Diversity and Decorum in Open Source Communities

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ABSTRACT

Open source software communities are increasingly aware of how social biases and discrimination negatively affect their culture. Many choose to establish policies regulating their contributors' social interactions without considering the efficacy of such measures. If these communities lack an empirical awareness of their policies' impact, they may find themselves adopting dogmatic practices that serve only to increase overhead maintenance costs. Conducting a gender diversity analysis of popular open source projects, I discovered no significant change in the proportion of women contributing to projects with or without a code of conduct. In light of this discovery, the open source community should consider supplemental strategies in order to foster diverse participation in their projects.

CCS CONCEPTS

• **Social and professional topics** → **Women**; *Codes of ethics*;

KEYWORDS

Free Software, Conduct, Gender

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1 INTRODUCTION

Gender diversity remains strikingly low in computer science, with only 26.4% of computer scientists identifying as women in the United States.[1] In open source software, the situation is similar. Participation from women can drop as low as 1.1%,[2] and researchers hypothesize that the open meritocracy of such communities promotes combative behaviors that society teaches women to consider socially unappealing [3]. In a 2014 blog post entitled *When Nerds Collide*, technology researcher and journalist Meredith Patterson discusses the crux of the issue facing the industry: how can the programming community, with a culture rooted in ostracization from mainstream society, break from the mold in which they were formed and foster an environment of diverse participation?[3]

[1] https://www.nsf.gov/statistics/wmpd/
[2] http://flossproject.merit.unu.edu/index.htm
[3] https://medium.com/@maradydd/when-nerds-collide-31895b01e68c

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Some project maintainers have taken the initiative to introduce a "code of conduct"—a definition of acceptable social behavior in the development group—as one strategy to address these concerns. Developers have expressed their desire for codes of conduct to protect the evolving culture that their project incubates, and to increase the comfort level of newcomers to the project while also deterring those contributors who would cause contention [5].

Outside of the software industry, previous investigation has found that the mere presence of a code of conduct within an organization's regulatory documents encourages members to engage in ethical behaviors and also perceive their peers to hold higher ethical standards [1]. In the open source community, however, the desired change is not just behavioral: the lack of diversity in participation must be addressed as well. Already, the overall acceptance rate of code submitted on GitHub by users identified as women is equivalent to or even higher than that of code submitted by men [2, 4]. Yet these very same studies found that their random sampling of GitHub contributions contained only 4.54% authorship by women.

This paper contributes an empirical study of how codes of conduct impact the demographic constituency of the open source software community. In order to do so, I begin with the question:

> RQ: To what extent do codes of conduct improve the gender diversity of the communities that adopt them?

I hypothesize that projects adopting a code of conduct will see a greater increase in the proportion of women participating after the introduction when compared to projects without such an intervention. The claim is grounded in the common-sense belief that a community's written expectations and cultural behaviors will correlate.

2 METHODOLOGY

Much of the data required for the analysis—statistics about GitHub users and repositories, along with gender data mined from Google—has already been obtained by the efforts of previous researchers [4]. Collaborating with the original research group, I updated the GitHub repository data with a snapshot from GHTorrent (a service mirroring GitHub API data) taken in June 2018. Additionally, the gender information collected from Google+ was extended to include accurate data from the same timeframe.

Communities could include a code of conduct in their projects in a variety of ways. The policy could reside in a dedicated document in the project source code repository, or it could be included as a section in another file. Sometimes, the project would host the contents of their code of conduct on a separate website and simply provide a link. In classifying repositories, I only considered projects to have a code of conduct when their source code repositories contained the contents of, or an accessible link to, a policy that explicitly governed the behavior of contributors to that project.

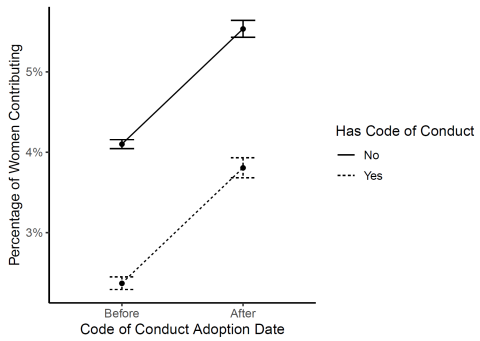

Figure 1: Contributors identifying as women before/after (median) policy introduction date.

In any case, the task of locating a code of conduct for each project was not trivial, and I found that automated searches were inaccurate. Instead, I had to manually search each repository for a code of conduct. To make this task feasible, I chose to sample the five hundred repositories with the highest quantity of total pull requests as reported by GitHub.

I used the proportion of women contributing to a project as a simple measure of gender diversity. My research question considers gender diversity over time, and as such I could not simply use the membership status of each GitHub user within a project to calculate proportions. GHTorrent cautions researchers that the provided membership dates are often inaccurate and that organizations can even hide membership information.

I chose to use users' commit history as a more robust contributor activity metric. Commit authorship data is public for open source projects, and the metric reveals activity trends over time that mere membership status would be unable to provide. Splitting all project history into 24-hour time periods, I queried the data to find at least one commit authored by a given user to a given repository during each period. If such a commit existed, I counted the user as a "contributor" for that day. Users for whom I could not find gender data, I discarded, and I divided the number of women contributing each day by the total count of remaining users.

Finally, I used the projects' code of conduct introduction date as an intervention point: on each side of that timestamp, I averaged the gender diversity proportions and compared them. For projects without a code of conduct, I used the median introduction date of conduct policies (in those projects that had them) as the splitting point. For this dataset, the median date is December 4, 2016.

3 RESULTS

Projects that introduced a code of conduct in their history saw the participation of women increase from 2.37% to 3.81% after the code's introduction; without codes of conduct, comparing gender diversity within similar time periods yields an increase from 4.10% to 5.53%. The average increases were by 1.44 and 1.43 percentage points, respectively. Figure 1 shows the binomial confidence intervals on these values.

4 DISCUSSION AND THREATS TO VALIDITY

The percentage increases mentioned in Section 3 mask a high amount of variation in the data. The outliers in the project sample could lose as many as 60 percentage points in gender diversity (dropping from 70% women to 10%, for example), and gains could be as high as 50pp (15% to 65%). Among projects with codes of conduct and without codes alike, the number of instances where diversity increased and decreased were approximately equal. Running a Wilcoxon rank-sum test on the two sets of ratios yields a p-value of 0.44, so the null hypothesis cannot be rejected. I could not conclude that the two project samples are distinct in terms of diversity; in other words, no correlation could be found between the event of introducing a code of conduct and a change in the gender diversity of a team.

Interestingly, projects without a code of conduct tended to have *higher* percentages of women involved in their community than projects with codes. One speculation explaining this trait is that communities with especially low diversity might be more aware of their deficiency and take active measures to combat that state.

Many confounding factors may also be at play. For example, open-source communities may exhibit a "clustering" effect, whereby projects with a marginally higher proportion of contributors who are women tend to attract more women, producing higher diversity measures. Project age can also skew the results, as more established projects/communities may not feel the need to jump on the code-of-conduct bandwagon. Perhaps these older communities exhibit a stability and camaraderie that encourages a diverse participant group naturally, whereas newer communities have less time to develop such traits.

To make any further conclusions regarding the impact of codes of conduct in open source communities, I would like to have a great deal more data: both in terms of repository quantity, and duration of history. I have concluded from this analysis that the efficacy of conduct policies in improving gender diversity cannot at present be empirically determined. To best prepare for the future, open source project maintainers should pursue a multifaceted strategy to ameliorate the gender gap present in their communities, and not rely on a written social policy alone.

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