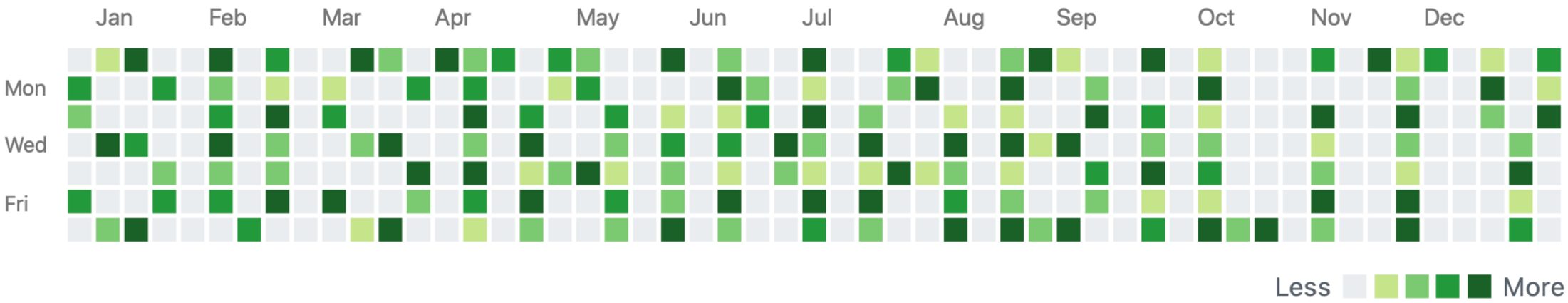
What can analyzing tens of terabytes of public trace data tell us about open source



Bogdan Vasilescu
@b_vasilescu

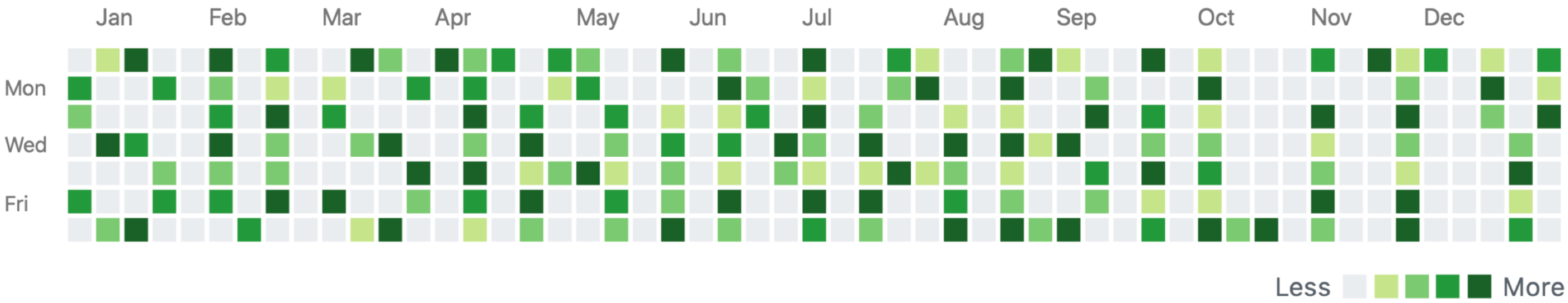
Christian Kästner
@p0nk

Sustaining open source is hard

However,

The fact that (almost) everything is archived and public makes it possible to study the problem empirically

What can analyzing tens of terabytes of public trace data tell us about open source



This talk is about some of the things we learned

Note: We have a singularly academic perspective

Ivory tower #1

Ivory tower #2

CMU Campus

Note: We have a singularly academic perspective

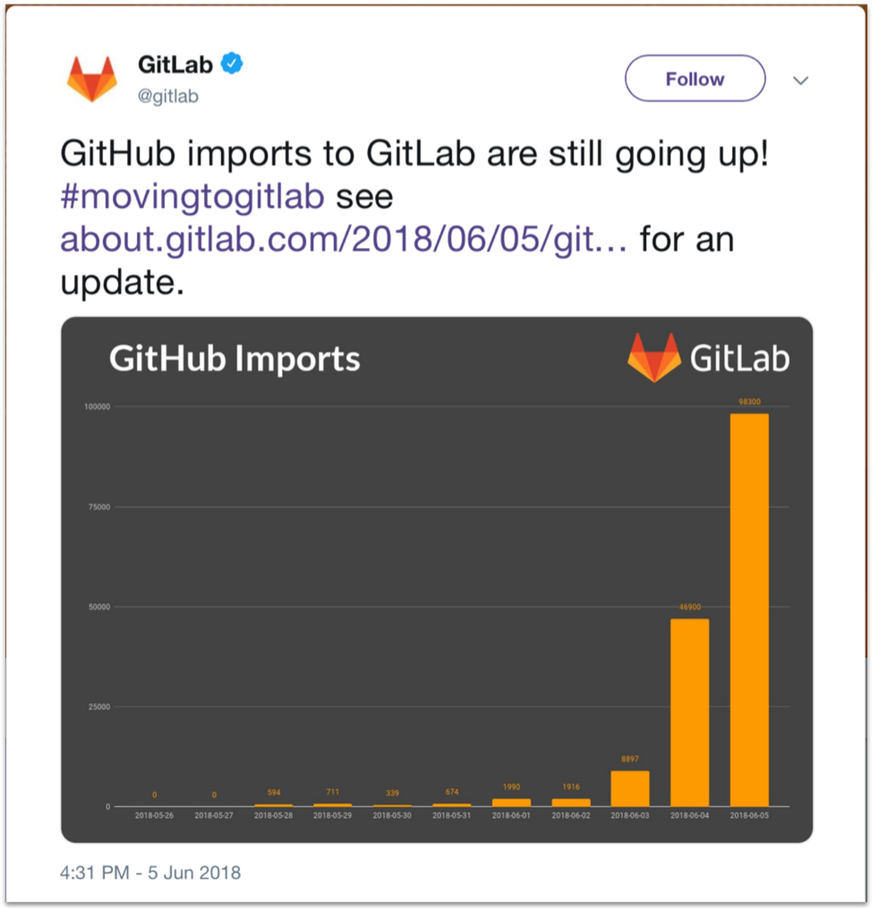
CMU Campus

We'd like to hear and learn from you!

How we see open source today

Change #1: More open source now than ever before

- Explosion of production in the past eight years



github SOCIAL CODING

100 million repositories

31 million users

(November 2018)

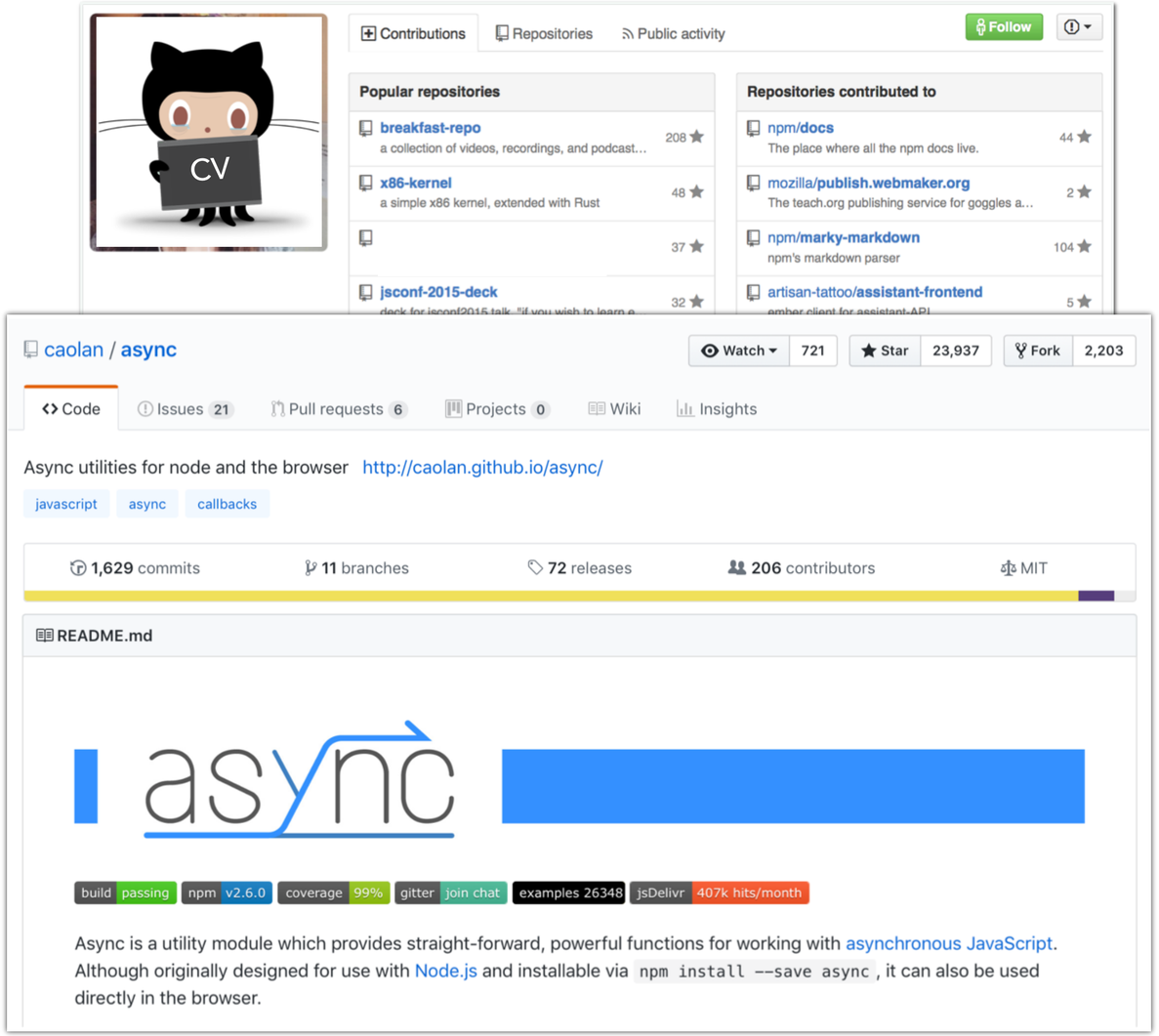
Bitbucket

6 million users

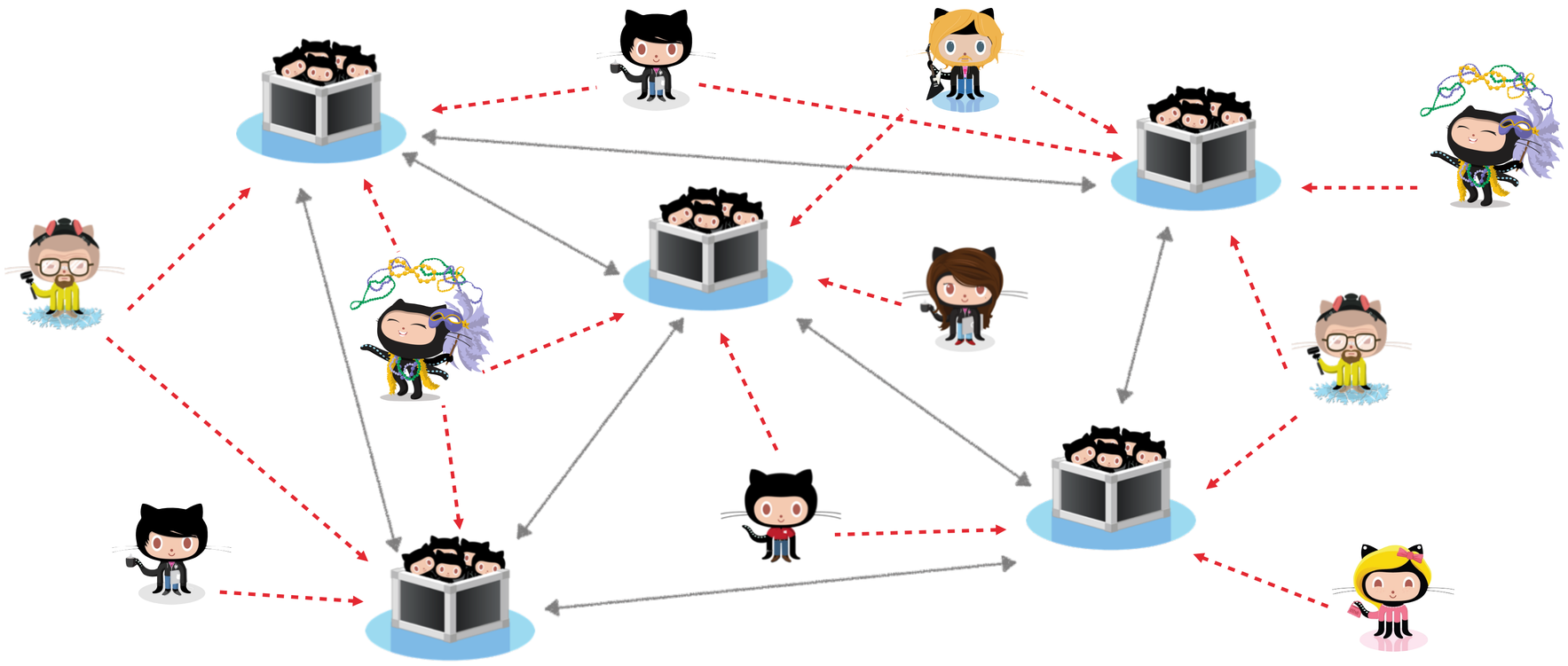
(March 2019)

Change #2: The rise of social platforms

- Profile pages for users and projects
- Rich inferences about people's expertise and level of commitment
- Impacts collaboration, but also recruiting and hiring
  - (Dabbish et al. 2012), (Marlow et al. 2013), (Marlow and Dabbish 2013)



Change #3: Complex socio-technical ecosystems



Interconnections & dependencies

Can be brittle

The Heartbleed Bug

The Heartbleed Bug is a serious vulnerability in the popular OpenSSL cryptographic software library. This weakness allows stealing the information protected, under normal conditions, by the SSL/TLS encryption used to secure the Internet. SSL/TLS provides communication security and privacy over the Internet for applications such as web, email, instant messaging (IM) and some virtual private networks (VPNs).

The Heartbleed bug allows anyone on the Internet to read the memory of the systems protected by the vulnerable versions of the OpenSSL software. This compromises the secret keys used to identify the service providers and to encrypt the traffic, the names and passwords of the users and the actual content. This allows attackers to eavesdrop on communications, steal data directly from the services and users and to impersonate services and users.

What leaks in practice?

We have tested some of our own services from attacker's perspective. We attacked ourselves from outside, without leaving a trace. Without using any privileged information or credentials we were able steal from ourselves the secret keys used for our X.509 certificates, user names and passwords, instant messages, emails and business critical documents and communication.

How to stop the leak?

As long as the vulnerable version of OpenSSL is in use it can be abused. Fixed OpenSSL (https://www.openssl.org/news/secadv/20140407.txt) has been released and now it has to be deployed. Operating system vendors and distribution, appliance vendors, independent software vendors have to adopt the fix and notify their users. Service providers and users have to install the fix as it becomes available for the operating systems, networked appliances and software they use.

https://heartbleed.com

NPM ERR!

How one programmer broke the internet by deleting a tiny piece of code

By Keith Collins · March 27, 2016

leftpad.js package.json

```
module.exports = leftpad;
function leftpad (str, len, ch) {
  str = String(str);
  var i = -1;
  if (!ch && ch !== 0) ch = ' ';
  len = len - str.length;
  while (++i < len) {
    str = ch + str;
  }
  return str;
}
```

https://qz.com/646467/how-one-programmer-broke-the-internet-by-deleting-a-tiny-piece-of-code/

Change #4: Increasing commercialization and professionalization

- Historically
  - Community-based projects (Python, RubyGems, Twisted)

- Currently
  - Lots of commercial involvement
    - Companies (Go - Google, React - Facebook, Swift - Apple)
    - Startups (Docker, npm, Meteor)

- 23% of respondents to 2017 GitHub survey: job duties include contributing to open source

http://opensourcesurvey.org/2017/

Change #5: High expectations toward the quality, reliability, and security of open source infrastructure

- Equifax (market cap $14 billion) built products on top of open-source infrastructure, including Apache Struts
- Equifax did not make any contributions to open source projects
- A flaw in Apache Struts contributed to the breach (CVE-2017-5638)
- Equifax publicly blamed (with national news coverage) Apache Struts for the breach

Equifax confirms Apache Struts security flaw it failed to patch is to blame for hack

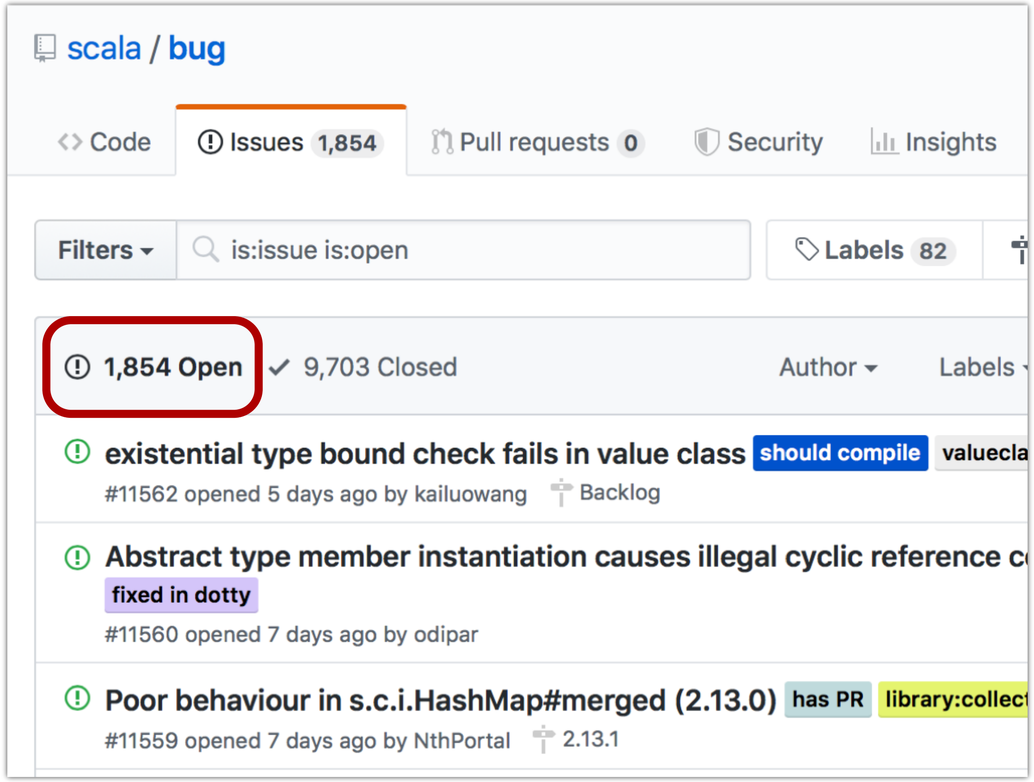
The company said the March vulnerability was exploited by hackers.

By Zack Whittaker | September 14, 2017 -- 01:27 GMT (18:27 PDT) | Topic: Security

https://www.zdnet.com/article/equifax-confirms-apache-struts-flaw-it-failed-to-patch-was-to-blame-for-data-breach/

Change #6: High level of demands & stress

- Easy to report issues / submit PRs
  - Growing volume of requests
- Social pressure to respond quickly
  - Otherwise, off-putting to newcomers (Steinmacher et al. 2015)
- Entitlement, unreasonable requests from users:
  - *"I have been waiting 2 years for Angular to track the 'progress' event and it still can't get it right?!?!"*
  - *"Thank you for your ever useless explanations."*



Lots of change, lots of challenges

- Best practices?
- What works?
- What doesn't?
- Long term sustainability?
- Equitable and healthy interactions?

Science is needed for evidence-based recommendations

Anecdotal evidence reliable? One man says "yes".

A STUDY CONDUCTED YESTERDAY by a man on himself concluded that self-reported anecdotal evidence is, in fact, both reliable and relevant.

The landmark study, conducted by Mark Mattingly of Virginia Beach in his apartment, concluded with 100% accuracy that data collected from personal experience can disprove other data conducted by reputable scientific institutions, thereby proving once and for all that "statistics can't be trusted".

In a press release Mr. Mattingly took aim at his detractors saying that "…this study shows what I've been telling people on the internet for years: all your fancy evidence and statistics don't mean nothing in the real world.".

A frequenter of internet forums, comment sections, and social media, Mr. Mattingly recounts that he was inspired to undertake the study when someone reportedly kept insisting that he provide evidence for his claims. "I think everyone's entitled to an opinion, and that my opinion is worth just as much as anyone else's" Mr. Mattingly said.

Academic types have criticised the study, and papers who are publishing it, saying that it lacks everything and makes no sense. When shown the study, Emeritus Professor James Albrecht of Carnegie Mellon University looked all confused and hopeless before making pining, guttural sounds.

Mr. Mattingly in his apartment looking all smug.

Mr. Mattingly has responded saying that this is just the first of many studies he intends to conduct, and that a meta-analysis of people who have opinions and anecdotal experiences independent of controls, methodological rigor, blinding and peer review are soon to be published, adding further weight to his initial findings.

***Published Saturday 22 February 2014 by** yourlogicalfallacyis.com/anecdotal* *Photo: Weasello*

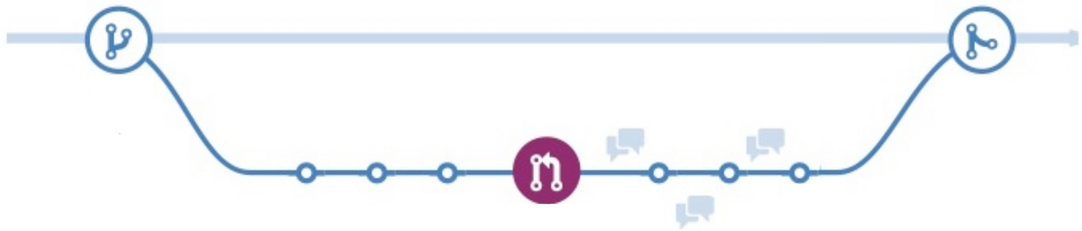
A great opportunity for research

GitHub standardized the practices

Version control

git

The Pull Request model



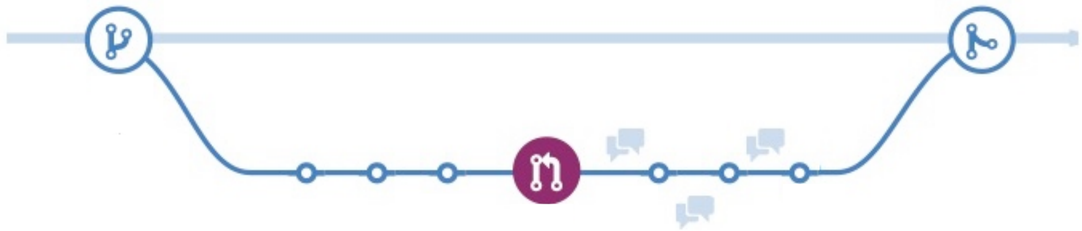
→ Uniform access to contribution data

GitHub standardized the practices

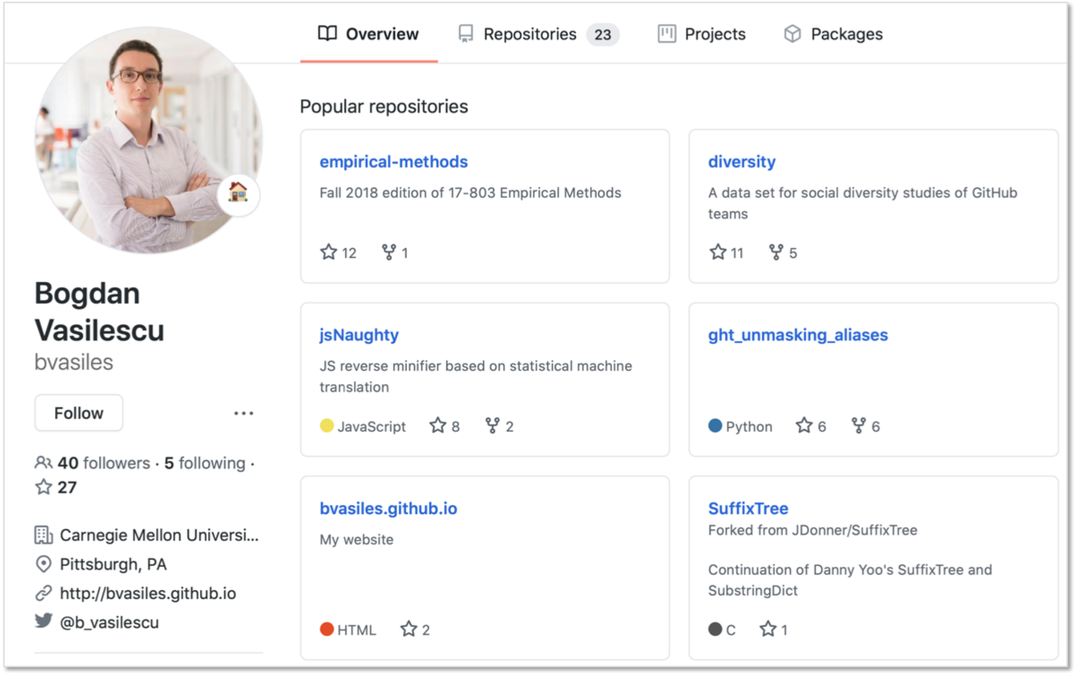
Version control

git

The Pull Request model



User profile pages



→ Uniform access to contribution and personal data

Heaps of data

GitHub alone:

More than 50M people and 100M repositories hosted as of August 2019

Beyond GitHub:

“The collection of public Git repositories as a whole […] exceeds 1.5PB” (Ma et al, 2019)

For reference: English Wikipedia

6M articles and 40M users as of August 2020

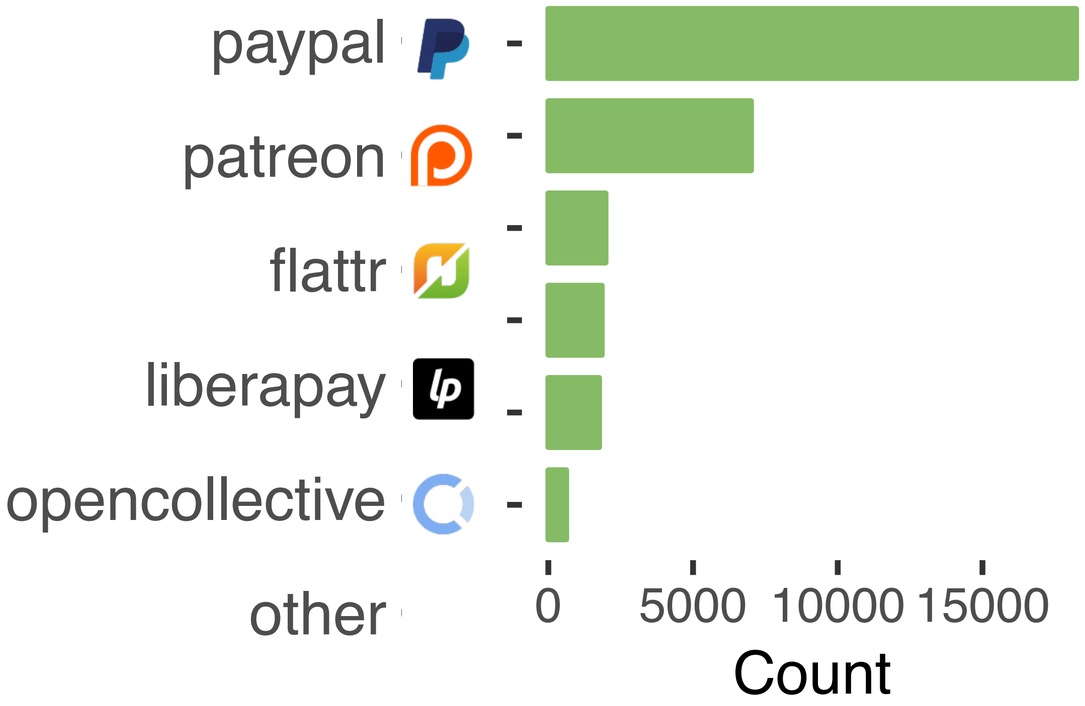
Ma, Y., Bogart, C., Amreen, S., Zaretzki, R., & Mockus, A. (2019, May). World of Code: An infrastructure for mining the universe of open source VCS data. In *2019 IEEE/ACM 16th International Conference on Mining Software Repositories (MSR)* (pp. 143-154). IEEE.

A great opportunity for research

From anecdotes and small-sample studies to ecosystem-wide censuses and large-scale quantitative models

GitHub

Overall, 0.04% of repos ask for donations



as of May 23, 2019

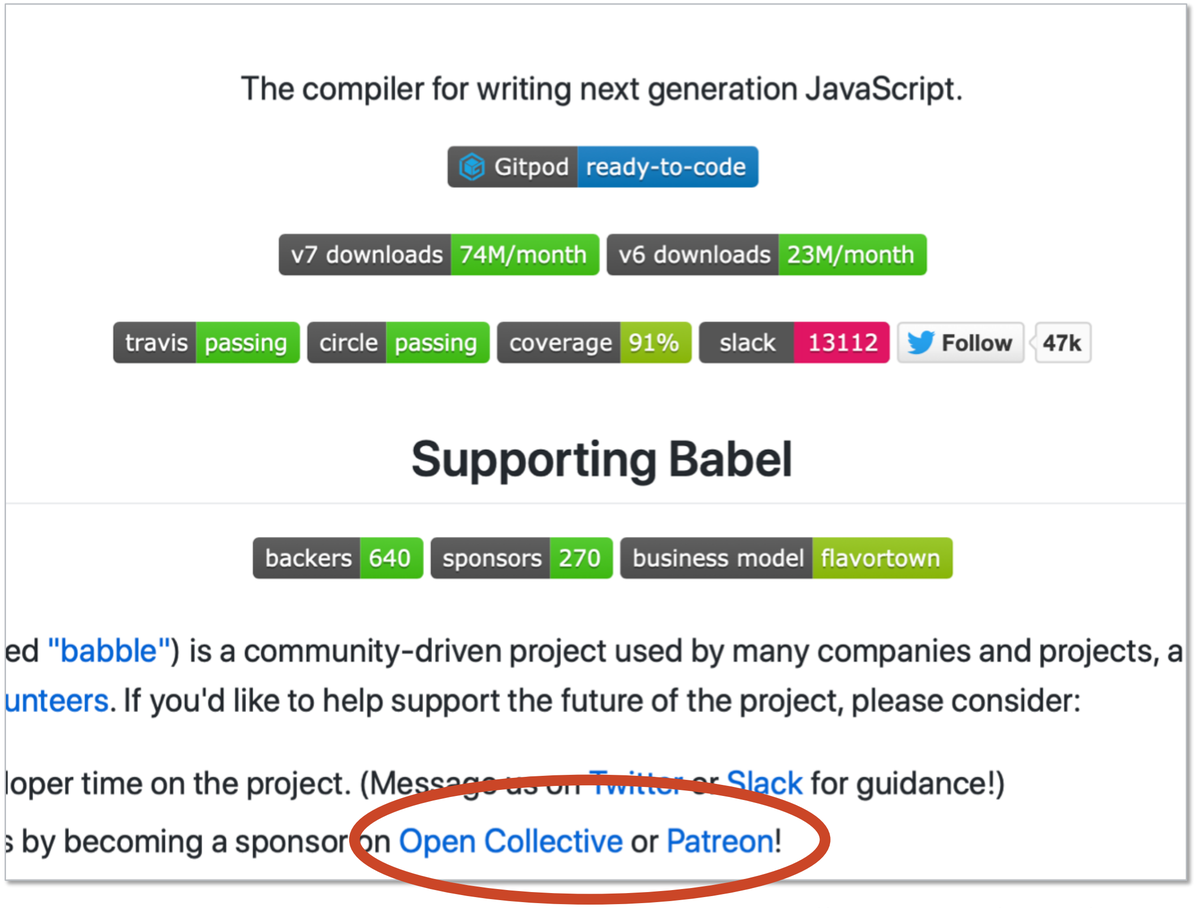
The data is naturally longitudinal

All events have timestamps:

- Commits
- Issues
- …

Therefore, one can:

- Track changes to files
- Track people joining and leaving projects
- …



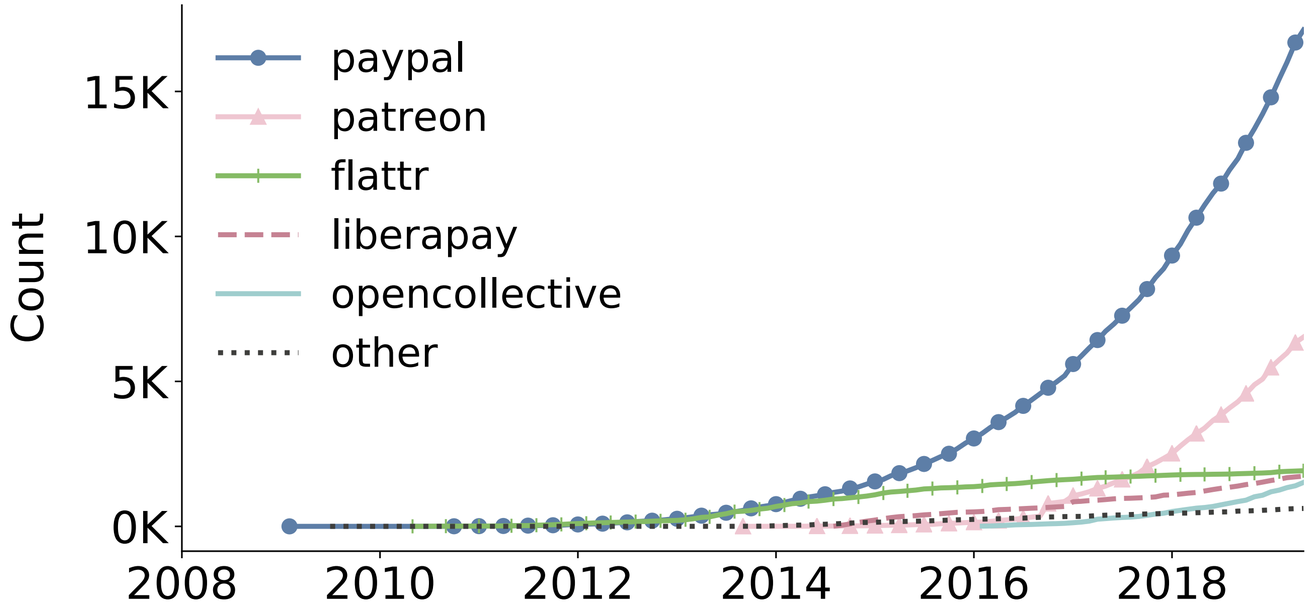
https://github.com/babel/babel

A great opportunity for research

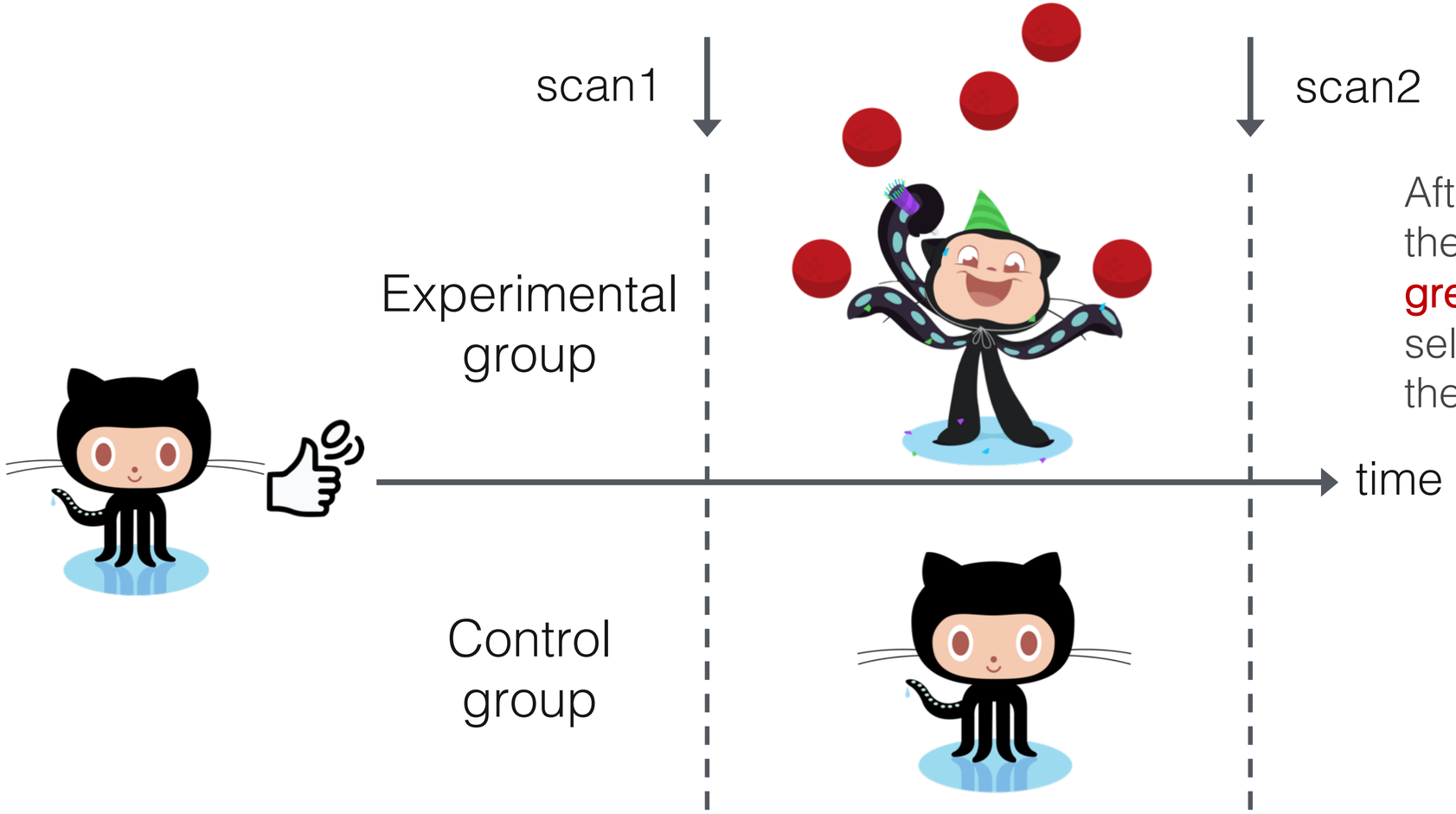
Capture and understand trends over time, analyze time series data

GitHub

Adoption of donation platforms over time



Juggling as a sustainability intervention?



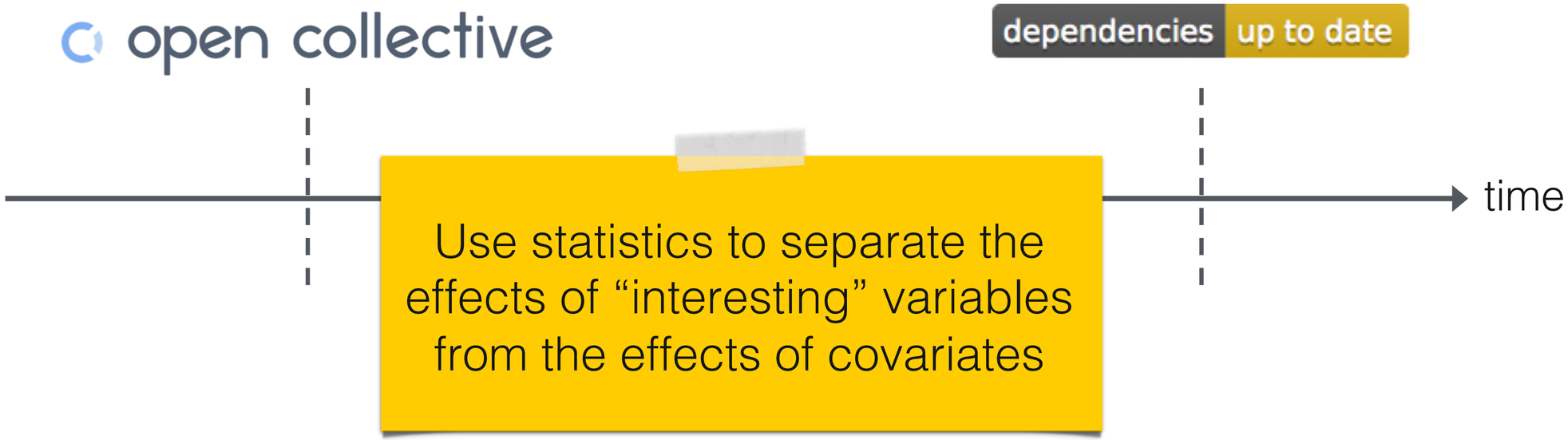
After just three months of practice the juggler group showed **increased grey matter volume** in motion-selective visual areas compared to the no-juggle control group

Bogdan Draganski, Christian Gaser, V. Busch, G. Schuierer, U. Bogdahn, and A. May. "Changes in grey matter induced by training." Nature 427, no. 6972 (2004): 311-312.

Natural experiments: interventions are outside the control of the researchers

Project started receiving donations

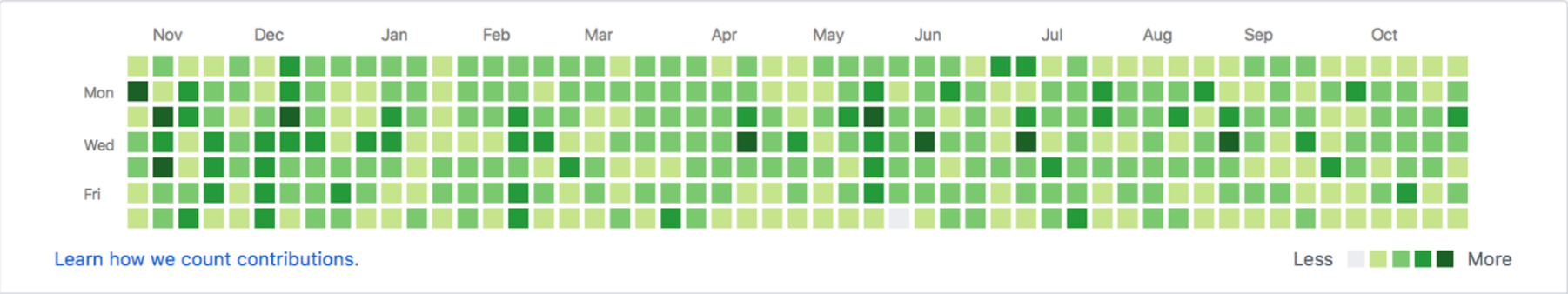
Project adopted a certain practice / tool



But be careful, the data is noisy!

- Hyperactive maintainer? No, bot

5,786 contributions in the last year

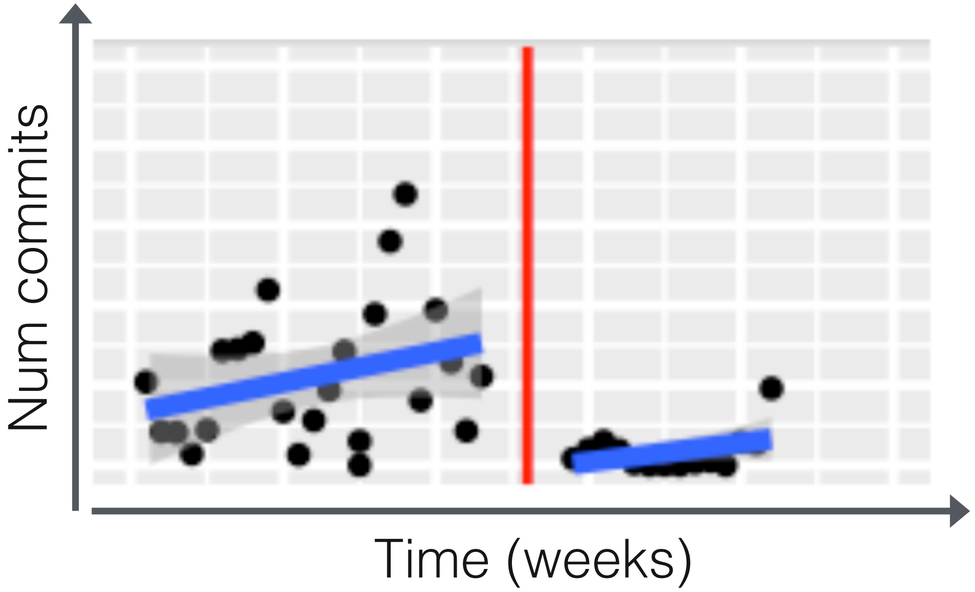


fossabot
fossabot

Follow

Your friendly neighborhood badge bot. Sends PRs to your READMEs when integrating tools from **@fossas** to track scan status. Feedback? Contact support@fossa.io!

Why did this person drop out?



- Social science theory
- Qualitative analysis (surveys, interviews)

Journal of Applied Psychology
2017, Vol. 102, No. 3, 530–545

0021-9010/17/$12.00 http://dx.doi.org/10.1037/apl0000103

One Hundred Years of Employee Turnover Theory and Research

Peter W. Hom
Arizona State University

Thomas W. Lee
University of Washington

Jason D. Shaw
Hong Kong Polytechnic University

John P. Hausknecht
Cornell University

We review seminal publications on employee turnover during the 100-year existence of the *Journal of Applied Psychology*. Along with classic articles from this journal, we expand our review to include other publications that yielded key theoretical and methodological contributions to the turnover literature. We first describe how the earliest papers examined practical methods for turnover reduction or control and then explain how theory development and testing began in the mid-20th century and dominated the academic literature until the turn of the century. We then track 21st century interest in the psychology of staying (rather than leaving) and attitudinal trajectories in predicting turnover. Finally, we discuss the rising scholarship on collective turnover given the centrality of human capital flight to practitioners and to the field of human resource management strategy.

Let’s look at some concrete examples

STRIDEL sustainability research on …

Open-source projects

Project practices

- ICSE 2020 (forking)
- ESEC/FSE 2019 (forking)
- ESEC/FSE 2018 (abandonment factors)
- FSE 2016 (breaking changes)

Attracting contributors

- MSR 2020 (Twitter)
- CSCW 2019 (signals)
- ESEC/FSE 2015 (social connections)

Funding models

- ICSE 2020 (donations)

Transparency and signaling

- ESEC/FSE 2020 (diffusion of practices)
- ICSE 2018 (badges)

Open-source people

Stress, burnout, disengagement

- ICSE NIER 2020 (toxic language)
- ICSE 2019 (overwork)
- OSS 2019 (dropout and survival analysis)

Diversity and inclusion

- ICSE 2019 (social capital)
- CHI 2015 (gender & tenure)
- CHASE 2015 (survey)

1.
Open Source and money

A handy guide to financial support for open source.

"I do open source work, how do I find funding?"

This document aims to provide an exhaustive list of all the ways that people get paid for open source work. Hopefully, projects and contributors will find this helpful in figuring out the best options for them.

The list below is roughly ordered from small to large. Each funding category links to several real examples (using topical articles or pages wherever possible instead of just a project's homepage.)

The categories are not mutually exclusive. For example, a project might have a foundation but also use crowdfunding to raise money. Someone else might do consulting and also have a donation button. Etc.

Table of Contents

https://github.com/nayafia/lemonade-stand

Donations are gaining in popularity as a potential solution

Only anecdotes about their prevalence and impact

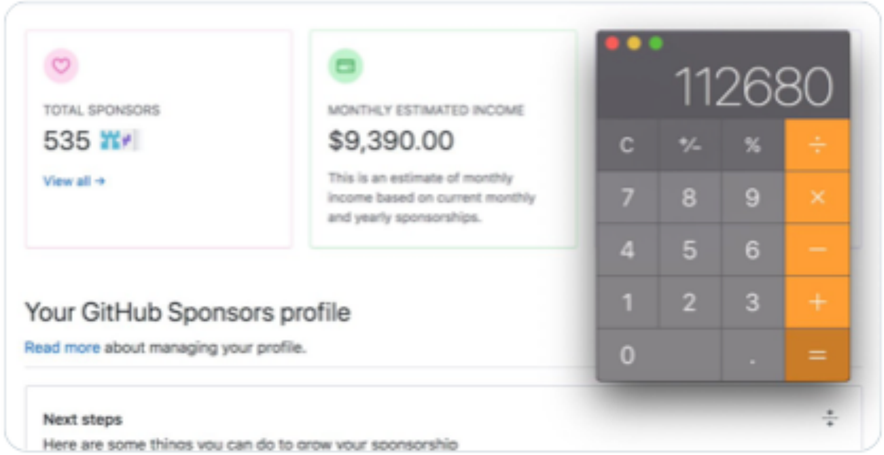
Caleb Porzio
@calebporzio

🎉❤️ I just cracked $100k/yr on GitHub Sponsors. ❤️🎉

Life. Changed.

Huge thanks to everyone's generosity and the GH Sponsors team! ❤️🙏

Did a writeup of the entire journey if you care:
calebporzio.com/i-just-hit-dol...



9:42 AM · Jun 23, 2020

5.2K 778 people are Tweeting about this

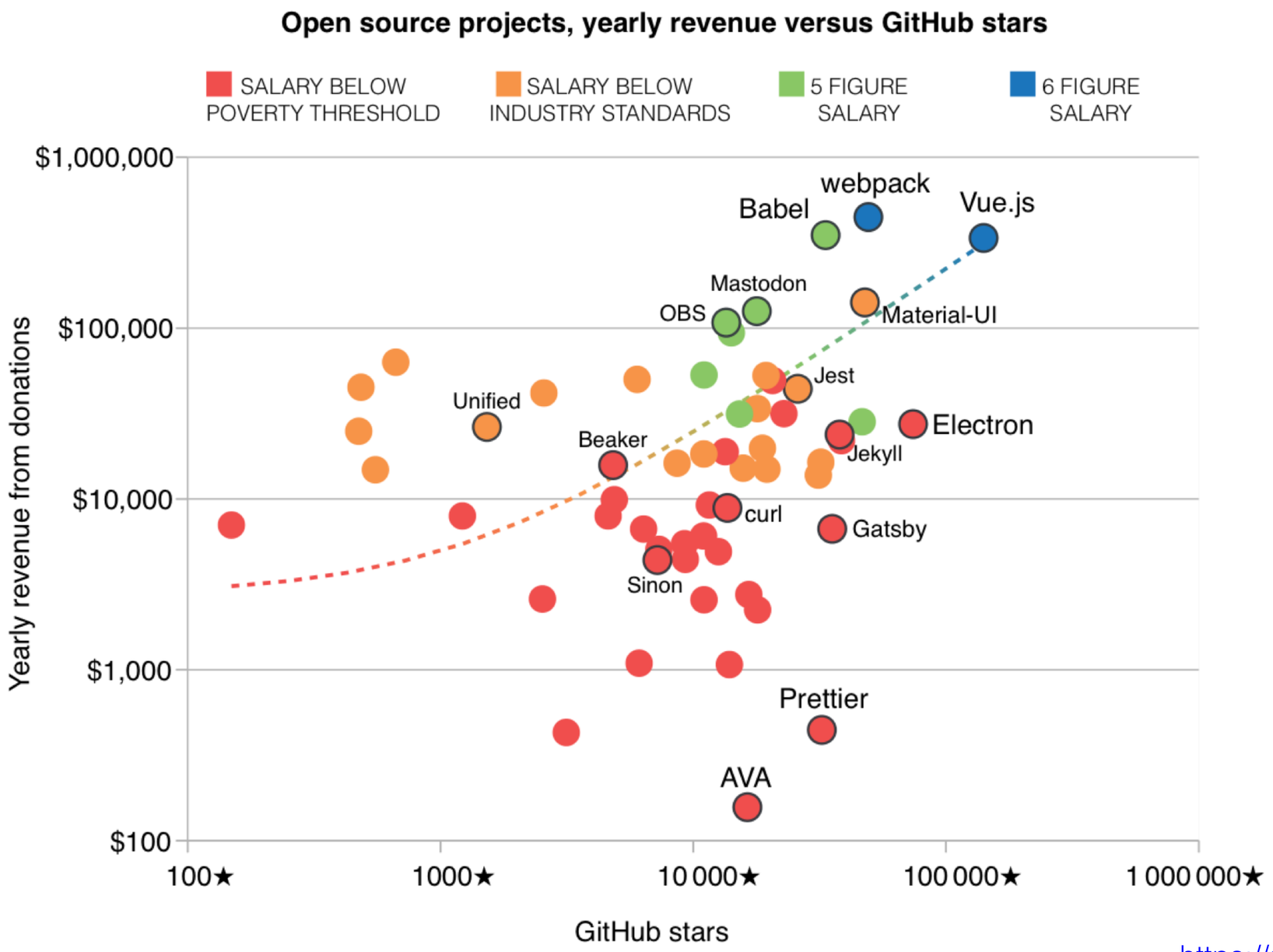
Chris Aniszczyk
@cra

paying maintainers via charity or donations is the wrong approach for long term sustainability, also shorts maintainers into a gig-style economy without benefits, it's corporations that need to give back through hiring and setting time for open source contribution

> **sMyle** @MylesBorins
> Open source doesn't work without large scale enterprise or corporate investment
>
> Simply paying maintainers has the wrong incentive model and is not scalable. twitter.com/AmarachiAmaech...

8:07 PM · Mar 10, 2019 from San Carlos, CA

57 See Chris Aniszczyk's other Tweets



Source: GitHub and OpenCollective web pages on June 11th 2019.

https://staltz.com/software-below-the-poverty-line.html

Lots to explore…

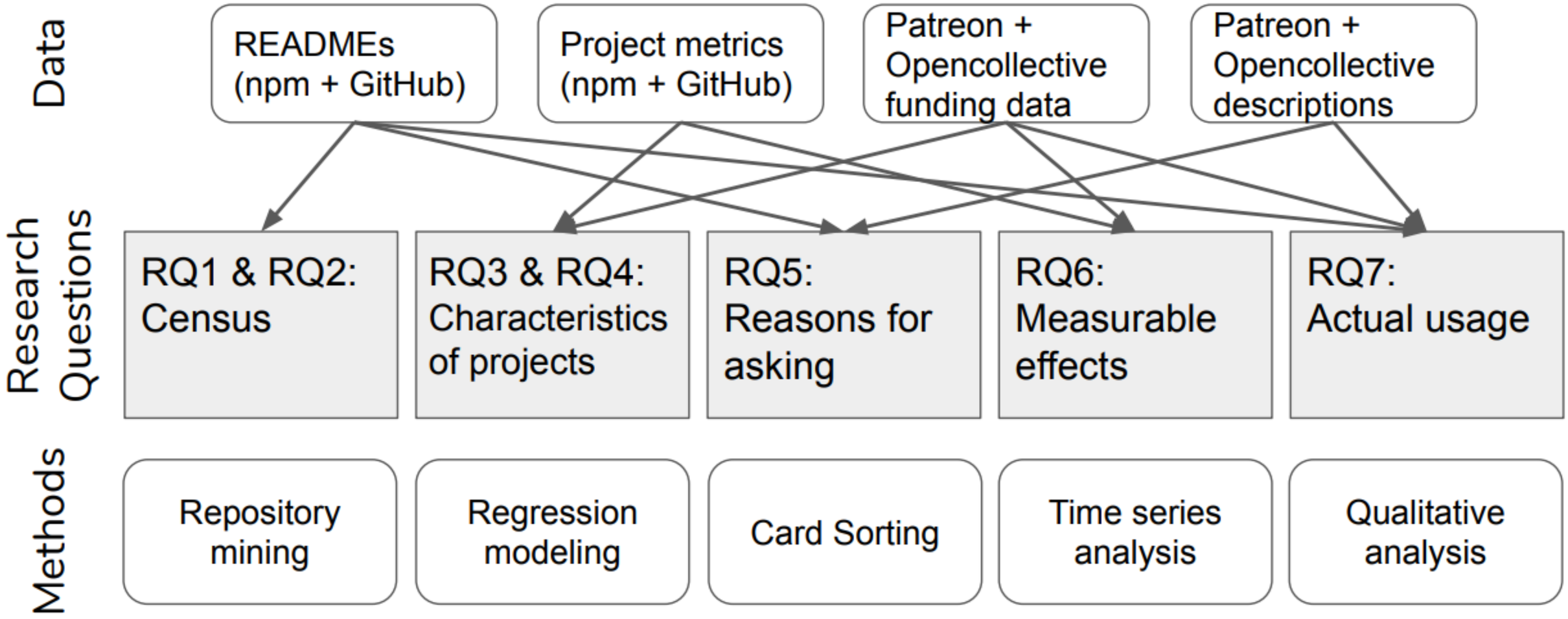
GitHub-scale
census of donation
requests

Stated
expectations
for donations

Actual
usage
of donations

Characteristics
of projects asking /
getting money

Measurable
effects
of donations


Data
READMEs (npm + GitHub)
Project metrics (npm + GitHub)
Patreon + Opencollective funding data
Patreon + Opencollective descriptions
Research Questions
RQ1 & RQ2: Census
RQ3 & RQ4: Characteristics of projects
RQ5: Reasons for asking
RQ6: Measurable effects
RQ7: Actual usage
Methods
Repository mining
Regression modeling
Card Sorting
Time series analysis
Qualitative analysis

Key insight for identifying donation platforms: README files contain signals of donation requests

The compiler for writing next generation JavaScript.

Gitpod ready-to-code

v7 downloads 74M/month v6 downloads 23M/month

travis passing circle passing coverage 91% slack 13112 Follow 47k

Supporting Babel

backers 640 sponsors 270 business model flavortown

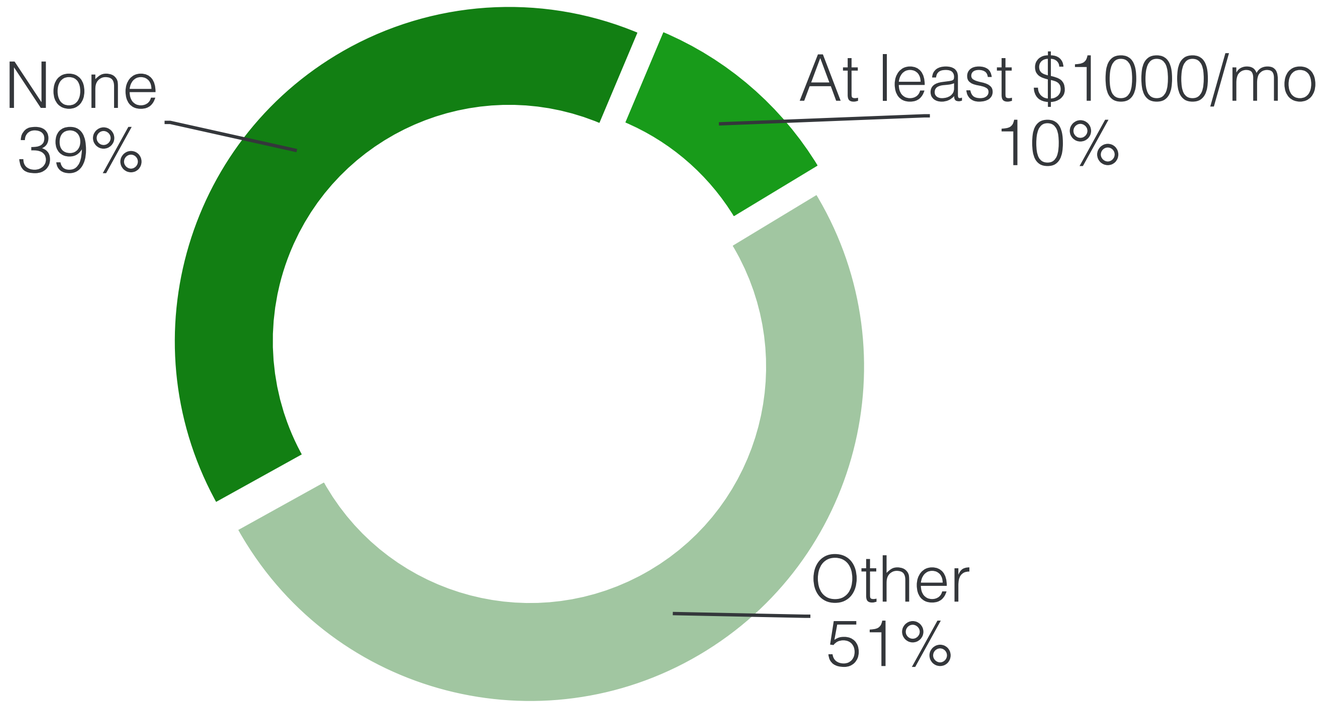
Babel (pronounced "babble") is a community-driven project used by many companies and projects, and is maintained by a group of volunteers. If you'd like to help support the future of the project, please consider:

- Giving developer time on the project. (Message us on Twitter or Slack for guidance!)
- Giving funds by becoming a sponsor on Open Collective or Patreon!

https://github.com/babel/babel

Most projects receive little funding

Sample: 6,516 repos using patreon / open collective



last 9 months before May 23, 2019

Statistical multi-variate analysis

	Resp: *Asks for donations*	
	Coeffs (Err.)	Deviance
(Intercept)	−4.01 (0.19)***	
commits (log)	0.40 (0.05)***	72.95***
size (log)	−0.30 (0.03)***	125.74***
project age	0.02 (0.00)***	85.94***
is active	1.95 (0.09)***	502.20***
is org	−0.57 (0.10)***	33.63***
stars (log)	0.27 (0.02)***	129.89***
downloads (log)	−0.02 (0.02)	0.88
dependents (log)	0.01 (0.05)	0.02
Num. obs.	9137	
R^2	0.31	

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

	Hurdle model		**Count model**	
	Resp: *Received any*		Resp: *Amount received*	
	Coeffs (Err.)	Deviance	Coeffs (Err.)	Sum sq.
(Intercept)	0.12 (0.38)		4.17 (0.39)***	
commits (log)	−0.20 (0.12)	3.05	−0.26 (0.11)*	20.41*
size (log)	−0.10 (0.06)	2.80	0.06 (0.07)	2.67
project age	0.05 (0.01)***	58.63***	−0.01 (0.00)	10.93
is active	1.33 (0.22)***	38.73***	0.00 (0.21)	0.00
is org	0.84 (0.26)**	10.78**	0.12 (0.20)	1.37
stars (log)	0.14 (0.06)*	6.06*	0.39 (0.06)***	182.17***
downloads (log)	−0.11 (0.06)	3.51	0.13 (0.05)**	28.60**
dependents (log)	0.31 (0.11)**	8.98**	−0.04 (0.08)	0.85
Num. obs.	735		527	
R^2	0.29		0.30	

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Projects asking for donations…

more active

more popular

smaller

personal accounts

Projects receiving more donations…

more stars

more downloads

Developers plan to spend donations on …

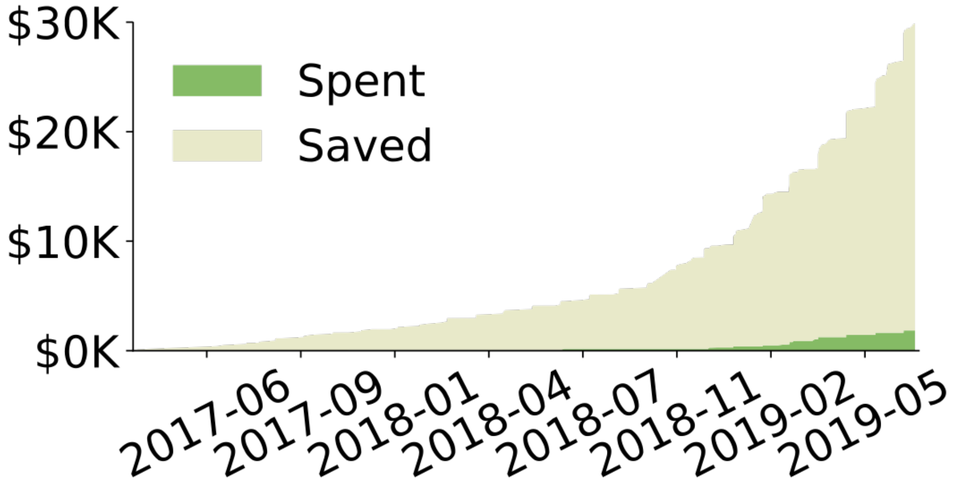
Engineering	Community	Project Expenses	Personal
48%	18%	13%	9%

Qualitative analysis of donation profile pages for 109 npm projects on patreon open collective KICKSTARTER

The use of donations varies widely: Savers vs spenders

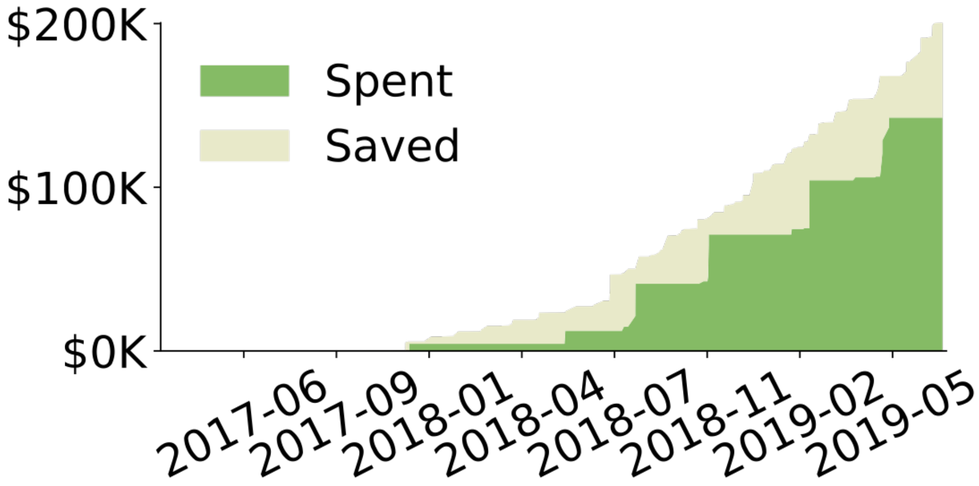
64% Savers

spend less than 25% of raised donations



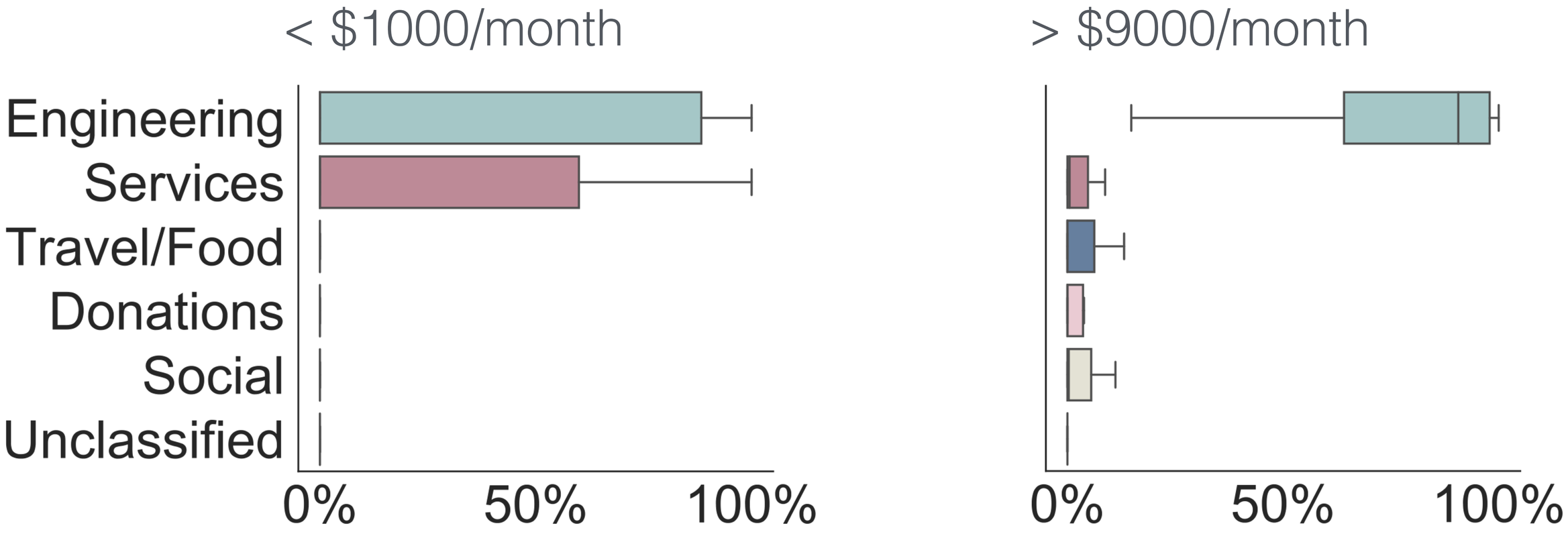
11% Spenders

spend more than 75% of raised donations



The use of donations varies widely:

Type of expenses



Takeaways on how to effectively raise donations

Reputation matters

Awareness of need

Efficiency of using funds

Dark Side of donations

Theory matters!

2.
Transparency and signaling

Key insight for identifying donation platforms: README files contain signals of donation requests

The compiler for writing next generation JavaScript.

Gitpod ready-to-code

v7 downloads 74M/month v6 downloads 23M/month

travis passing circle passing coverage 91% slack 13112 Follow 47k

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backers 640 sponsors 270 business model flavortown

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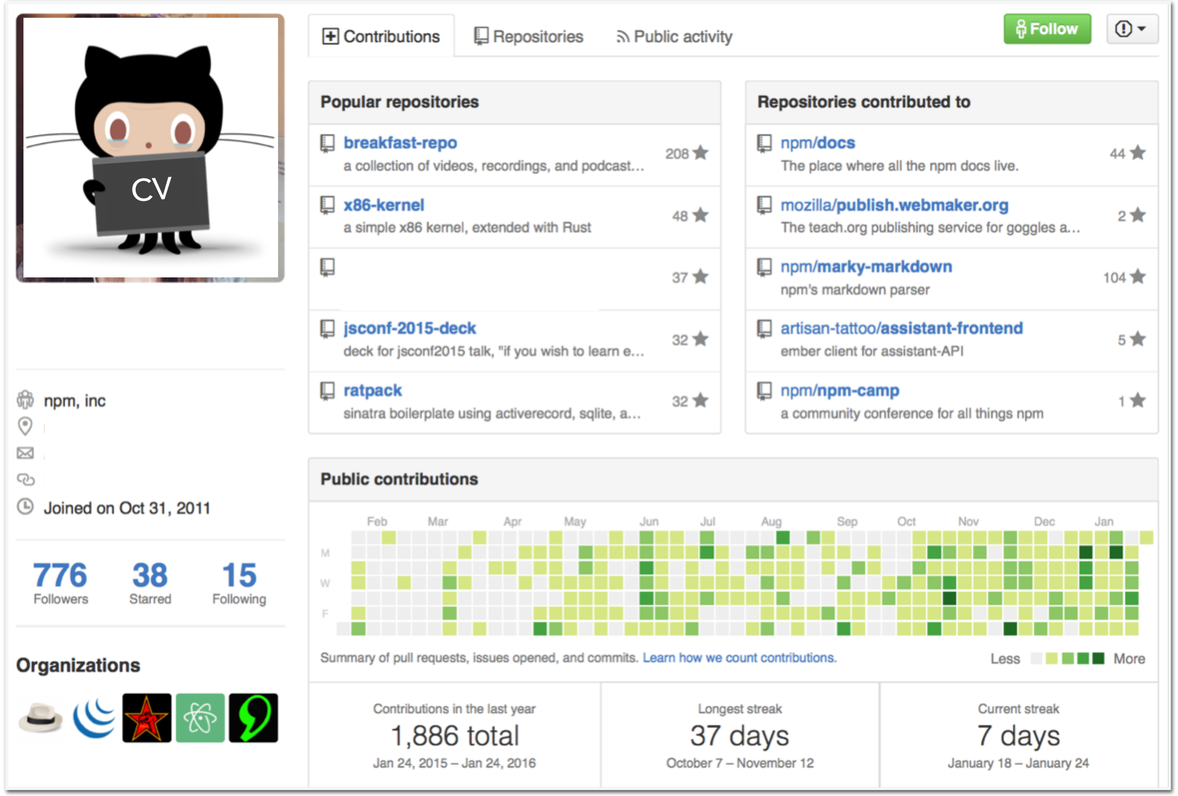
https://github.com/babel/babel

Transparency is already a defining characteristic of the environment



Signals are customizable

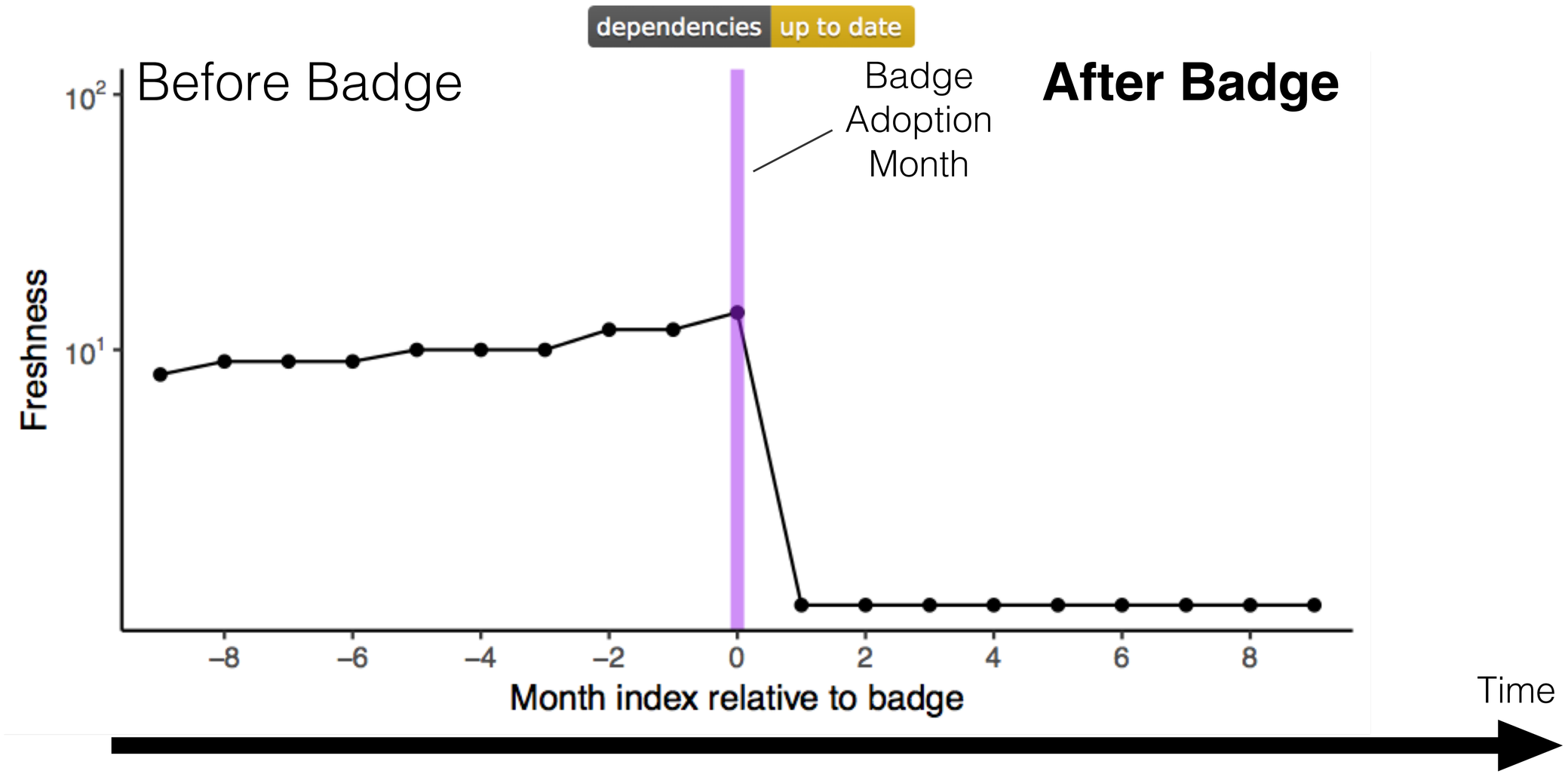
- E.g., repository badges

README.md

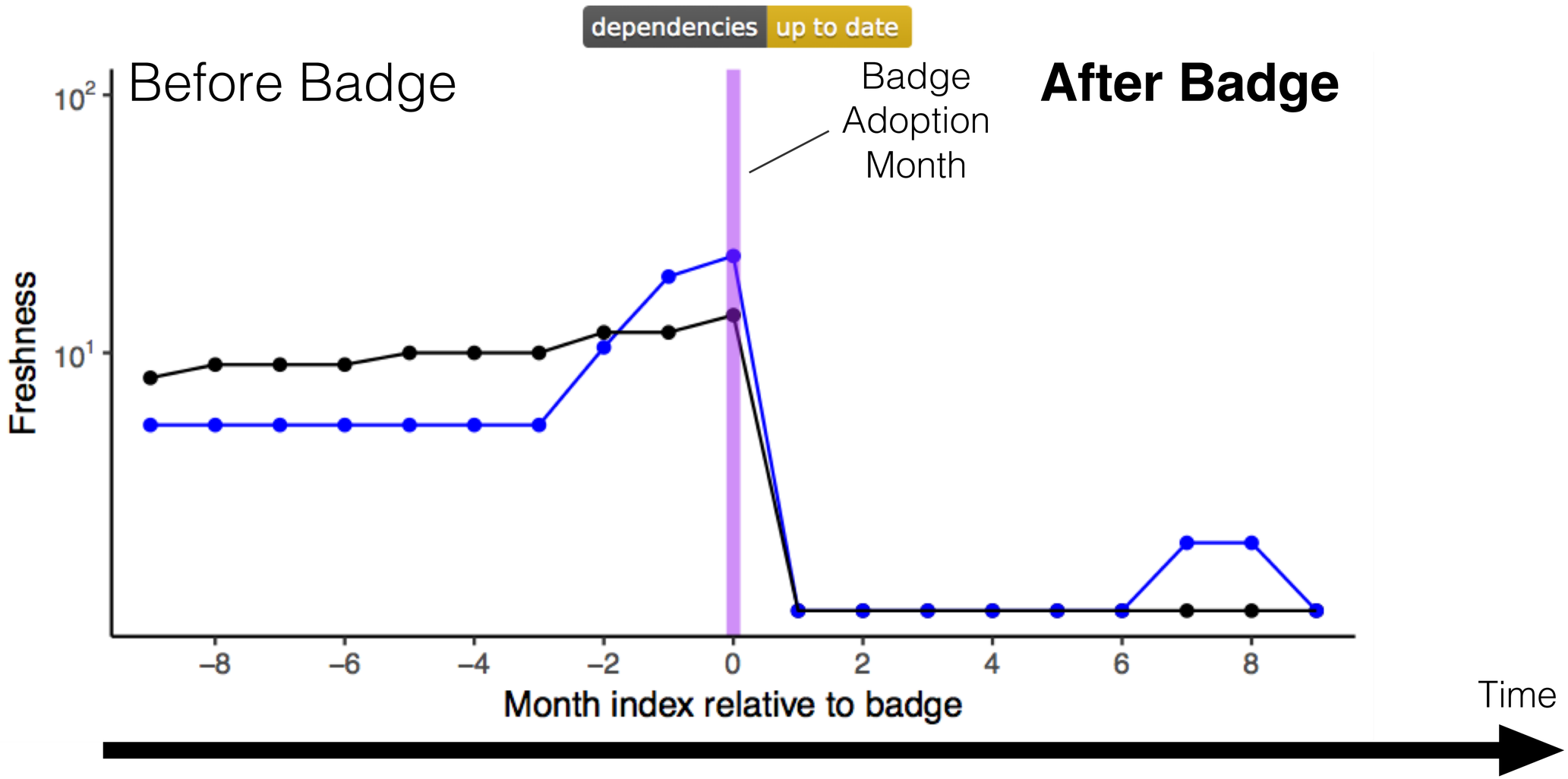
Async is a utility module which provides straight-forward, powerful functions for working with
Although originally designed for use with Node.js and installable via `npm install --save as`
directly in the browser.

- Adding Sparkle to Social Coding: An Empirical Study of Repository Badges in the npm Ecosystem. Trockman, A., Zhou, S., Kästner, C., and Vasilescu, B. *ICSE 2018*

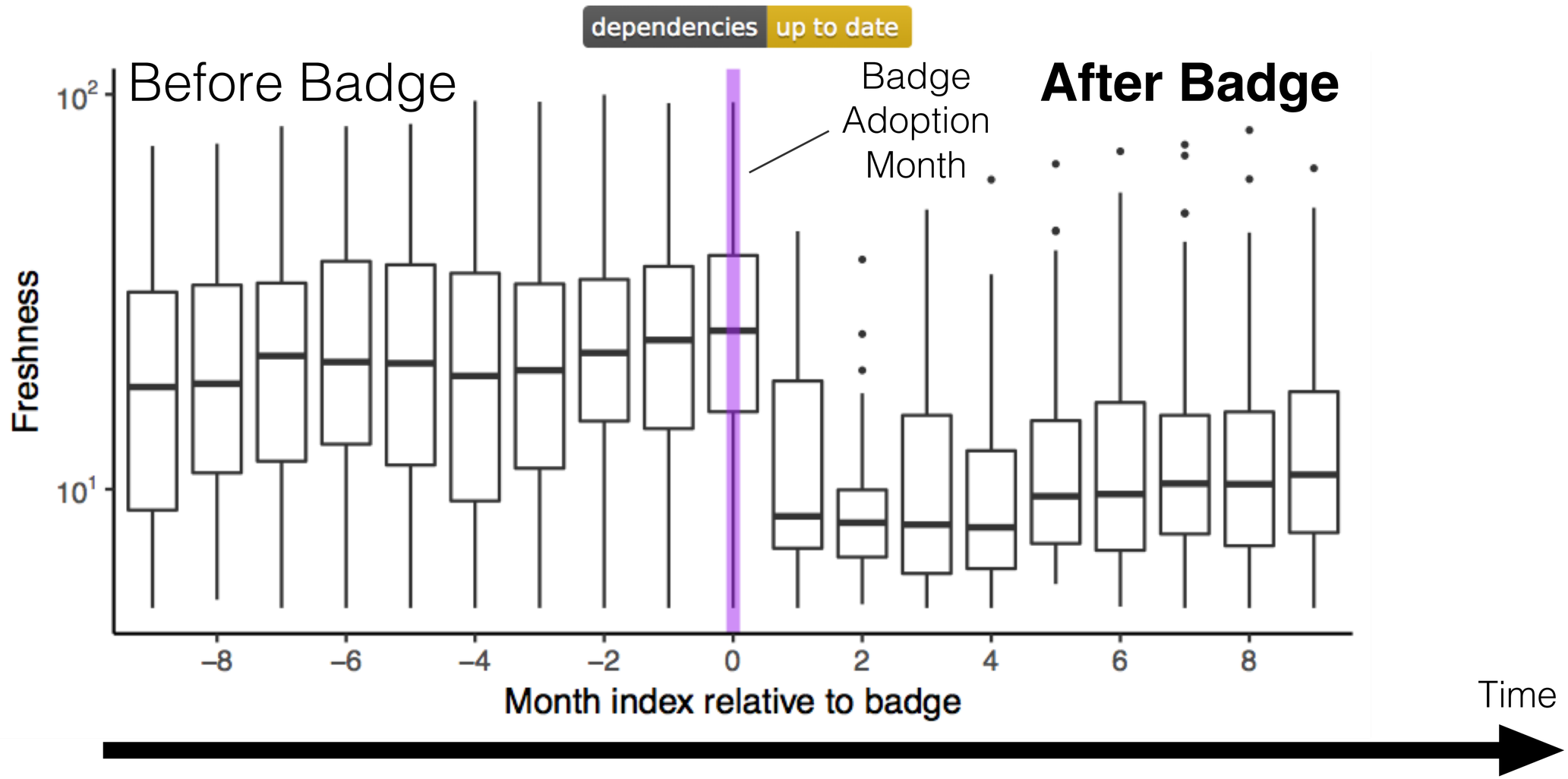
Time Series Analysis



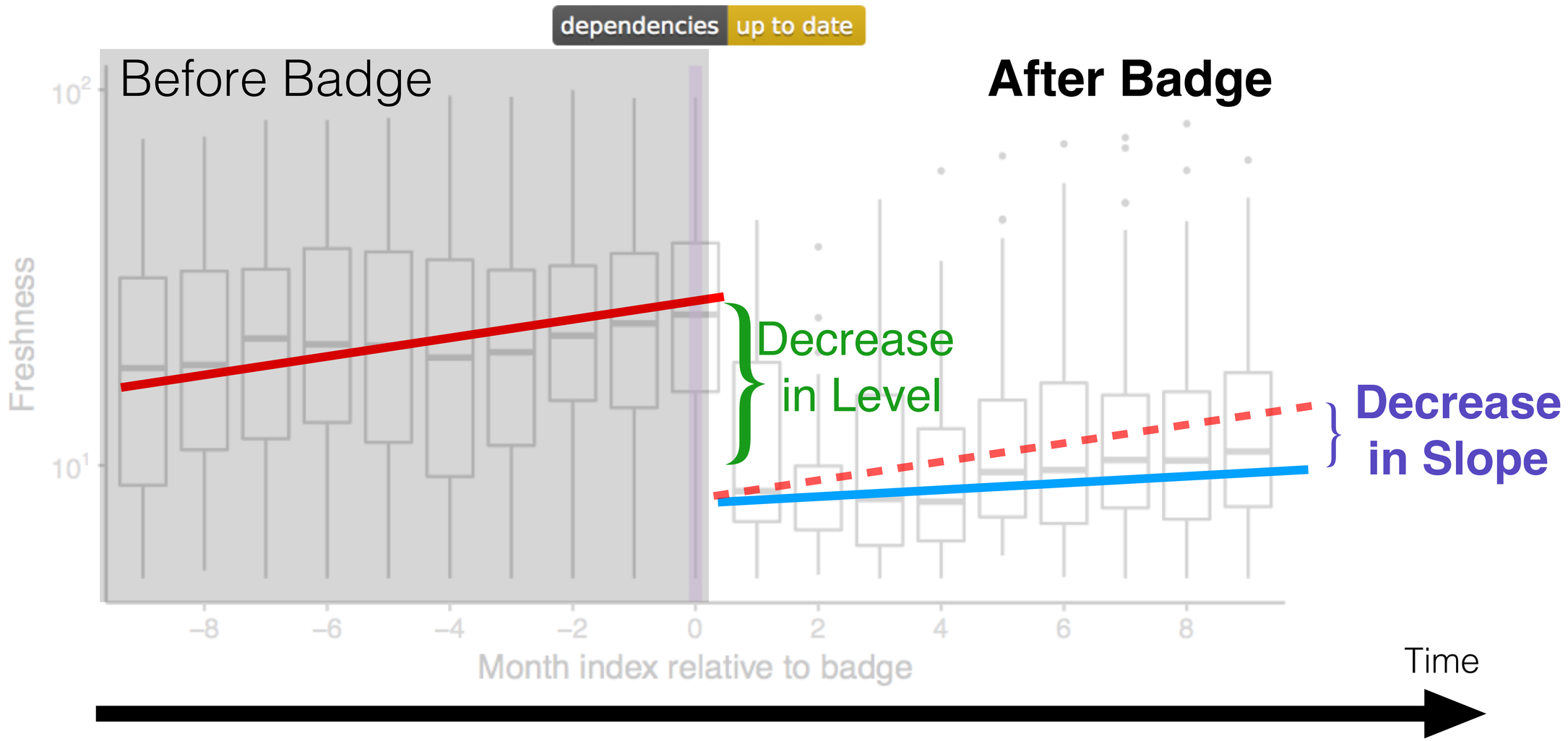
Time Series Analysis



Time Series Analysis



Time Series Analysis



Statistical multi-variate analysis

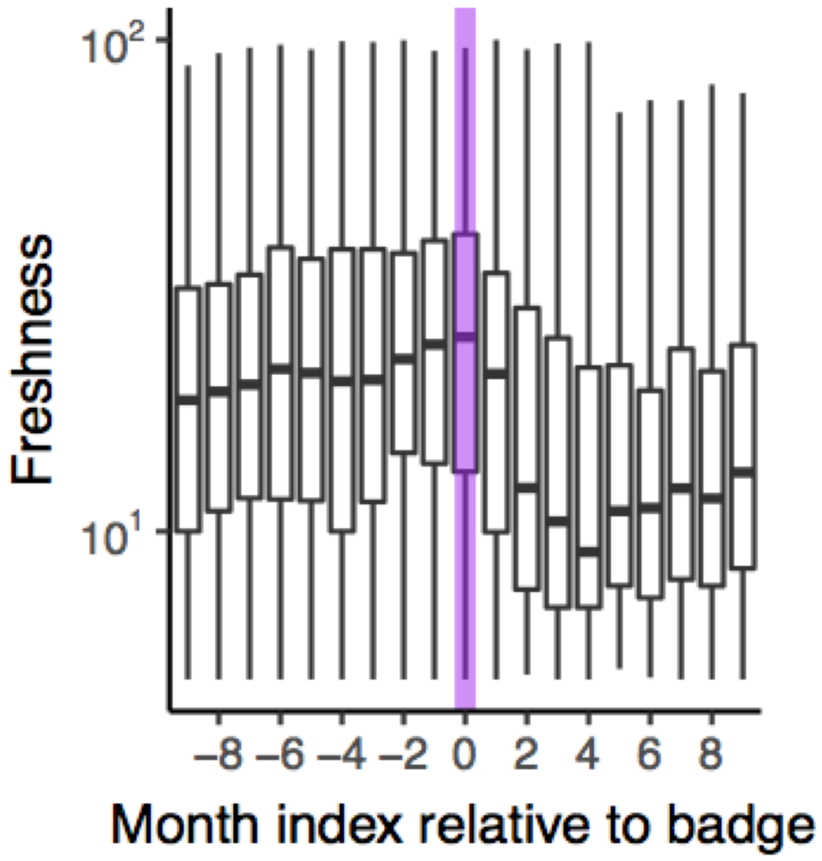
	Basic Model response: *freshness = 0* 17.3% deviance explained		**Full Model** response: *freshness = 0* 17.4% deviance explained		**RDD** response: log(*freshness*) $R^2_m = 0.04$, $R^2_c = 0.35$	
	Coeffs (Err.)	LR Chisq	Coeffs (Err.)	LR Chisq	Coeffs (Err.)	Sum sq.
(Interc.)	3.54 (0.03)***		3.50 (0.03)***		1.45 (0.09)***	
Dep.	−1.78 (0.01)***	32077.8***	−1.79 (0.01)***	32292.8***	−0.04 (0.02)	3.01
RDep.	0.22 (0.01)***	610.3***	0.21 (0.01)***	560.6***	−0.01 (0.02)	0.11
Stars	−0.08 (0.00)***	301.4***	−0.09 (0.00)***	311.2***	0.00 (0.01)	0.00
Contr.	−0.24 (0.01)***	500.5***	−0.25 (0.01)***	548.7***	−0.04 (0.02)*	4.39*
lastU	−0.65 (0.01)***	12080.9***	−0.64 (0.01)***	11537.9***	0.01 (0.02)	0.37
hasDM			0.24 (0.03)***	116.1***	0.45 (0.08)***	2.43
hasInf			0.11 (0.02)***	48.3***	0.04 (0.05)	0.45
hasDM:hasInf			−0.05 (0.04)	1.9	−0.32 (0.10)**	
hasOther			0.01 (0.01)			
time					0.03 (0.00)***	82.99***
intervention					−0.93 (0.03)***	1373.22***
time_after_intervention					0.11 (0.00)***	455.56***
time_after_intervention:hasDM					−0.10 (0.01)***	230.36***
time_after_intervention:hasInf					−0.00 (0.01)	1.14
time_after_intervention:hasDM:hasInf					0.03 (0.01)**	10.62**

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$;
Dep: dependencies; RDep: dependents; Contr.: contributors; lastU: time since last update; hasDM: has dependency-manager badge; hasInf: has information badge; hasOther: adopts additional badges within 15 days

Badges are Mostly Reliable Signals

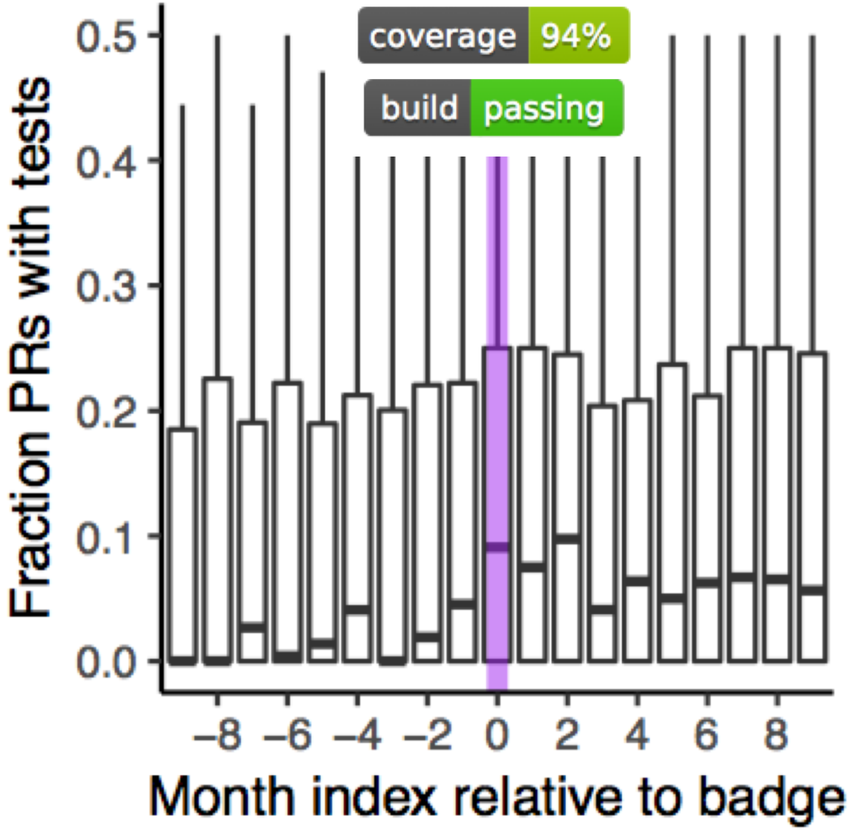
dependencies | up to date

up-to-date and **secure** dependencies



build | passing + coverage | 94%

tests in PRs



Take-away: Prefer “assessment” badges

Badges with **underlying analyses:**

build passing | codacy A | dependencies out of date | vulnerabilities 0

code climate 4.0 | coverage 94% | docs | issue resolution 3 h

} *assessment signals*

are **stronger predictors** than badges that merely state intentions or provide links:

cdnjs v3.2.1 | license BSD | PRs welcome | code style standard | gitter join chat

Patreon | commitizen friendly | code style standard

} *conventional signals*

Take-away: Prefer “assessment” badges

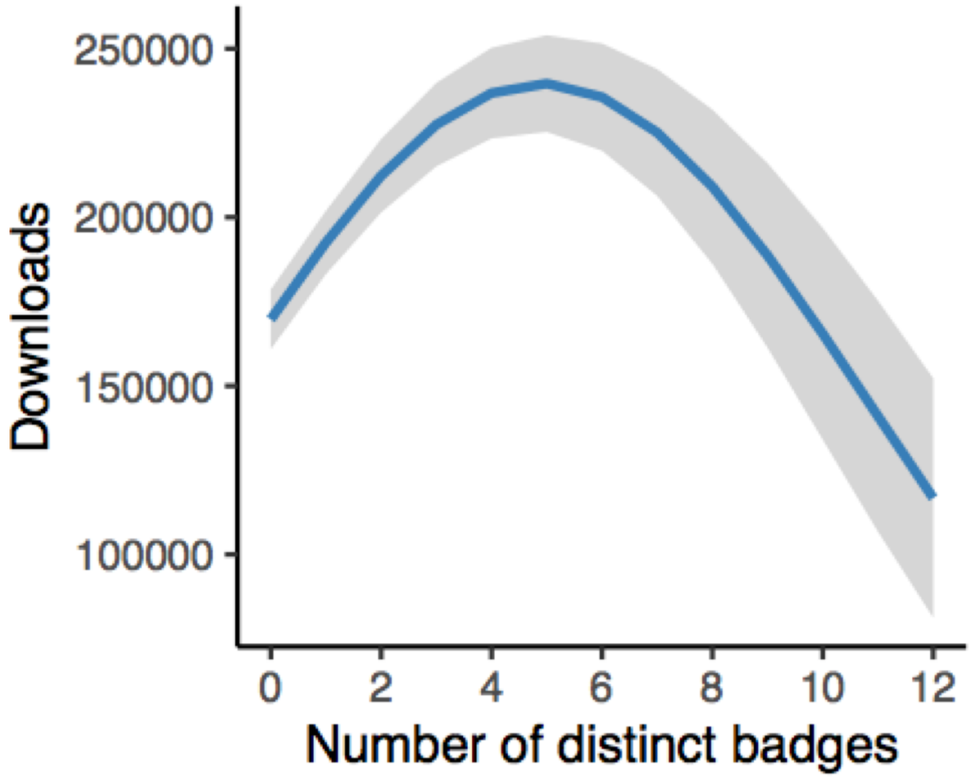
assessment signal

>

conventional signal

Take-away: Don’t add too many

Attractiveness wears off beyond 5 badges



“It’s most important that the people seem nice”

How do people choose which project to contribute to?

The tone of the community is an important factor in both interviews and model.

maintainers | polite ?

Asking for help explicitly is an important factor in the interviews.

PRs | welcome help | wanted ?

"help wanted" issues | 20 open

Interviews:
15 GitHub users

Data:
~10K npm packages

Model:
Logistic regression
(has new contributors)

- The Signals that Potential Contributors Look for When Choosing Open-source Projects. Qiu, S., Li, Yucen., Padala, S., Sarma, A., and Vasilescu, B. *CSCW 2019*

3.
The Dark Side of Transparency

Developers are aware of each other's gender

Survey, 816 responses

Which of the following characteristics of your team members are you aware of?

- 74% • Programming skills
- 48% • Gender
- 45% • Real name
- 42% • Social skills
- 40% • Country of residence
- 39% • Personality
- 31% • Reputation as programmer
- 30% • Ethnicity
- 30% • Employment
- 28% • GitHub experience
- 26% • Educational level
- 23% • Age
- 11% • Hobbies
- 4% • Political views

"I have used a fake GitHub handle [...] so that people would assume I was male"

“Sexist behavior in F/LOSS is as constant as it is extreme”

Article

new media & society
14(4) 669–683

DOI: 10.1177/1461444811422887
nms.sagepub.com
SAGE

‘Patches don’t have gender’: What is not open in open source software

Dawn Nafus
Intel Labs, USA

Abstract
While open source software development promises a fairer, more democratic model of software production often compared to a gift economy, it also is far more male dominated than other forms of software production. The specific ways F/LOSS instantiates notions of openness in everyday practice exacerbates the exclusion of women. ‘Openness’ is a complex construct that affects more than intellectual property arrangements. It weaves together ideas about authorship, agency, and the circumstances under which knowledge and code can and cannot be exchanged. While open source developers believe technology is orthogonal to the social, notions of openness tie the social to the technical by separating persons from one another and relieving them of obligations that might be created in the course of other forms of gift exchange. In doing so, men monopolize code authorship and simultaneously de-legitimize the kinds of social ties necessary to build mechanisms for women’s inclusion.

Pull request acceptance rates are lower when gender is apparent

Article

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PeerJ Computer Science

Gender differences and bias in open source: pull request acceptance of women versus men

Josh Terrell[1], Andrew Kofink[2], Justin Middleton[2], Clarissa Rainear[2], Emerson Murphy-Hill[2], Chris Parnin[2] and Jon Stallings[3]

[1] Department of Computer Science, California Polytechnic State University—San Luis Obispo, San Luis Obispo, CA, United States
[2] Department of Computer Science, North Carolina State University, Raleigh, NC, United States
[3] Department of Statistics, North Carolina State University, Raleigh, NC, United States

ABSTRACT
Biases against women in the workplace have been documented in a variety of studies. This paper presents a large scale study on gender bias, where we compare acceptance rates of contributions from men versus women in an open source software community. Surprisingly, our results show that women's contributions tend to be accepted more often than men's. However, for contributors who are outsiders to a project and their gender is identifiable, men's acceptance rates are higher. Our results suggest that although women on GitHub may be more competent overall, bias against them exists nonetheless.

Less gender diversity in open source than most places

- Gender representation reality

stackoverflow 5.8%

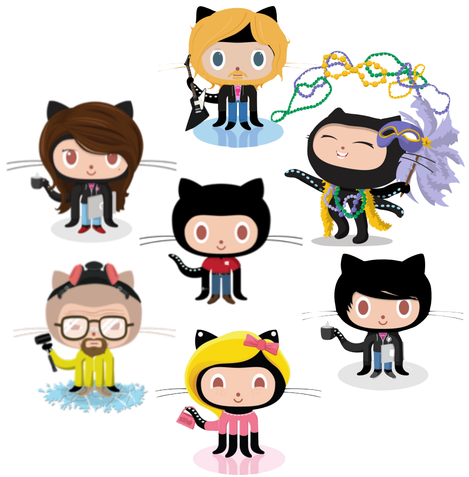
github SOCIAL CODING ~5%

open source 10.9%

Google 18%

16.6%

- Expectation



"*More about the contributions to the code than the 'characteristics' of the person*"

"*Any demographic identity is irrelevant*"

"*Code sees no color or gender*"

- FLOSS 2013: A survey dataset about free software contributors: challenges for curating, sharing, and combining G Robles, L Arjona-Reina, B Vasilescu, A Serebrenik, JM Gonzalez-Barahona. *MSR 2014*
- Google Diversity (2015) www.google.com/diversity/index.html#chart
- Inside Microsoft (2015) https://goo.gl/nT4YiI

- Exploring the data on gender and GitHub repo ownership Alyssa Frazee. http://alyssafrazee.com/gender-and-github-code.html
- Stack Overflow 2015 Developer Survey (26,086 people from 157 countries) http://stackoverflow.com/research/developer-survey-2015#profile-gender

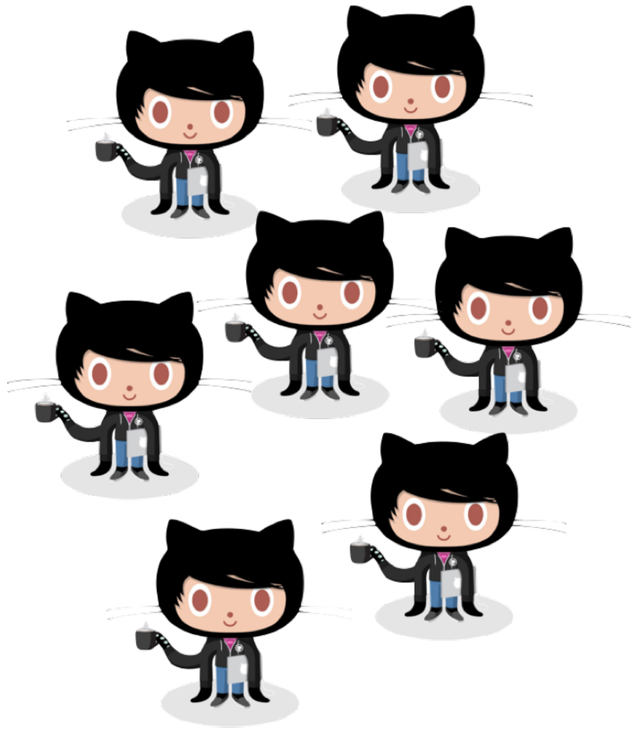
- Perceptions of Diversity on GitHub: A User Survey. Vasilescu, B., Filkov, V., and Serebrenik, A. *CHASE 2015*

Again, lots of anecdotes

Experiences working in a diverse team

"**code sees no color or gender**"	Meritocracy; no effects of diversity
"diverse viewpoints often lead to **lively discussions and new ideas**"	Positive effects of diversity
"I have used a **fake GitHub handle** (my normal GitHub handle is my first name, which is a distinctly female name) **so that people would assume I was male**"	Negative effects of diversity

Which tends to be more effective, on average?



Which tends to be more effective, on average?

Natural experiment

1. Mine data from many **collaborative projects**

2. Compare **outputs produced per unit time** in more/less diverse teams

Gender diversity
= mix women/men

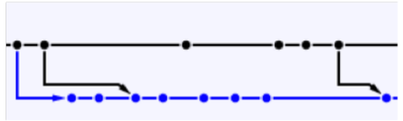
Simplifying assumption: gender is binary

Tenure diversity
= mix junior/senior

GitHub coding experience

Response

Productivity
(#commits/quarter)



Controls

Human resources

Team size

Experience

Project size

Total commits

Evolution of GitHub & time passing

Project age

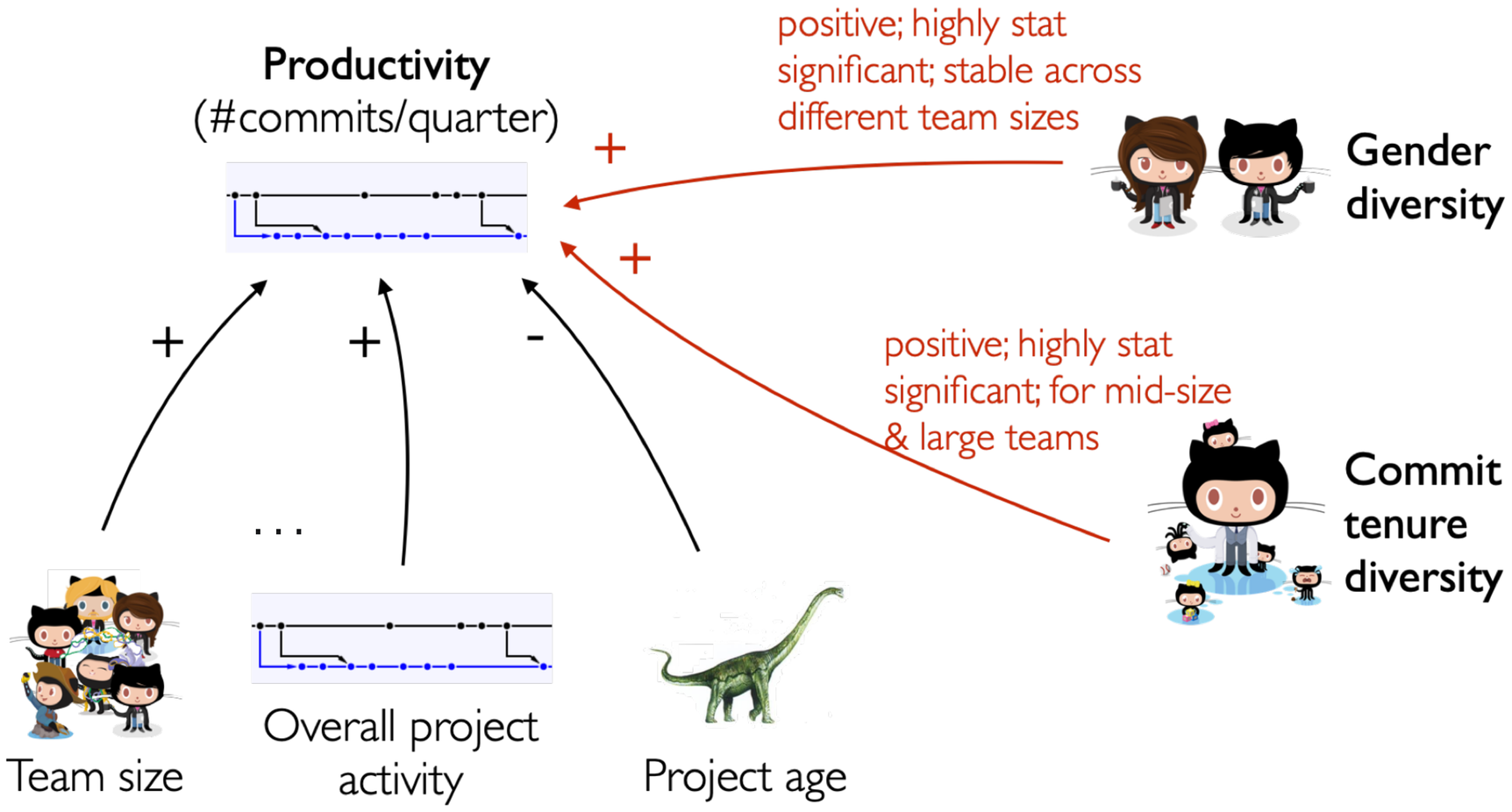
Time

Popularity / Distributed development

Comments

Forks

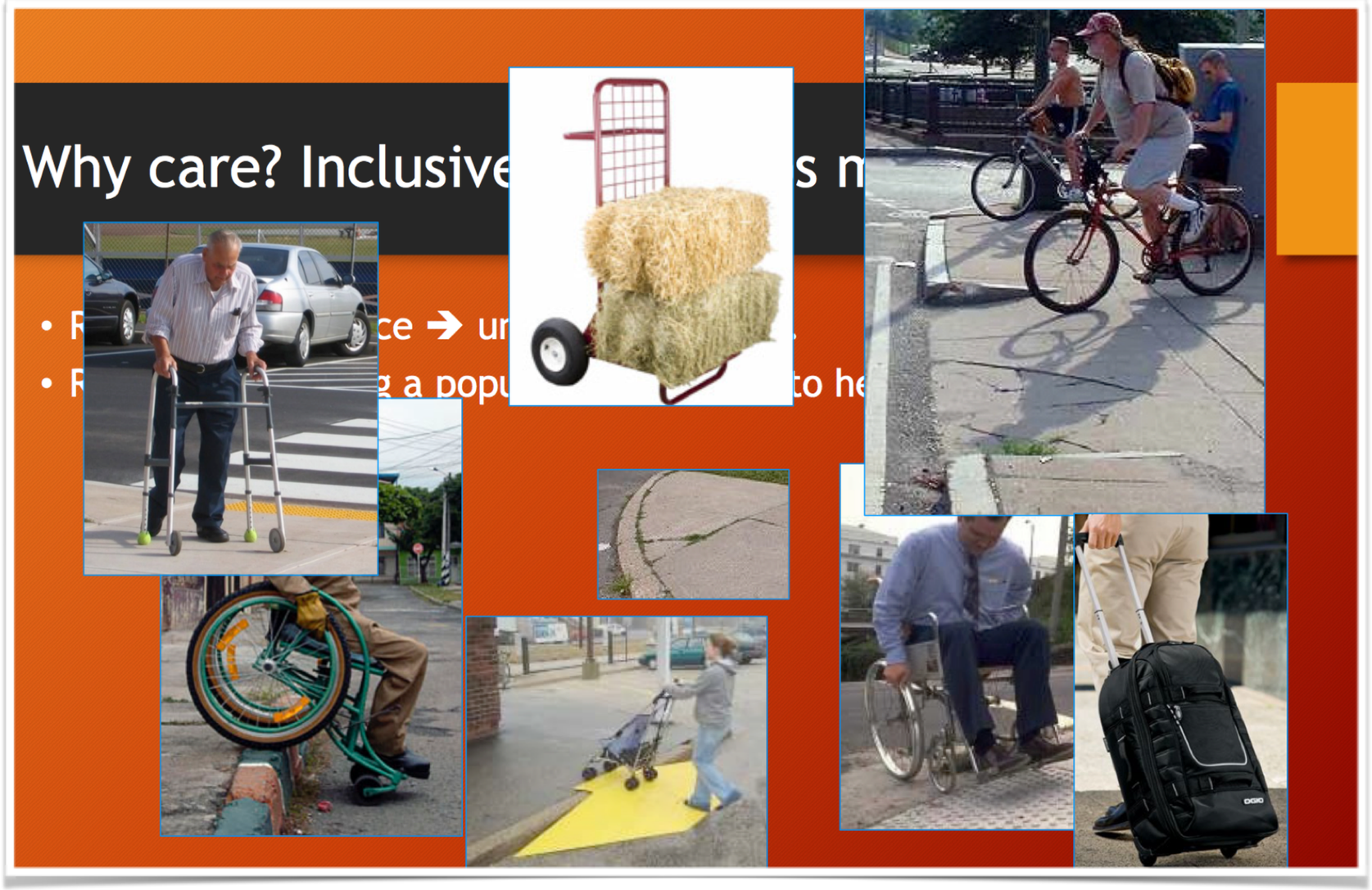
Increased diversity correlates to higher productivity



- **Gender and tenure diversity in GitHub teams.** Vasilescu, B., Posnett, D., Ray, B., Brand, M.G.J. van den, Serebrenik, A., Devanbu, P., and Filkov, V. *CHI 2015*

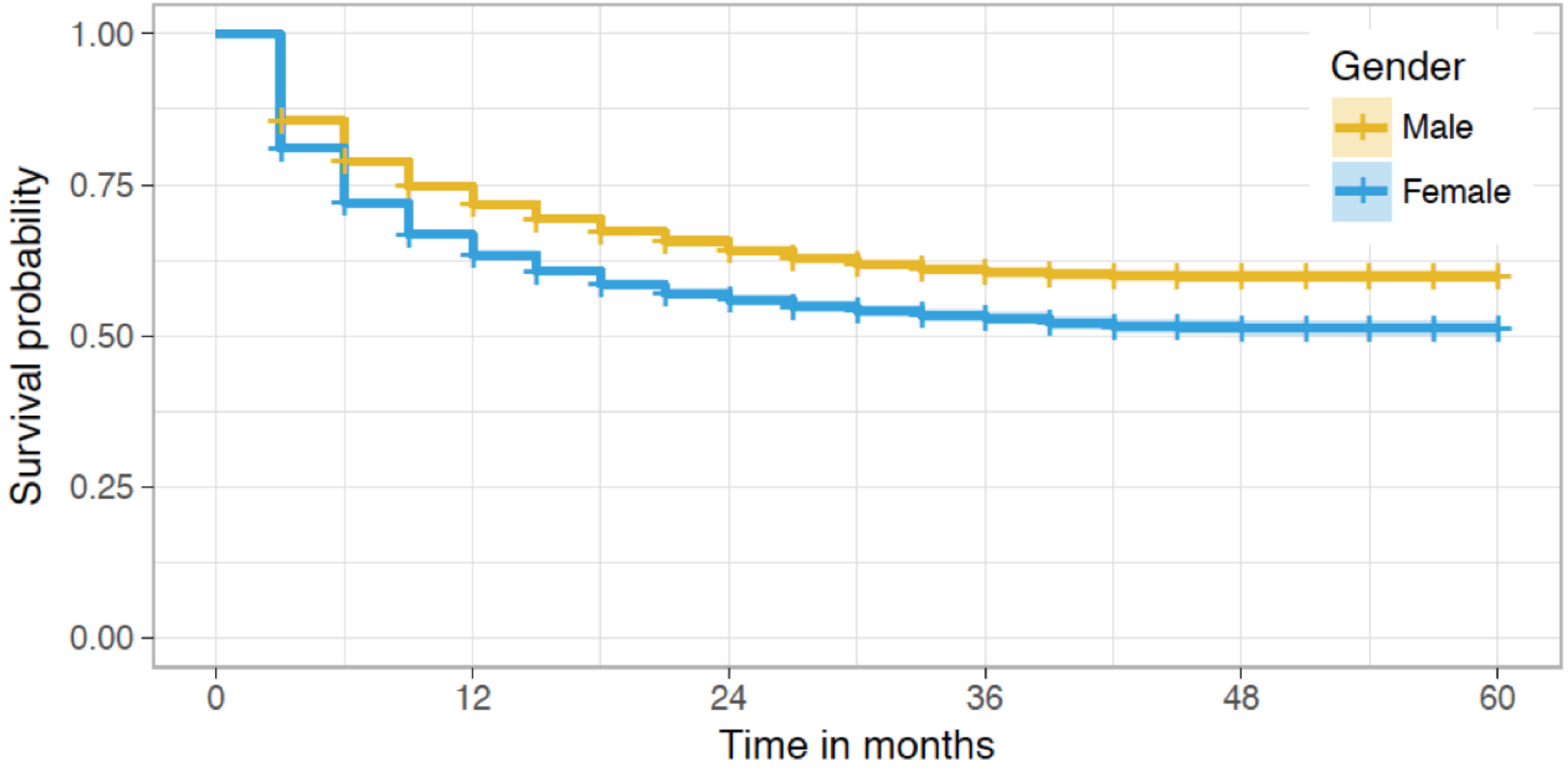
But small effects!

Aside: Inclusivity helps everyone



4.
Dropout and retention

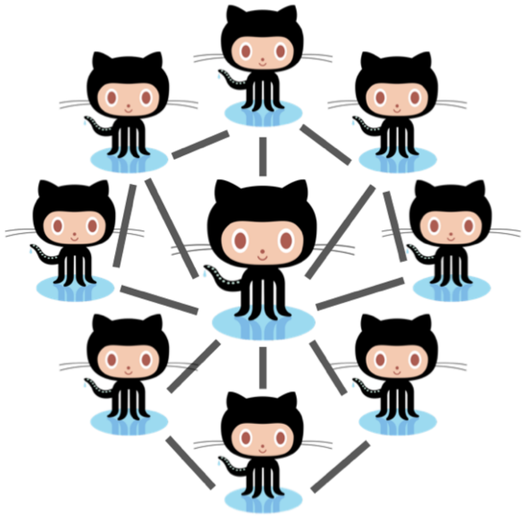
Women on GitHub disengage earlier than men



- Going Farther Together: The Impact of Social Capital on Sustained Participation in Open Source. Qiu, H.S., Nolte, A., Brown, A., Serebrenik, A., and Vasilescu, B. *ICSE 2019*

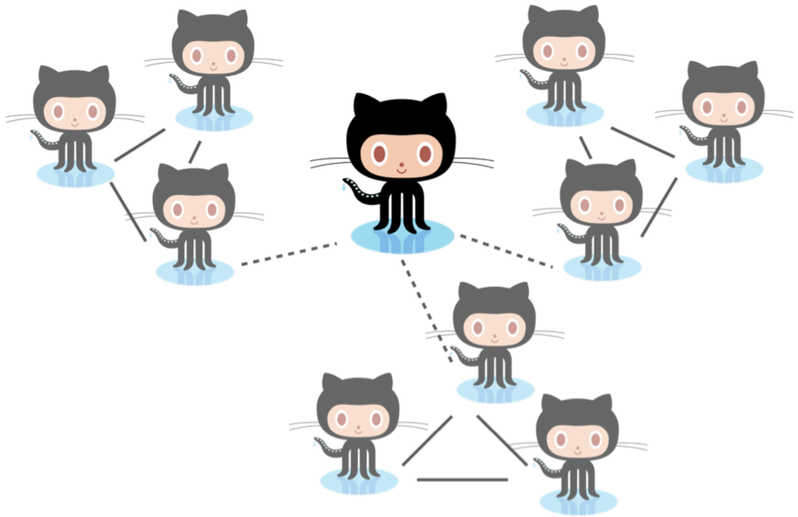
Social capital theory explains long-term engagement

Bonding social capital:
benefiting from strongly
connected network



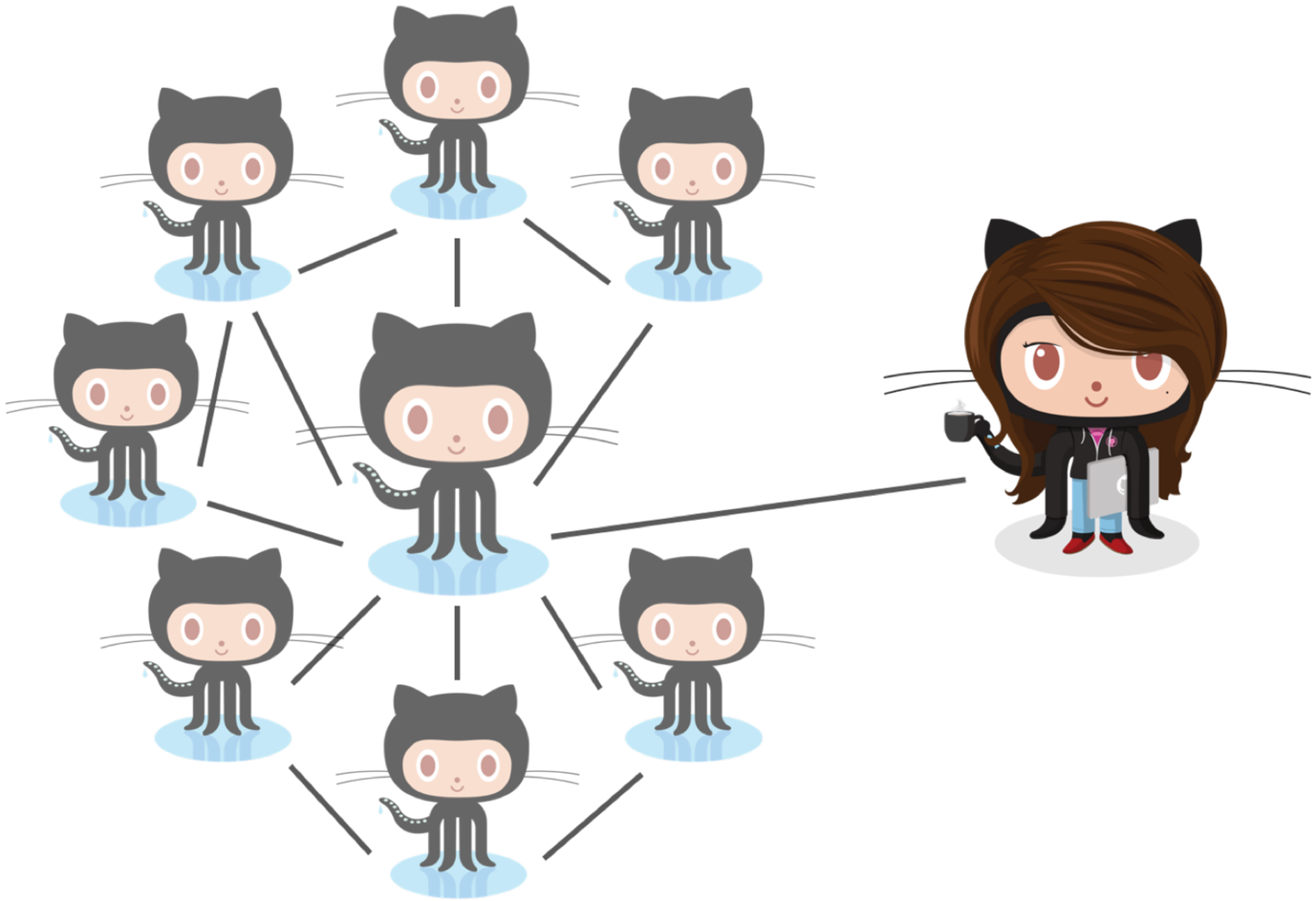
Willingness to continue
(Coleman, 1990)

Bridging social capital:
benefiting from network
with diverse info



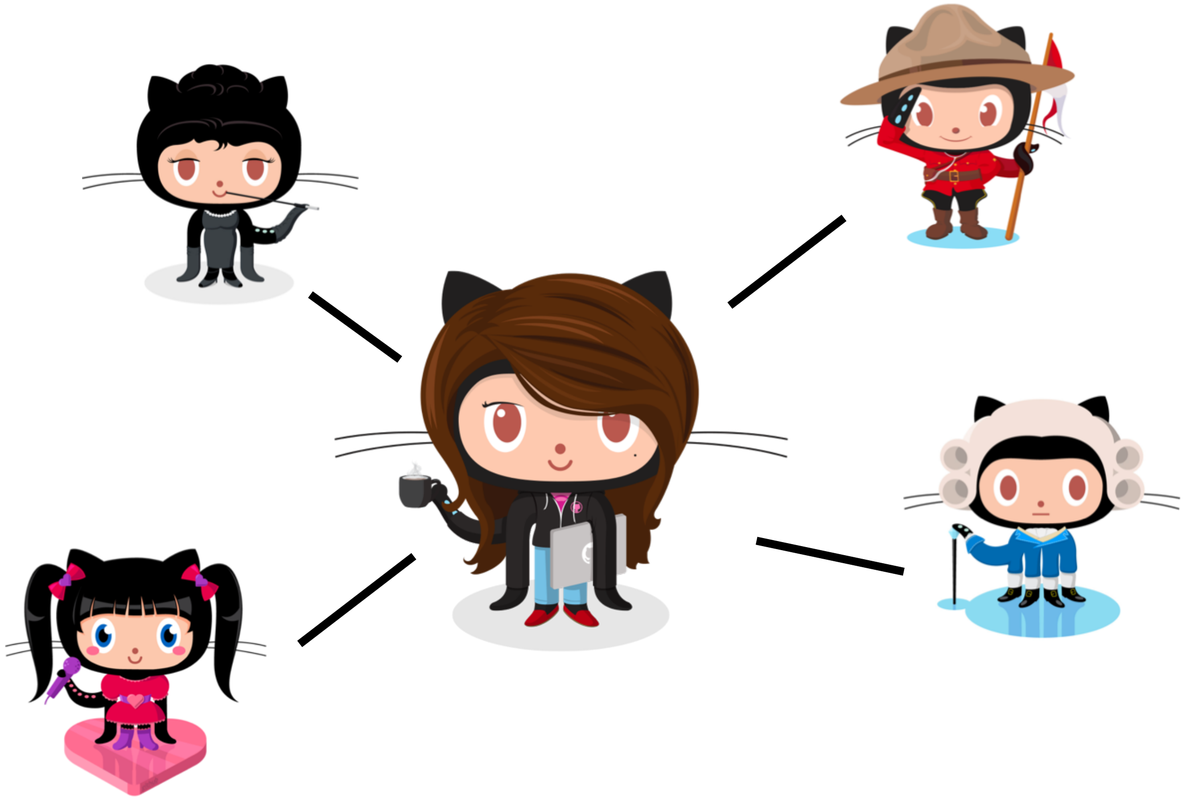
Opportunity to continue
(Burt, 1998, 2001)

Cohesive networks might foster discrimination / exclusion

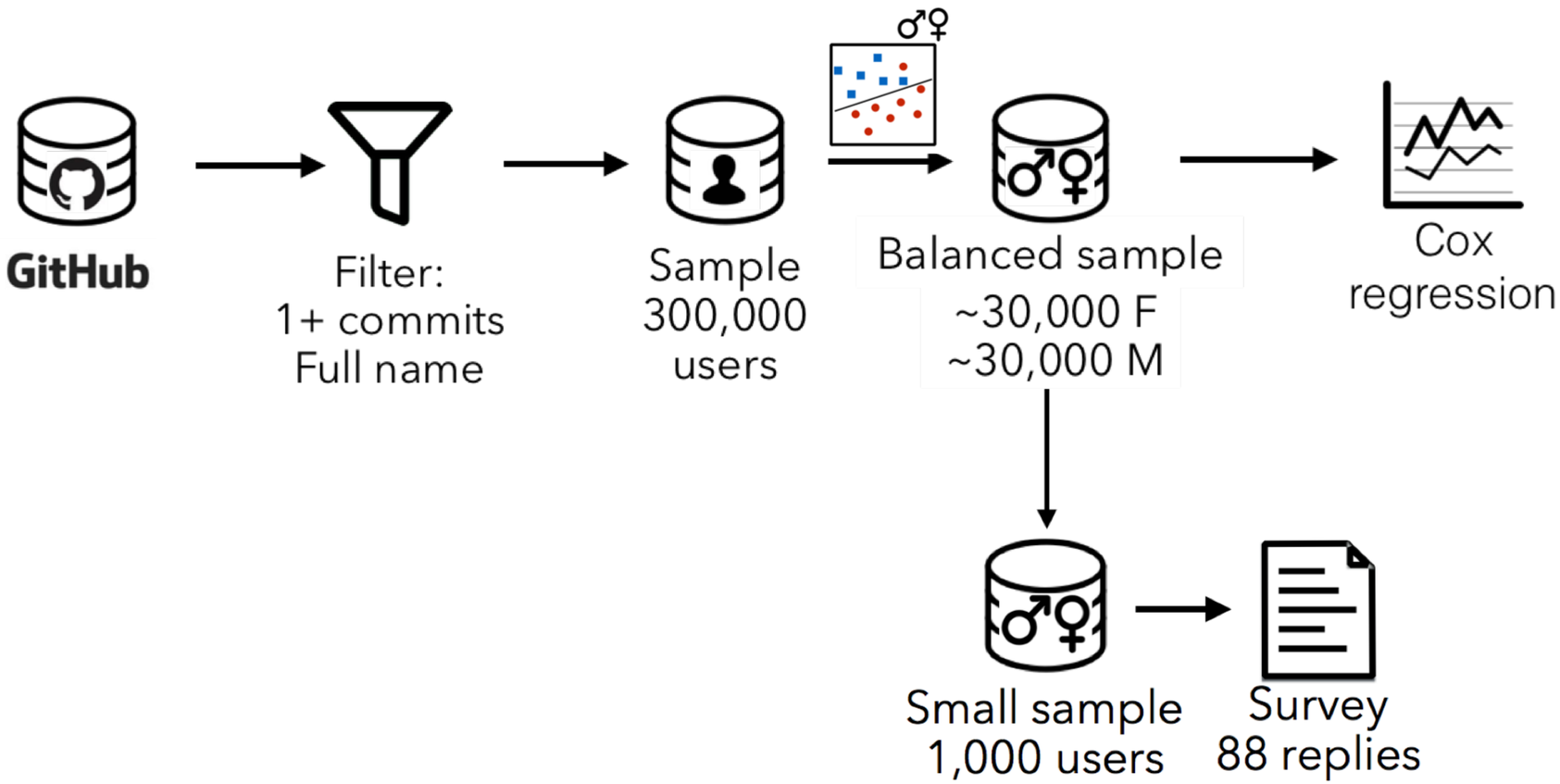


Being part of teams with more diverse information ~ more prolonged engagement, esp. for women

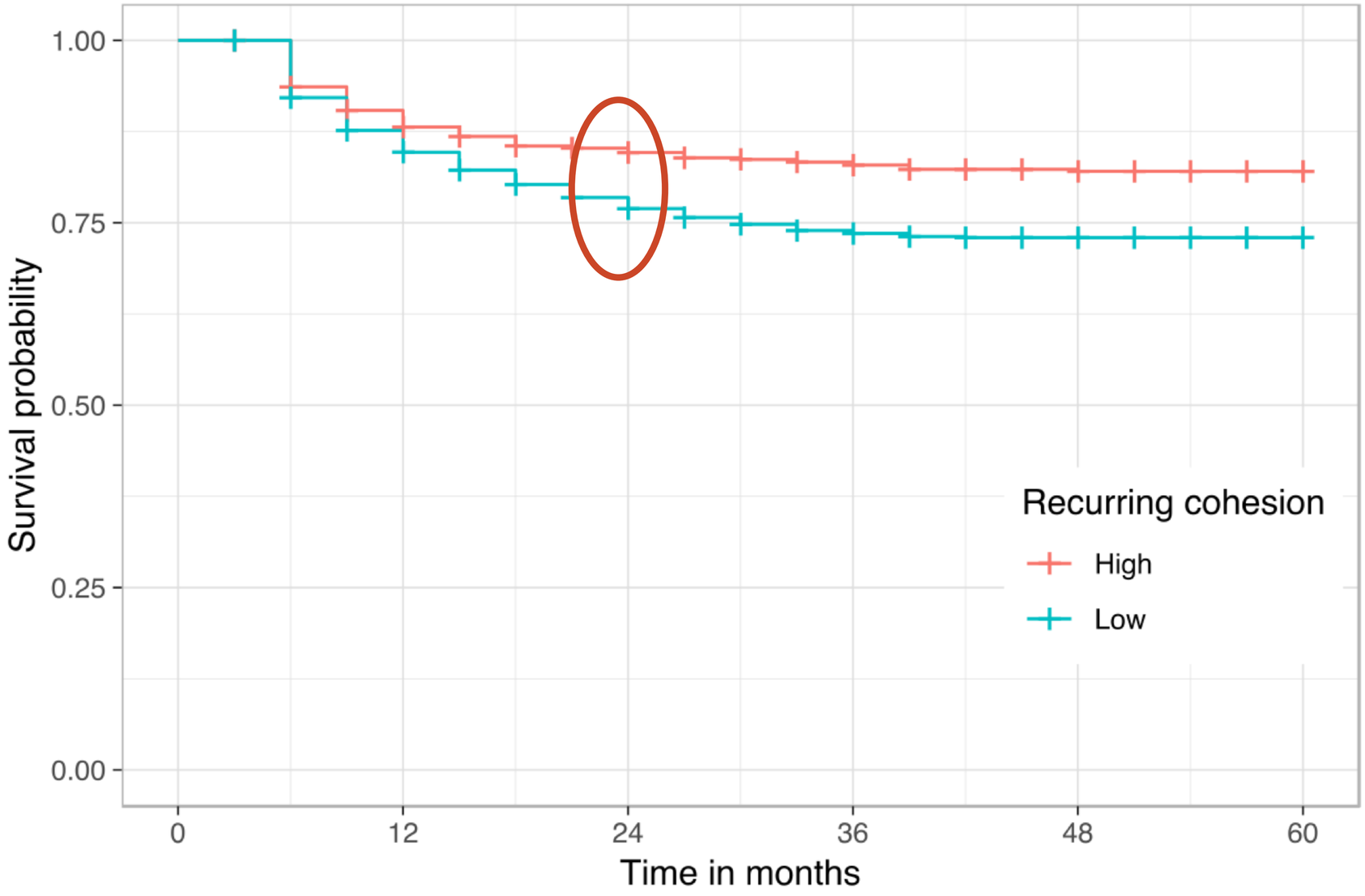
Information diversity should reduce the risk of demographic-based echo chambers.



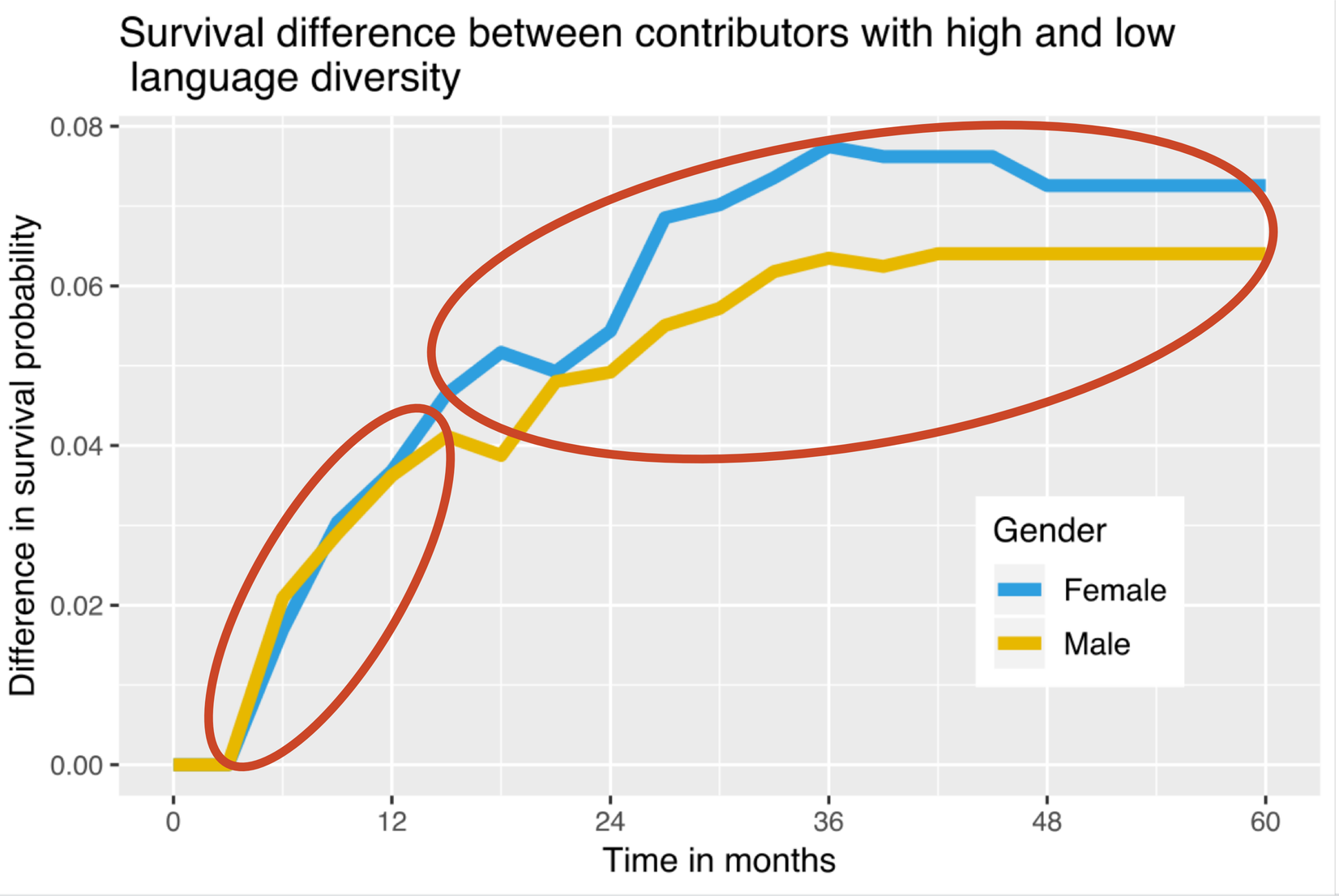
Large-scale mixed-methods study



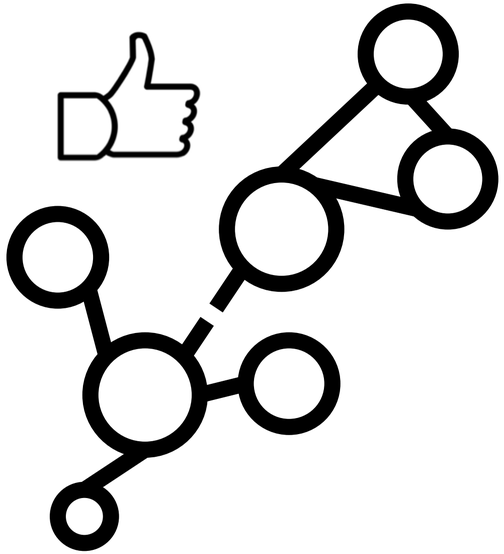
More social capital ~ more prolonged engagement



Women in language- (informationally-) diverse teams disengage at lower rates

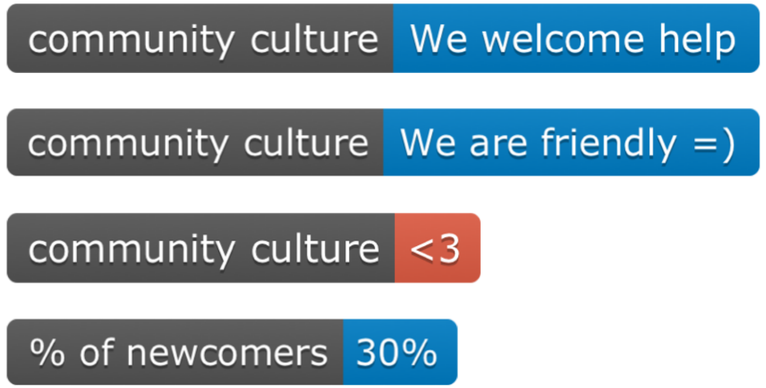


Take away: Invest in building social capital & Foster informationally diverse teams



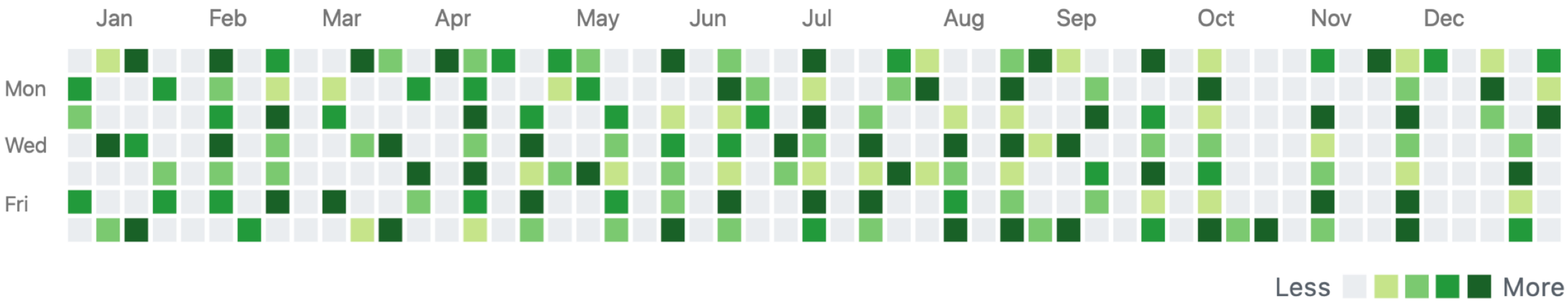
Recommend projects that can help build social capital

Find relevant mentorship



Signal social capital moderators

Summary



Equifax confirms Apache Struts security flaw it failed to patch is to blame for hack

The company said the March vulnerability was exploited by hackers.

By Zack Whittaker | September 14, 2017 -- 01:27 GMT (18:27 PDT) | Topic: Security

The Heartbleed Bug

The Heartbleed Bug is a serious vulnerability in the popular OpenSSL cryptographic software library. This weakness allows stealing the information protected, under normal conditions, by the SSL/TLS encryption used to secure the Internet. SSL/TLS provides communication security and privacy over the Internet for applications such as web, email, instant messaging (IM) and some virtual private networks (VPNs).

The Heartbleed bug allows anyone on the Internet to read the memory of the systems protected by the vulnerable versions of the OpenSSL software. This compromises the secret keys used to identify the service providers and to encrypt the traffic, the names and passwords of the users and the actual content. This allows attackers to eavesdrop on communications, steal data directly from the services and users and to impersonate services and users.

What leaks in practice?

We have tested some of our own services from attacker's perspective. We attacked ourselves from outside, without leaving a trace. Without using any privileged information or credentials we were able steal from ourselves the secret keys used for our X.509 certificates, user names and passwords, instant messages, emails and business critical documents and communication.

How to stop the leak?

As long as the vulnerable version of OpenSSL is in use it can be abused. Fixed OpenSSL (https://www.openssl.org/news/secadv/20140407.txt) has been released and now it has to be deployed. Operating system vendors and distribution, appliance vendors, independent software vendors have to adopt the fix and notify their users. Service providers and users have to install the fix as it becomes available for the operating systems, networked appliances and

We have seen…

- Limitations of donations as a sustainable funding source
- Badges as a transparent signaling mechanism
- A dark side to transparency
- Social capital theory suggesting path to improve retention

We have seen…

- Analysis of terabytes of public trace data
- Mixed methods research
- The slow process from anecdotal evidence to evidence-based recommendations
- Eventual goal: intentional design of tools, communities, and interventions

STRIDEL sustainability research on …

Open-source projects

Project practices

- ICSE 2020 (forking)
- ESEC/FSE 2019 (forking)
- ESEC/FSE 2018 (abandonment factors)
- FSE 2016 (breaking changes)

Attracting contributors

- MSR 2020 (Twitter)
- CSCW 2019 (signals)
- ESEC/FSE 2015 (social connections)

Funding models

- ICSE 2020 (donations)

Transparency and signaling

- ESEC/FSE 2020 (diffusion of practices)
- ICSE 2018 (badges)

Open-source people

Stress, burnout, disengagement

- ICSE NIER 2020 (toxic language)
- ICSE 2019 (overwork)
- OSS 2019 (dropout and survival analysis)

Diversity and inclusion

- ICSE 2019 (social capital)
- CHI 2015 (gender & tenure)
- CHASE 2015 (survey)

Google Scholar

"open source" + "sustainability"

Articles

About 132,000 results (**0.09** sec)

Any time
Since 2020
Since 2019
Since 2016
Custom range...

Sort by relevance
Sort by date

include patents
include citations

Create alert

Sustainability of free/libre **open source** projects: A longitudinal study
IS Chengalur-Smith, A Sidorova… - Journal of the Association …, 2010 - aisel.aisnet.org
This paper examines the factors that influence the long-term **sustainability** of FLOSS projects. A model of project **sustainability** based on organizational ecology is developed and tested empirically. Data about activity and contribution patterns over the course of five years …
Cited by 85 Related articles All 5 versions Import into BibTeX

[HTML] **Sustainability** of **Open Source** software communities beyond a fork: How and why has the LibreOffice project evolved?
J Gamalielsson, B Lundell - Journal of Systems and Software, 2014 - Elsevier
Many organisations are dependent upon long-term sustainable software systems and associated communities. In this paper we consider long-term **sustainability** of **Open Source** software communities in **Open Source** software projects involving a fork. There is currently a …
Cited by 98 Related articles All 8 versions Import into BibTeX

Acknowledgements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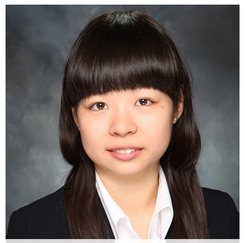
Anita Sarma


Cassandra Overney


Audris Mockus

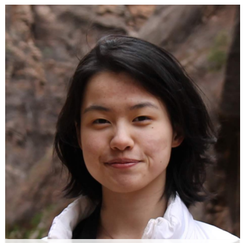

Alex Nolte


Sophie Qiu


Alex Serebrenik


Marat Valiev


Laura Dabbish


Lily Li


Naveen Raman

National Science Foundation

Alfred P. Sloan FOUNDATION

FORDFOUNDATION

What are the main sustainability challenges to the open-source projects you participate in?

Bogdan Vasilescu
@b_vasilescu
vasilescu@cmu.edu

Christian Kaestner
@p0nk
kaestner@cs.cmu.edu