### 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
- <u>82% of users dropped out!!</u>



# 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</p>
- Terrell et al.: not about competence



# Why Care? Society's health

#### • Premises:

- Bad: bias in software
- **Good**: diversity of thought



- Fix the people: force us all to think as software "likes"
- Fix the software: support diverse ways of problem-solving







#### Lot of researchers are looking into Diversity and Inclusion in OSS communities...

#### ... but what about the tools?

#### How are tools contributing to...

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- **Everybody** getting left behind by OSS
- Newcomers getting left behind by OSS
- Newcomer <u>women</u> getting left behind by OSS



Newcomers

Newcomer women

# 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



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### 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" P62:"I know my stuff works' but 'I don't really know what a pull request looks like'" 12

P57: "Abby is new...not even know what CLA is" P61:"the hard part about PR is to find the right button."

### Issues exists across different contexts

Use Case (Abby wants to:)	% Issues found evaluated	per steps
Find help with pull requests on Github	54% (13/24)	
Use GitHub issue tracker to find an issue	71% (12/17)	
Get familiar with open source project and find a task to work on	53% (9/17)	
Set up the environment	44% (40/91)	
Review Submitted pull Request	7% (1/15)	

#### Bottom line



Not just feature bugs or UI issues, but whole sociotechnical spectrum

#### Newcomer tool barriers

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

Finding a task to start with NO1 ••• Finding a mentor NO2 ••• Finding the correct artifacts to fix an issue Poor "How to contribute" available NO3 ••• Outdated list of bugs Reproducing issues Newcomers don't know ...flow NO4 •••

#### Newcomer Orientation Barriers

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• Directions on how to contribute

<> Code

() Issues 303 1 Pull requests 21

Projects 1

🗉 Wiki 🔢 Insights

#### Compare changes

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



#### 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.



- 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)

Barrier categories	# in Tools	Most identified barriers
Newcomer Orientation	56	Newcomers don't know what's the contribution flow
Documentation barriers	36	Unclear Documentation
Cultural differences	7	Some newcomers need to contact a real person
Technical hurdles	56	Building workspace locally
•••		

#### 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 usersA: NOUnconscious bias, supporting (mainly) 1 kind of smart user







#### Gender biases

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- How can we identify gender biases in tools?
- We can use GenderMag

# GenderMag: support inclusive tool design



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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)



Abby

Tim

#### Pat (Patrick & Patricia)

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- 22 years old
- Senior in Computer Science
- Lives in Corvallis, Oregon

When Abby drives to school in the mornings, she listens to her favorite music. She likes a variety of music, and adds to her music collection often. When she arrives at school, she scans over her assignments for the week to get an overall picture of her workload before starting an assignment. (This extra pass takes time but seems worth it.) Some nights she goes to yoga classes, and plays computer puzzle games.

#### **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 <u>has sufficient programming knowledge</u> from her coursework. She has <u>experience with version control but has never used Github</u>.

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

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

learns new she needs to, but she is <u>already familiar</u> keep her focus on the

- 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 <u>rarely has spare time</u>. So she is <u>risk averse about using unfamiliar</u> 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.

#### 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 <u>gathers</u> 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 <u>doesn't particularly like</u> <u>learning by tinkering with software</u> (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.

#### Abby Jones<sup>1</sup>



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#### 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 counterproductive to the way Abby likes to learn" 30

# Gender biases...continued

Barrier Categories	Barriers with gender bias
Newcomer Orientation	41/56 (73%)
Documentation barriers	23/36 (64%)
Cultural Differences	6/7 (86%)
Technical hurdles	37/56 (66%)
•••	
Barriers Totals	160/220 (73%)

### 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)

Gender	Newcomer barriers with gender biases	
Women	153/251 (61%)	
Men	32/83 (39%)	



#### 

#### Bottom line

#### Tools and Infrastructure are implicated in gender biases

	Professionals	Newcomers	Prior Empirical Work	Theoretical Models and Frameworks
Barriers	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
Facets	$\checkmark$	$\checkmark$	$\checkmark\checkmark\checkmark\checkmark$	$\checkmark$ $\checkmark$ $\checkmark$

### 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





### 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, #GenderMaggendermag.method

#### Resources: gendermag.org

Flyer, papers, personas, foundations, ... Download the kit!



Make it happen @ your university/company! anita.sarma@oregonstate.edu

# Backup Slides

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### Stereotyping? Multi-personas help



• List friends like/unlike Abby





• Combat techno-stereotyping.