

## Introduction

Gender discrimination is a problem, especially in the technology industry. A recent study by [CITE] looked at GitHub, one of the most popular software repositories with 14 million users, to see if the effect can be seen by comparing pull requests between male and female contributors. A pull request happens when someone proposes changes on a software code repository that is being hosted on GitHub. The request can either be accepted or denied by the owners of the repository. The researchers found that the approval rates of pull requests, when made without revealing one's gender, were comparable between both genders. The rate of approval for women fell significantly if the coder's gender was identifiable upon requesting a pull whereas the rates for men did not change much.

Wikipedia, the largest encyclopedia mankind has ever created, also has a gender problem. Estimations about exact numbers are difficult to find but it is undisputed, that most contributors and even editors are of male gender. Especially the latter is important since editors, specifically veteran editors, do have the powers to reject articles and restrict access of other contributors which has a severe impact on the acceptance rate regarding articles that are written about female figures. The resulting bias with respect to the variety of content is increasingly recognized leading to Wikipedia's gender gap to be an ever-increasing topic of interest, drawing the attention of scholars of new media and similar fields.

Discussing the systemic bias on Wikipedia is important as the platform poses the most powerful source of information worldwide. It is available in 275 languages and is being accessed by millions of people regularly. Many assistive devices and applications such as Smartwatches, Google Assistant, Alexa, Siri or Cortana draw their knowledge directly from Wikipedia without informing their users about the source or authors. Through these developments, the world, as it is represented by Wikipedia, is widely being considered as natural.

In this work, we address gender bias discrepancies within the technology industry by providing facts on historical developments and current events. Additionally, we try to measure possible trends for the future of digital environments that have collaborative characteristics, draw implications for the quality of publicly available information and participation rates and provide suggestions that may have an impact on future developments.

## Considerations and Limitations

Most studies on gender bias have been conducted either in Europe or in the United States. Only very few researchers actively work on that topic from other parts of the world. The participants of the studies conducted are more likely to be people from those geographical regions. Thus, their provided data and insights inherently carry strong biases and are not globally representative. A lot of studies in this area are user studies, which poses an issue in our specific case as it can be shown [CITE], that women are overall less likely to participate in user studies compared to men. As an example, this phenomenon has an impact on the data used in Figure 1 since the underlying studies could be skewed accordingly.

## Wikipedia

In the following we examine several issues connected to Wikipedia's gender gap and different reasons that are responsible for the low contribution rates of female participants or the low

acceptance rate regarding articles about women. We then also make suggestions on how to combat these issues effectively.

#### What proportion of female editors are women?

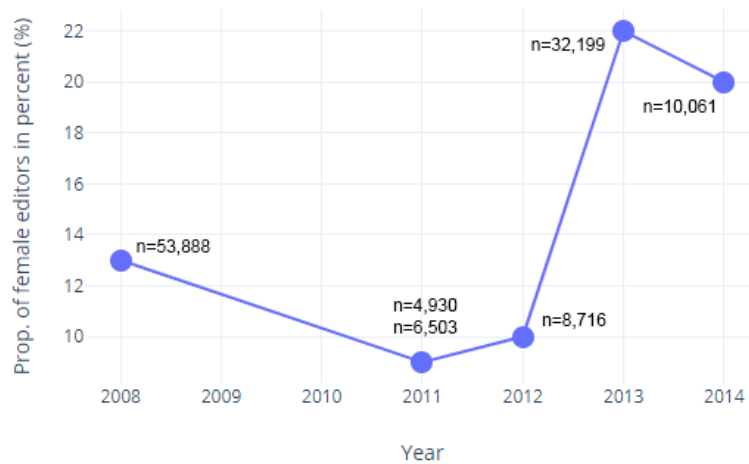


Figure 1: 6 Studies were conducted by the Wikimedia Foundation between 2008 and 2014 to measure the proportions between male and female editors that are active on Wikipedia. The corresponding number of participants is annotated for each study accordingly.

#### Low proportions of female editors

The Wikimedia Foundation conducts various user studies at annual intervals, and the data thus collected is made publicly available. Part of these studies is also to determine the ratio of female to male editors on Wikipedia. We analyzed the results of those studies to see how the ratios have changed over time. We found that women are strongly underrepresented on Wikipedia, even in the strongest estimate. However, a positive trend can also be observed from the year 2011 onward.

#### Self-perception as a major cause for the gender gap

A characteristic with a particularly strong influence on the interest in participating in the processing of publicly accessible information is self-perception. Helgeson et al. [CITE] showed, that there are significant differences in self-perception and confidence between both genders. The reason for that is unknown. This difference could be due to women being socialized to be less self-confident or that their experiences lead them to become less self-confident, as the authors note, but this needs to be subject for further studies and investigations as the paper did not aim to find the cause for the discrepancy found.

Hinnosaar et al. [CITE] showed, that the gender gap in Wikipedia editing is, to a large share, because one's belief about competence and draws parallels to the findings of Helgeson et al. [CITE]. These findings are supported by the studies of Collier & Bear et al. [CITE] and Protonotarios & Sarimpei et al. [CITE], but it cannot be shown if the reasons for that lie within the internal structures of Wikipedia or if these are caused by external factors such as societal standards and expectations.

#### The influence of conflicts on female contributions

Lam & Uduwage [CITE] performed a variety of quantitative analyses on publicly available English Wikipedia articles and found, that new users, who could be publicly identified as female, were more likely to stop editing and leave Wikipedia when their edits were reverted. This poses an issue regarding the balance of equal representatives on Wikipedia since the number of female editors attempting to join Wikipedia is already very low. They also found that articles, where female editors dominated on the amount of contributions, had significantly more disagreements in discussions

around edits than other articles [CITE SAME AS BEFORE]. Being subject to large amounts of conflicts causes discomfort and demotivation when it comes to editing other people's work, since the editors fear to receive even more critical feedback and have their contributions being reverted.

### Article rejection due to notability criteria

Wikipedia consists of multiple categories for different types of topics. Although all articles seem to share a similar styling, they belong to different categories. A user can navigate through those categories and see lists of articles belonging to any selected category. For example, there is a category on computer scientists, where a user can find various related lists of scientists such as lists by nationality. Such categories often have their own communities of editors that are active in the corresponding field who can sometimes impose very harsh acceptance criteria, so that the attempt to publish articles in the respective area often gets rejected due to the lack of fulfillment of said criteria. Wagner et al. [CITE] found, that there are many areas in Wikipedia where the criteria are unfavorable towards female figures. This is the reason why many articles about women are rejected which further leads to discrepancies when it comes to the ratio of male to female representation regarding Wikipedia articles.

But Klein et al. [CITE] shows that this situation is getting considerably better as societal changes take place with the feminism movement gaining more traction and with public attention being drawn towards a more considerate behavior towards other genders. Initiatives such as meet-ups, talks and competitions with special emphasis on female participants show a net positive development when it comes to public perception and awareness towards females and women's rights worldwide fostering opportunities for women to overcome societal hurdles and gain equal access to positions within higher ranking institutions and well paid job opportunities. Such societal changes are strongly reflected within Wikipedia as well.

### How to combat the gender gap on Wikipedia

To prevent newcomers from being further scared off because of conflicts, Wikipedia editors must be more careful with their power to discard proposed changes. This aspect should be included in the Wikipedia guidelines and clearly emphasized. Proposed changes of positive intent should be encouraged by giving more thought to thanking users for their contributions. Such a reaction is also publicly visible and of great interpersonal importance. It can also strengthen the self-esteem of the users concerned, thereby improving the perception of the competence of newcomers. This in turn could be beneficial in terms of motivation to edit existing articles or to create new articles.

To further battle the gap, increasing efforts need to be put to invite women as contributors on Wikipedia. This can be done through explicit information events that focus on women. There are independent associations around the world that are affiliated with the Wikimedia Foundation and promote Wikipedia's mission to facilitate the distribution of freely available information. One such organization exists in Vienna, for example, and stages weekly open access information events where anyone can visit their office and learn how to write or edit articles on Wikipedia. Such associations need to put more effort into attracting the attention of women and encouraging their contributions, considering the use of direct and indirect marketing methods with appropriately targeted content. In addition, opportunities could be created for women to socialize with each other.

[TODO: how to combat article rejection due to notability criteria]