Gender and Tenure Diversity in GitHub Teams

Bogdan Vasilescu, Daryl Posnett, Baishakhi Ray, Mark van den Brand, Alexander Serebrenik, Prem Devanbu, Vladimir Filkov

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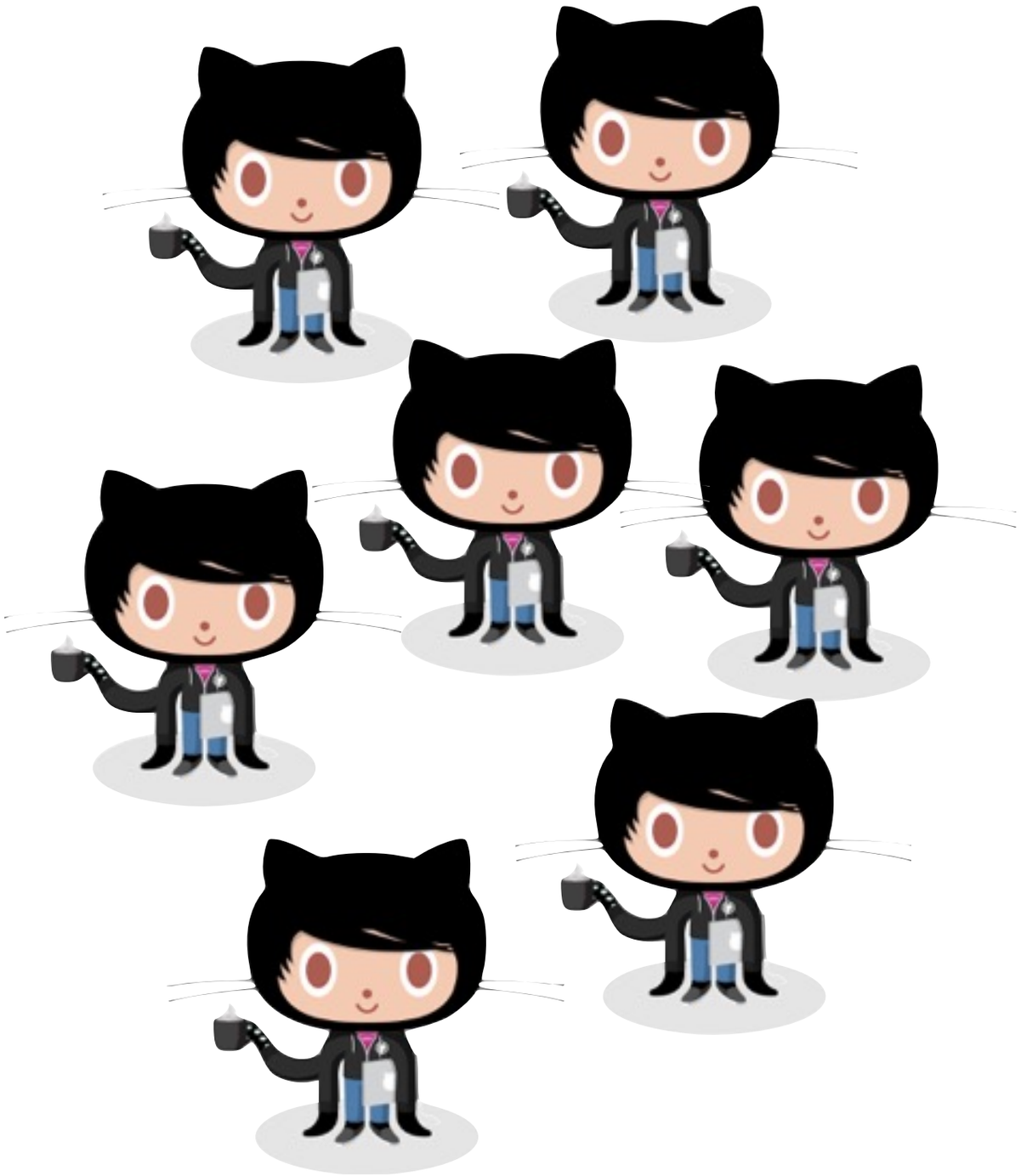
Which is more effective?



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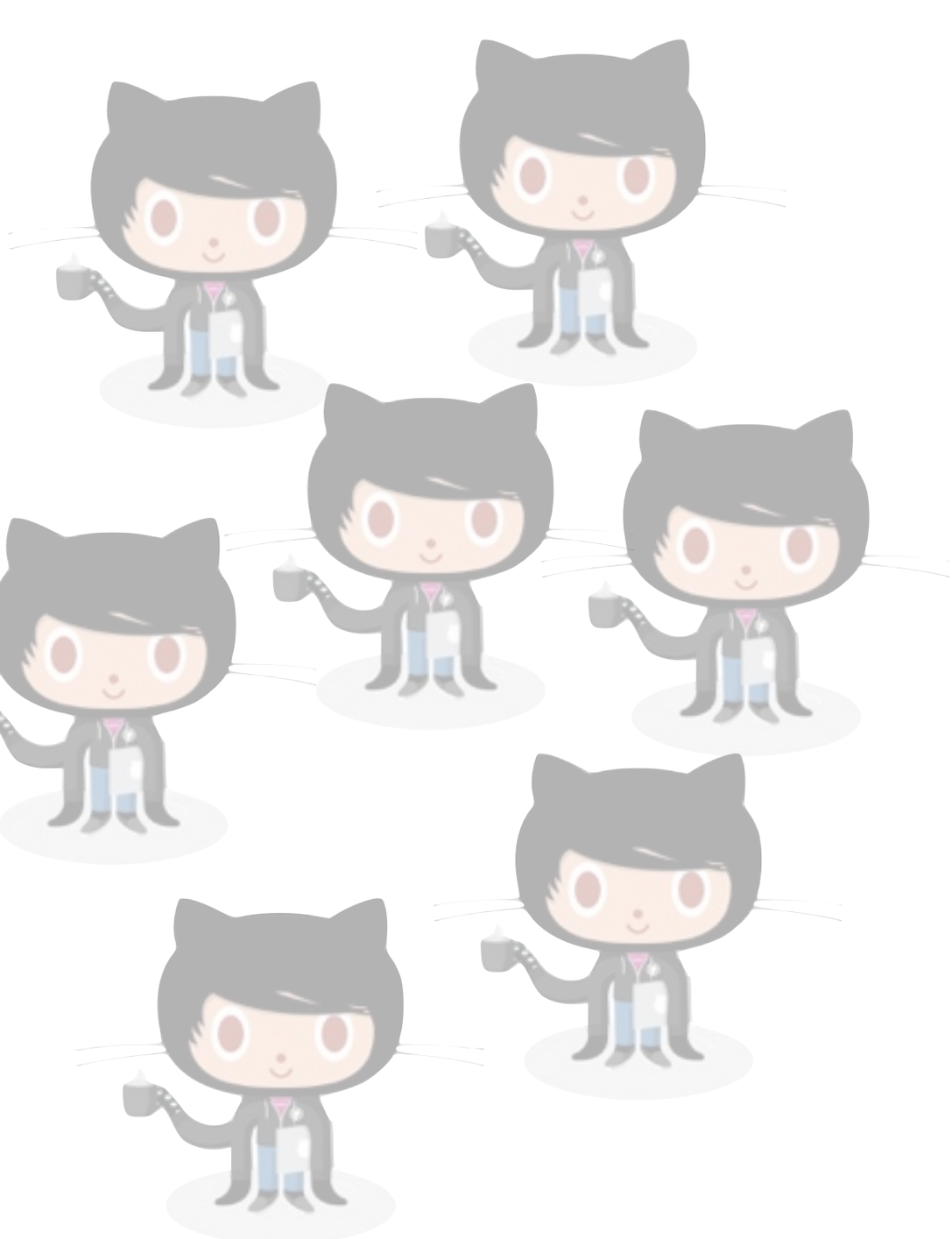

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Diversity 👎

Similarity attraction theory

People prefer working with others similar to them in terms of values, beliefs, and attitudes [Byrne]

Social identity and social categorization theory

People categorize themselves into specific groups. Members of own group are treated better than outsiders [Tajfel]

Due to greater perceived differences between groups than within groups, diversity can lead to confusion, stress, and conflict [Horwitz & Horwitz]

Diversity 👍

Driver of internal innovation and **business growth** [Forbes]

Diverse problem solvers **outperform high ability problem solvers** [Hong & Page]

Companies with diverse executive boards have higher earnings and **returns on equity** [McKinsey]

Multicultural social networks **promote creativity** [Harvard Business School]

Diversity 👍




Information Processing Theory

Mixture of cultural/educational backgrounds
+ access to different networks/broader information
=> creativity, adaptability, & problem solving skills.
[Salancik & Pfeffer]

Today: diversity in open source software (OSS) GitHub teams

Different settings

Geographic & cultural dispersion

Online communities & distributed comm. channels

Different methods

Quantitative; large-scale trace data

Today: gender & tenure diversity in open source software (OSS) GitHub teams

Gender diversity
= mix women/men

simplifying assumption: gender is binary

The "hacker" culture is male-dominated and unfriendly to women [Turkle]

Women are <10% in OSS [Robles et al]

Reports of active discrimination and sexism towards women [Nafus]

Today: gender & tenure diversity in open source software (OSS) GitHub teams

Tenure diversity
= mix junior/senior

The "onion" structure of OSS: small (stable) core + large (loose) periphery [Ducheneaut]

High turnover [Robles & Gonzalez-Barahona]

Today: gender & tenure diversity in open source software (OSS) GitHub teams

World's largest open source community

Trace data available @ghtorrent [Gousios et al]

Today: gender & tenure diversity in open source software (OSS) GitHub teams

Theoretical

Technical

OSS as meritocracy; contribution quality as main driver of impression formation
[Dabbish et al, Marlow et al]

Today: gender & tenure diversity in open source software (OSS) GitHub teams

Theoretical

Technical

Demographics are less salient in OSS [Riordan & Shore]

Today: gender & tenure diversity in open source software (OSS) GitHub teams

Theoretical

Technical

Anyone can contribute to any repository.
Who's on a team?

Today: gender & tenure diversity in open source software (OSS) GitHub teams

Theoretical

Technical

Gender is not explicitly recorded

Today: gender & tenure diversity in open source software (OSS) GitHub teams

Theoretical

Technical

People contribute under multiple aliases

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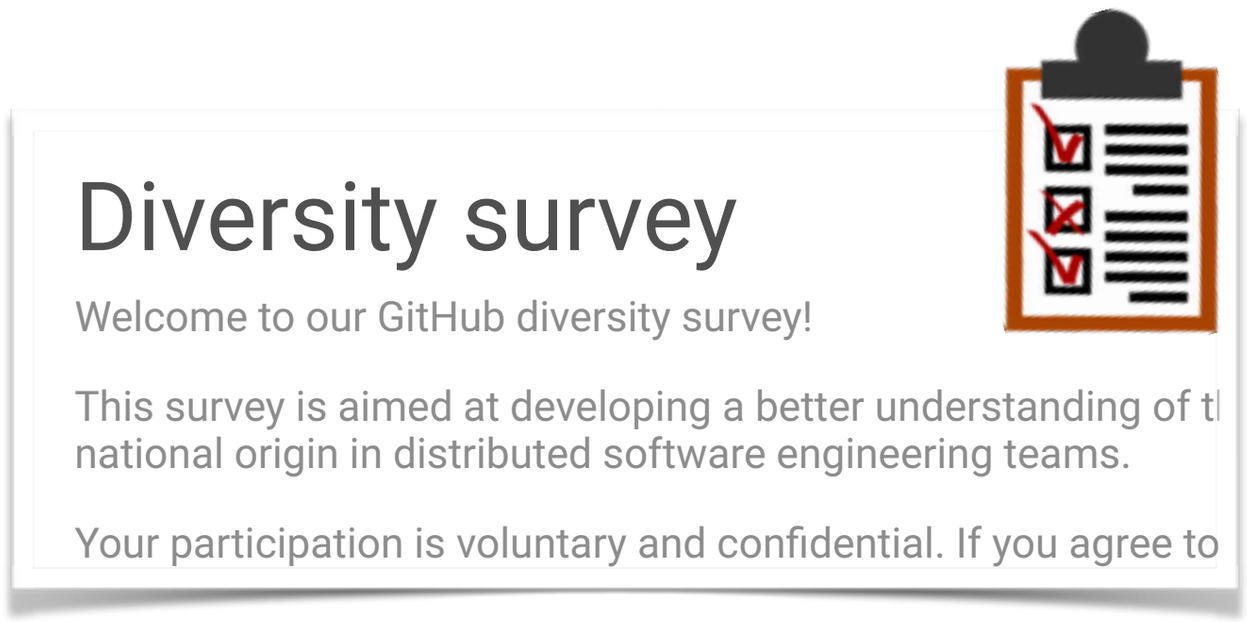
Today: gender & tenure diversity in open source software (OSS) GitHub teams

Theoretical

Technical

How to analyze such large-scale longitudinal trace data?

Approach: mixed methods



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[Vasilescu et al, CHASE'15]

http://bvasiles.github.io/papers/chase15.pdf

Survey

4,500 invitations, 816 responses

What constitutes a team?

Which differences do people recognize among team members?

Does diversity matter?

[Vasilescu et al, CHASE'15]

http://bvasiles.github.io/papers/chase15.pdf

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Survey

4,500 invitations, 816 responses

What constitutes a team?

The team is everyone

Which differences do people recognize among team members?

Gender is surprisingly salient

Does diversity matter?

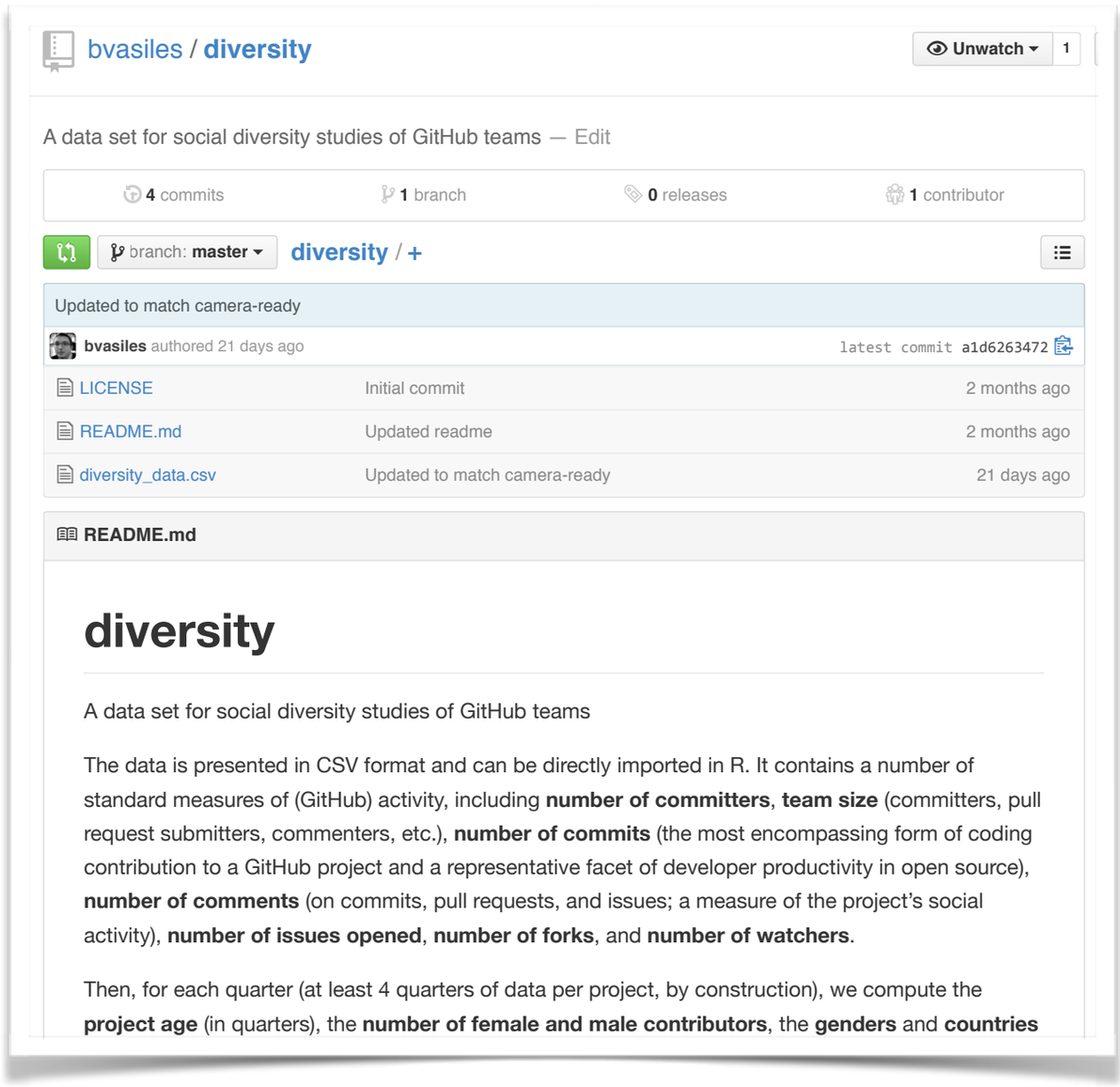
Positive/negative/no effects of diversity

[Vasilescu et al, CHASE'15]

http://bvasiles.github.io/papers/chase15.pdf

Mining

Sample
4K projects



[Vasilescu et al, MSR'15]

- http://bvasiles.github.io/papers/msr_data15.pdf
- https://github.com/bvasiles/diversity

Mining

github SOCIAL CODING

Infer genders (93% precision) [Vasilescu et al, IWC'13]

Sample 4K projects

Bogdan Vasilescu

bvasiles

University of California
Davis, CA
http://bvasiles.github.io
Joined on Jul 3, 2012

Contributions | Repositories | Publi

Popular repositories

- **bvasiles.github.io** — My website
- **diversity** — A data set for social diversity studies of GitHu…
- **flask_assets_tutorial** — Maxime Bouroumeau-Fuseau's tutorial on flas…
- **ghtorrent.org** — The GHtorrent project website
- **ght_unmasking_aliases**

Contributions

Apr May Jun Jul Aug Sep

Bing Maps + Heuristics
http://github.com/tue-mdse/countryNameManager

Bogdan + USA

Name frequency tables for 30 countries
http://github.com/tue-mdse/genderComputer

male

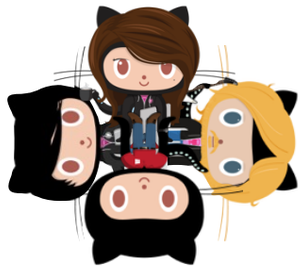
Andrea + Italy = male
Andrea + USA = female

Mining

Sample
4K projects

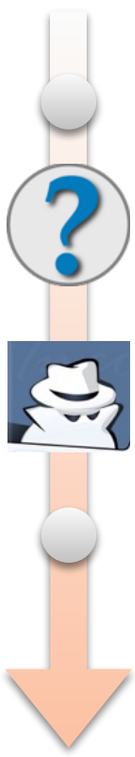
Response

Productivity
(#commits/quarter)



Turnover
(fraction team new
w.r.t. prev. quarter)

Mining



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4K projects

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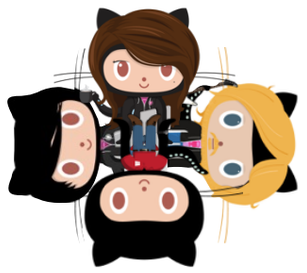

Turnover
(fraction team new
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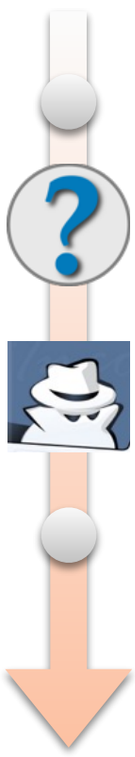
Independent

Gender
diversity
(Blau index)

Tenure diversity
(coeff. variation)

- project
- overall coding

Mining



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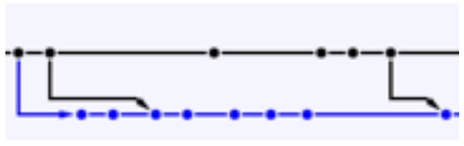
Controls

Team size

Time

Project age

Project activity



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Analysis

Nesting: projects

Project	Created on	Project age	Total #commits	#Forks	Time	#Commits	#Comments	Team size	Gender diversity	Commit tenure diversity	Turnover
A	2011-02-15	12	557	51	Q2	47	26	9	0.25	0.47	0.67
					Q5	19	12	10	0.00	0.93	0.75
					Q6	7	13	12	0.25	0.54	0.67
					Q7	56	53	20	0.00	0.56	0.87
					…						
B	2010-09-21	11	2075	578	Q4	71	169	83	0.03	0.66	0.87
					Q5	116	219	93	0.05	0.73	0.56
					Q6	186	367	119	0.06	0.80	0.86
					Q7	129	453	114	0.08	0.85	0.82
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Cross-classification: quarters

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Nesting: projects
Cross-classification: quarters

Linear mixed-effects (hierarchical) models

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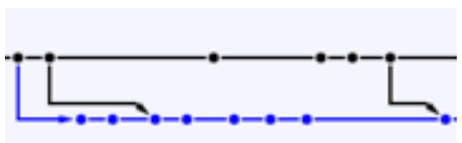
Results

Productivity
(#commits/quarter)

\+ \+ \- \-

Gender diversity

Team size



Overall project activity

Forks

Project age

Tenure diversity

…

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Results

Productivity
(#commits/quarter)

\+ all team sizes

Gender diversity

\+ mid-size & large teams

Tenure diversity

\+ Team size

\+ Overall project activity

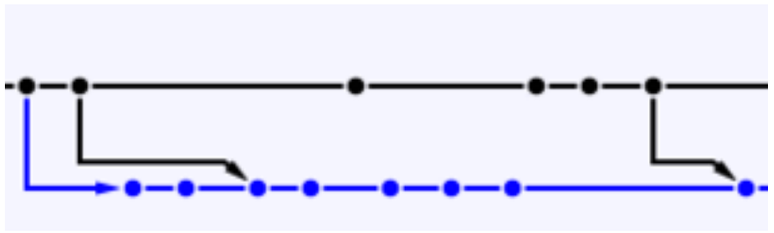
\- Forks

\- Project age

…

Results

Productivity
(#commits/quarter)



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Gender diversity

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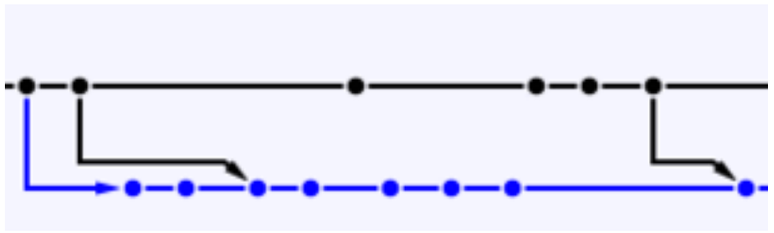
Tenure diversity

Results

Productivity
(#commits/quarter)



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Turnover (fraction team new w.r.t. prev. quarter)

Tenure diversity

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The takeaway

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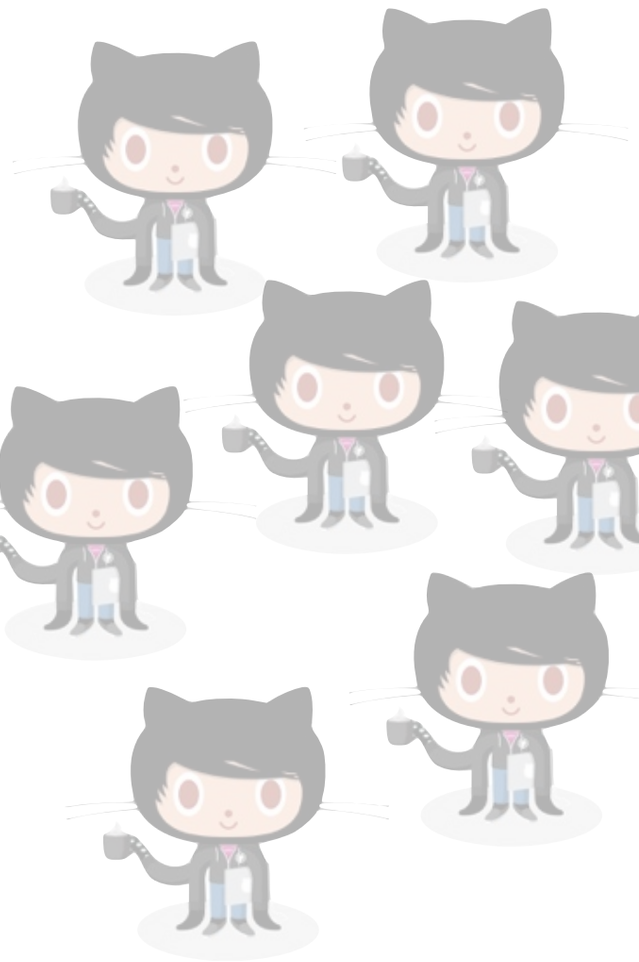

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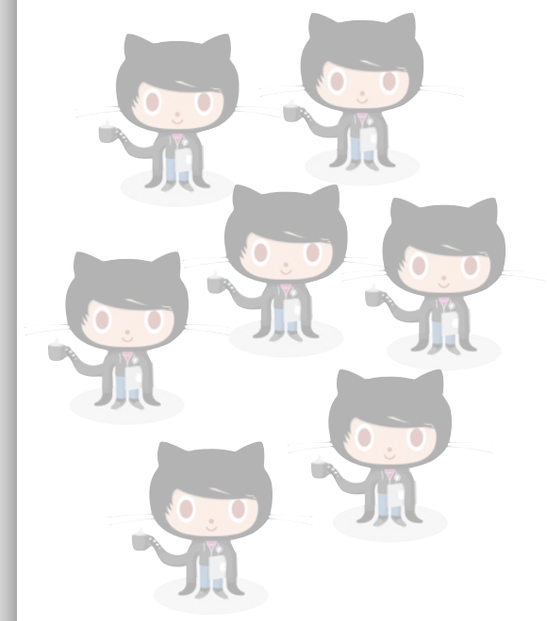

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NWO Netherlands Organisation for Scientific Research

NSF

AFOSR AIR FORCE OFFICE OF SCIENTIFIC RESEARCH

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Octocats from the GitHub Octodex https://octodex.github.com/