Gender Biases Embedded in Open Source Software

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In collaboration with

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Lots of people are left behind!

- OSS communities rely on newcomers
- Steinmacher et al., analyzed OSS communities
- Absence of response, politeness, usefulness

- 82% of users dropped out!!
Women especially are left behind

- Women: underrepresented in CS
  - David/Shapiro, Robles: <10% of OSS contributions
  - Ghosh: 1.5%
  - <5% women owners of top 5000 OSS projects
  - Terrell et al.: not about competence
Why Care? Society’s health

• Premises:
  • **Bad**: bias in software
  • **Good**: diversity of thought

• Solutions:
  • Fix the people: force us all to think as software “likes”
  • Fix the software: support diverse ways of problem-solving
Why care? Inclusive tools helps many

- Reason 2. Ignorance → unwitting barriers.
- Reason 3. Studying a population segment to help everyone.
Lot of researchers are looking into Diversity and Inclusion in OSS communities...

... but what about the tools?
How are tools contributing to...

- **Everybody** getting left behind by OSS
- **Newcomers** getting left behind by OSS
- Newcomer **women** getting left behind by OSS
Study methodology

• Field study: 5 teams, 2 companies
• Software professionals used GenderMag
• Evaluated software with Abby persona, a woman newcomer
• Use-Case: “Abby wants to”
  • e.g. submit a pull request
Issues in tools & infrastructure

• Software professionals found issues:
  • Their own OSS projects
  • The tools they use
    • Github command line
    • Github website
  • The infrastructure they use
    • Documentation
    • Wikis
Example tool issues

P60: “set up development environment...not where to find things to work on”

P57: “Abby is new...not even know what CLA is”

P62: “I know my stuff works’ but ‘I don’t really know what a pull request looks like’”

P61: “the hard part about PR is to find the right button.”
**Issues exists across different contexts**

<table>
<thead>
<tr>
<th>Use Case (Abby wants to:)</th>
<th>% Issues found per steps evaluated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Find help with pull requests on Github</td>
<td>54% (13/24)</td>
</tr>
<tr>
<td>Use GitHub issue tracker to find an issue</td>
<td>71% (12/17)</td>
</tr>
<tr>
<td>Get familiar with open source project and find a task to work on</td>
<td>53% (9/17)</td>
</tr>
<tr>
<td>Set up the environment</td>
<td>44% (40/91)</td>
</tr>
<tr>
<td>Review Submitted pull Request</td>
<td>7% (1/15)</td>
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</tbody>
</table>
Not just feature bugs or UI issues, but whole sociotechnical spectrum
Newcomer tool barriers

- Research has found: 6 categories, 58 types
- Our study used 24 of these types, all 6 categories
  (e.g., Category: Newcomer Orientation)
Newcomer Orientation Barriers

• Directions on how to contribute
Compare changes

Compare changes across branches, commits, tags, and more below. If you need to, you can also compare across forks.

Create pull request

Choose different branches or forks above to discuss and review changes.

Compare and review just about anything

Branches, tags, commit ranges, and time ranges. In the same repository and across forks.
Open a pull request
Create a new pull request by comparing changes across two branches. If you need to, you can also compare across forks.

Before you submit a pull request please review the contributing guidelines for this repository.
• Newcomers don’t know the contribution flow
• Poor “How to contribute” available

P59: So she [Abby] is confused about how to contribute.
### Newcomer tool barriers (continued)

<table>
<thead>
<tr>
<th>Barrier categories</th>
<th># in Tools</th>
<th>Most identified barriers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newcomer Orientation</td>
<td>56</td>
<td>Newcomers don’t know what’s the contribution flow</td>
</tr>
<tr>
<td>Documentation barriers</td>
<td>36</td>
<td>Unclear Documentation</td>
</tr>
<tr>
<td>Cultural differences</td>
<td>7</td>
<td>Some newcomers need to contact a real person</td>
</tr>
<tr>
<td>Technical hurdles</td>
<td>56</td>
<td>Building workspace locally</td>
</tr>
<tr>
<td>...</td>
<td></td>
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</table>
Bottom line

Newcomer barriers: due at least in part to tools
Gender biases

Why might gender biases be embedded in tools?

Q: does software support a variety of smart users
A: NO

Unconscious bias, supporting (mainly) 1 kind of smart user
Gender biases

• How can we identify gender biases in tools?
• We can use GenderMag
GenderMag: support inclusive tool design

Image Credit: LGBTQ Symbols; CCO Public Domain / CC BY-SA 4.0
GenderMag

- **Gender Inclusiveness Magnifier**
  - Process: Evaluate tools’ inclusiveness

GenderMag Personas:
- “representatives” of a range of users, but only...

...from the perspective of 5 Problem Solving facets:
- Motivations
- Information processing style
- Computer self-efficacy
- Risk averseness
- Tech learning style (tinkering)
Background and skills

Abby is a senior in college. She is looking to build up her resume and contribute to open source projects. Although, she isn't a professional programmer she has sufficient programming knowledge from her coursework. She has experience with version control but has never used Github.

Abby has programming experience with Java, Ruby, GitBash and HTML. She knows her friends are contributing to open source projects, and want to contribute as well.

Abby enjoys working with numbers and logic in her free time. She especially likes working with puzzles, either on paper or on the computer, such as Sudoku and other puzzle games.

How Abby Works with Information and Learns:

- **Information Processing Style:** Abby tends towards a comprehensive information processing style when she needs to study. Instead of acting upon the first option that seems promising, she gathers information comprehensively to try to form a complete understanding of the problem before trying to solve it. Thus, her style is "burst-y": first she reads a lot, then she acts on it in a batch of activity.

- **Computer Self-Efficacy:** Abby has low confidence about doing unfamiliar computing tasks. If problems arise with her technology, she often blames herself for these problems. This affects whether and how she will persevere with a task if technology problems have arisen.

- **Attitude toward Risk:** Abby’s life is a little complicated and she rarely has spare time. So she is risk averse about using unfamiliar technologies that might need her to spend extra time on them, even if the new features might be relevant. She instead performs tasks using familiar features, because they’re more predictable about what she will get from them and how much time they will take.

- **Learning:** by Process vs. by Tinkering: When learning new technology, Abby leans toward process-oriented learning, e.g., tutorials, step-by-step processes, wizards, online how-to videos, etc. She doesn’t particularly like learning by tinkering with software (i.e., just trying out new features or commands to see what they do), but when she does tinker, it has positive effects on her understanding of the software.
Attitude toward Risk: Abby rarely has spare time. So she is risk averse about using unfamiliar technology that might need her to spend extra time on them…

How Abby Works with Information and Learns:
- **Information Processing Style:** Abby tends towards a comprehensive information processing style when she needs to more information. So, instead of acting upon the first option that seems promising, she gathers information comprehensively to try to form a complete understanding of the problem before trying to solve it. Thus, her style is “burst-y”; first she reads a lot, then she acts on it in a batch of activity.

- **Learning: by Process vs. by Tinkering:** When learning new technology, Abby leans toward process-oriented learning, e.g., tutorials, step-by-step processes, wizards, online how-to videos, etc. She doesn’t particularly like learning by tinkering with software (i.e., just trying out new features or commands to see what they do), but when she does tinker, it has positive effects on her understanding of the software.
Most tolerant answers by 1/3 of everyone (1 - 2)
Middle 1/3 (2.5 - 3)
Most averse answers by 1/3 of everyone (3.5 - up)

Risk facet
How GenderMag works

1. Pick a persona. eg: Abby

2. Pick a use case/scenario in your tool, eg:
   in Augmented (Physical) Bookstore
   “Find science fiction books”

3. Walk thru scenario via “intended” subgoals & actions
Gender biases embedded in the tools

P62: “...might take a while... comprehensive information processing”

P61: “resources provided would be counter-productive to the way Abby likes to learn”
<table>
<thead>
<tr>
<th>Barrier Categories</th>
<th>Barriers with gender bias</th>
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<tbody>
<tr>
<td>Newcomer Orientation</td>
<td>41/56 (73%)</td>
</tr>
<tr>
<td>Documentation barriers</td>
<td>23/36 (64%)</td>
</tr>
<tr>
<td>Cultural Differences</td>
<td>6/7 (86%)</td>
</tr>
<tr>
<td>Technical hurdles</td>
<td>37/56 (66%)</td>
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<tr>
<td>...</td>
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<tr>
<td>Barriers Totals</td>
<td>160/220 (73%)</td>
</tr>
</tbody>
</table>
What do newcomers think?

- How accurate were the software professionals’ analysis?
- How can we validate the findings with newcomers?
Newcomers’ perspective

- Empirical study of 18 newcomers (9 women and 9 men)
- Significant difference in number of gendered barriers (p<0.01)

<table>
<thead>
<tr>
<th>Gender</th>
<th>Newcomer barriers with gender biases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women</td>
<td>153/251 (61%)</td>
</tr>
<tr>
<td>Men</td>
<td>32/83 (39%)</td>
</tr>
</tbody>
</table>
Newcomers' perspective

- Empirical study of 18 newcomers (9 women and 9 men)
- Significant difference in number of gender barriers (p<0.01)

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<tr>
<th>Gender</th>
<th>Most tolerant</th>
<th>Middle 1/3</th>
<th>Most averse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women</td>
<td>42%</td>
<td>26%</td>
<td>29%</td>
</tr>
<tr>
<td>Men</td>
<td>25%</td>
<td>33%</td>
<td>38%</td>
</tr>
</tbody>
</table>

Most tolerant answers by 1/3 of everyone (1-2)
Middle 1/3 (2.5-3)
Most averse answers by 1/3 of everyone (3.5-8)
## Bottom line

Tools and Infrastructure are implicated in gender biases

<table>
<thead>
<tr>
<th></th>
<th>Professionals</th>
<th>Newcomers</th>
<th>Prior Empirical Work</th>
<th>Theoretical Models and Frameworks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barriers</td>
<td>✓</td>
<td>✓</td>
<td>✓✓✓</td>
<td>✓</td>
</tr>
<tr>
<td>Facets</td>
<td>✓</td>
<td>✓</td>
<td>✓✓✓✓</td>
<td>✓✓✓✓</td>
</tr>
</tbody>
</table>
Conclusion: the glass floor

“Women in tech do not generally need extra help, but the current environment in which they work does need help.”

- Gender inclusive software rests on...
  supporting **diverse** ways of thinking & problem-solving.
  - One gender at a time

-facet-
Be a partner in the GenderMag work

- Use GenderMag in your own tools and infrastructure
- Contribute to the GenderMag Recorder’s Assistant (gendermag.org)
- Help us identify best practices in creating inclusive design
  - Process
  - Product
- Help us identify the signals that GitHub provides and how it affects PR acceptance of women newcomers

- How you can help:
  - Collaborate
  - Support our graduate students in researching this
Follow-ups & Resources

@GenderMag, #GenderMag
gendermag.method

Resources: gendermag.org
   Flyer, papers, personas, foundations, ...
   Download the kit!

Make it happen @ your university/company!
   anita.sarma@oregonstate.edu
Backup Slides
Stereotyping? Multi-personas help

• List friends like/unlike Abby

• Combat techno-stereotyping.