined the overall distribution of each of four types of contributions by gender and anonymity. The results of this study are shown in 1. Women are more likely to contribute anonymously in every post category. 69% of questions asked by women are asked anonymously, compared to only 50% of questions asked by men ($z = 9.67$, $p < 0.001$). For each of the other three posts categories, 63% of contributions from women are anonymous, compared to 37% (Start Answer) ($z = 7.38$, $p < 0.01$), 41% (Post Followup) ($z = 7.06$, $p < 0.01$), and 40% (Reply to Followup) ($z = 6.86$, $p < 0.01$) from men. This analysis thus supports hypothesis (a): women elect to post anonymously more often across all contribution types.

In our second study, we derived measures for Actual, Visible, and Perceived distribution of forum posts by gender. Actual distribution represents the underlying gender distribution of contributions; Visible distribution looks at what distribution is visible to the reader, including anonymous as a separate category; Perceived distribution extrapolates from the Visible distribution to what distribution students may assume based only on non-anonymous posts. The results of this study are shown in 2. In five of the six semesters, forum contributions from women outnumber those from men. In three of those five semesters, the perceived distribution based only on identified posts would suggest men are the more frequent contributors, and in all

six semesters, the perceived distribution based only on identified posts is skewed toward men compared to the actual distribution. These patterns support the acceptance of hypothesis (b): there is a notable difference between the actual distribution of contributions to the forum based on gender and the perceived distribution due to the increased frequency with which women elect to contribute anonymously compared to men; further, while this discrepancy is present throughout, it is most dramatic in terms of answering classmates' questions.

In our third study, we examined the possible explanation that a small number of "super-posters"—individuals who post extremely often—are responsible for these trends. We did this by summarizing each individual student's posting habits by whether they post always anonymously, always non-anonymously, or somewhere in between; then, we count the students in each category by gender. In this way, one student's frequent contributions still only represent one data point instead of many. The results of this study are shown in 3. We find that women are more likely to be Always Anonymous ($z = 2.56$, $p < 0.05$) and Mostly Anonymous ($z = 3.22$, $p < 0.01$) than men, while men are significantly more likely to be Always Identified ($z = 4.27$, $p < 0.01$). These data support accepting hypothesis (c): the trend toward women contributing anonymously more often is not due to a small number of super-posters skewing the data set; instead, women systematically elect to post anonymously more often.

In our final study, we attempt to quantify the amount of missed opportunity present as a result of these trends by counting the number of instances of each type of interaction specifically in the context of question-and-answer. The results of this study are shown in 4. We find only 9 instances in the entire dataset of a non-anonymous woman answering a non-anonymous woman classmate's question; we find 59 instances where one participant was anonymous but not the other; and further, we find 68 instances where both individuals were anonymous. Taken together, 93% of all Q&A interactions between women involve at least one anonymous party. This supports hypothesis (d), that within existing interactions there exist significant missed opportunities to diminish the perception that CS is male-dominated.

Thus, all four hypotheses may be accepted: although allowing anonymous posting lets individuals feel more comfortable contributing questions and answers (especially individuals who may feel insecure about their identity relative to stereotypes of the field), the patterns that result may reinforce the very stereotypes that give rise to the disparate tendency in the first place. This is not to suggest anonymous posting should be prohibited, but rather that instructors should be aware of this effect and develop other mechanisms to counteract it.

# References

[Birch(2022)] Katy Birch. 2022. 21. Gender, Anonymity, and Humour in Women's Writing for Punch. In *Women, Periodicals and Print Culture in Britain, 1830s-1900s*. Edinburgh University Press, 351–364.

[Flanagin et al.(2002)] Andrew J Flanagin, Vanessa Tiyaamornwong, Joan O'Connor, and David R Seibold. 2002. Computer-mediated group work: The interaction of sex and anonymity. *Communication Research* 29, 1 (2002), 66–93.

[Sankar et al.(2015)] Pooja Sankar, Jessica Gilmartin, and Melissa Sobel. 2015. An examination of belongingness and confidence among female computer science students. *Acm Sigcas Computers and Society* 45, 2 (2015), 7–10.

| Contrib. Type | Total by Women | By Anon. Women | Total by Men | By Anon. Men |
|---|---|---|---|---|
| Start Question | 1742 | 1204 | 948 | 476 |
| Start Answer | 328 | 207 | 515 | 191 |
| Post Followup | 705 | 445 | 403 | 166 |
| Reply to Followup | 525 | 328 | 387 | 153 |

Figure 1: Contribution type by gender and anonymity.

| Sem. | Actual Distribution (% W / % M) | Visible Distribution (%W / %M / %A) | Perceived Distribution (%W / %M) |
|---|---|---|---|
| 1 | 41.9% / 57.3% | 16.7% / 36.8% / 46.4% | 31.2% / 68.8% |
| 2 | 63.6% / 36.3% | 19.2% / 19.9% / 60.8% | 49.1% / 50.9% |
| 3 | 56.9% / 41.6% | 33.8% / 21.4% / 44.9% | 61.2% / 38.8% |
| 4 | 60.9% / 39.1% | 17.0% / 20.6% / 62.4% | 45.2% / 54.8% |
| 5 | 77.3% / 22.7% | 14.9% / 10.0% / 75.4% | 59.8% / 40.2% |
| 6 | 52.6% / 47.4% | 17.8% / 27.6% / 54.6% | 39.2% / 60.8% |

Figure 2: Actual distribution of forum contributions by gender, visible distribution based on anonymous posting, and perceived distribution extrapolating from visible distribution.

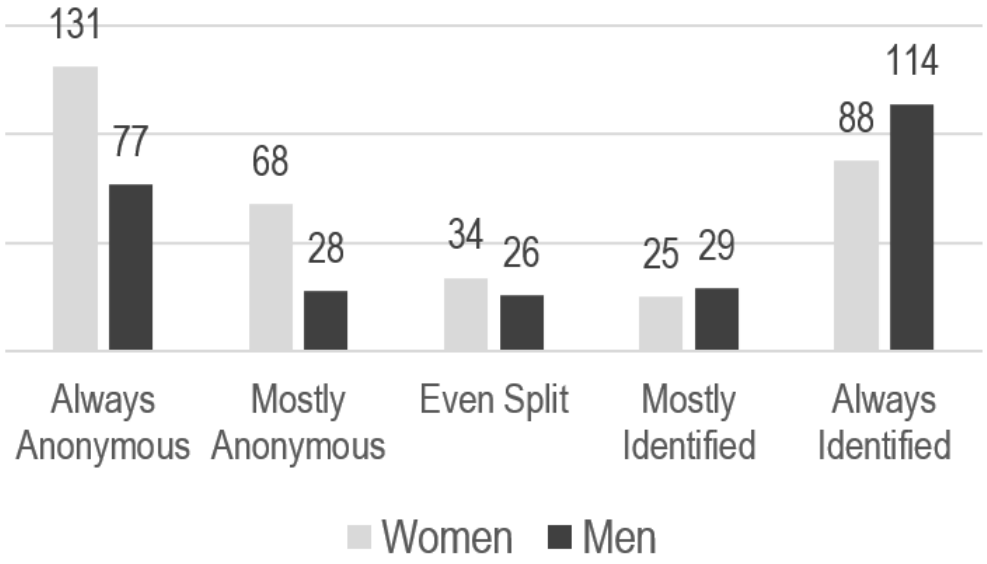


Figure 3: Whether each individual student by gender is likely to post anonymously or non-anonymously.

| | | | Answerer | | | |
|---|---|---|---|---|---|---|
| | | | Women | | Men | |
| | | | Anon | Iden | Anon | Iden |
| Asker | Women | Anon | 68 | 43 | 85 | 120 |
| | | Iden | 16 | 9 | 19 | 45 |
| | Men | Anon | 26 | 13 | 21 | 78 |
| | | Iden | 14 | 8 | 22 | 31 |

Figure 4: Individual interactions based on gender and anonymity.