Do Time of Day and Developer Experience Affect Commit Bugginess?

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Goal

- Find correlation between commit "bugginess" vs time-of-day, day-of-week and experience/commit frequency of developers
- Perhaps build prediction models to identify bugs or better allocate developer time
- Construct and make available database of bug introducing/fixing commits with useful metadata

Summary of Findings

- Data is available and browsable at `http://www.eyolfson.com/scc/`
- Commits between midnight and 4 AM are more likely to be buggy
- Commits between 7 AM and noon are less likely to be buggy
- More active developers commit fewer bugs
- More experienced developers commit fewer bugs
- The worst day of the week varies between projects

Example

Bug-fixing commit

```
Commit: 2cdc03fe...
Author: Alice <alice@project.com>
Message: I fixed a bug!
@@ -100,1 +100,1 @@
-     if (i <= 128) {
+     if (i < 128) {
```

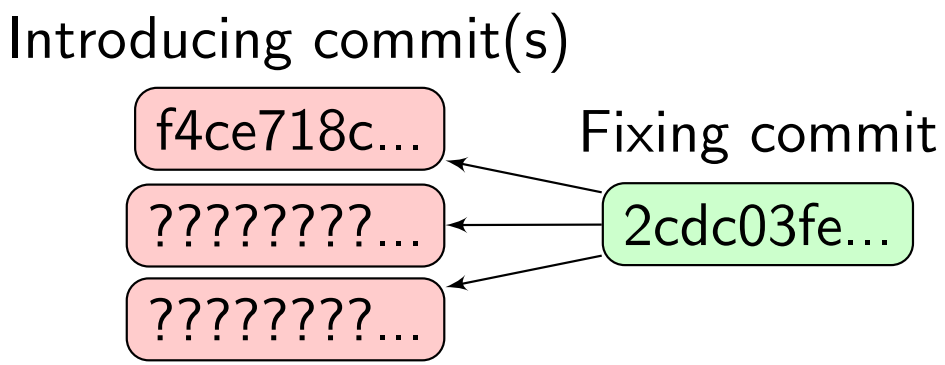
Blame of previous version

```
f4ce718c...   100     if (i <= 128) {
```

Creating Connections

Definition

A "buggy" or introducing commit is a commit changed by at least one fixing commit



- Find the bug fixing commits using a keyword search for "fix"
- Keyword search precision of 86%–87% and recall of 71%–73%

Additional Information

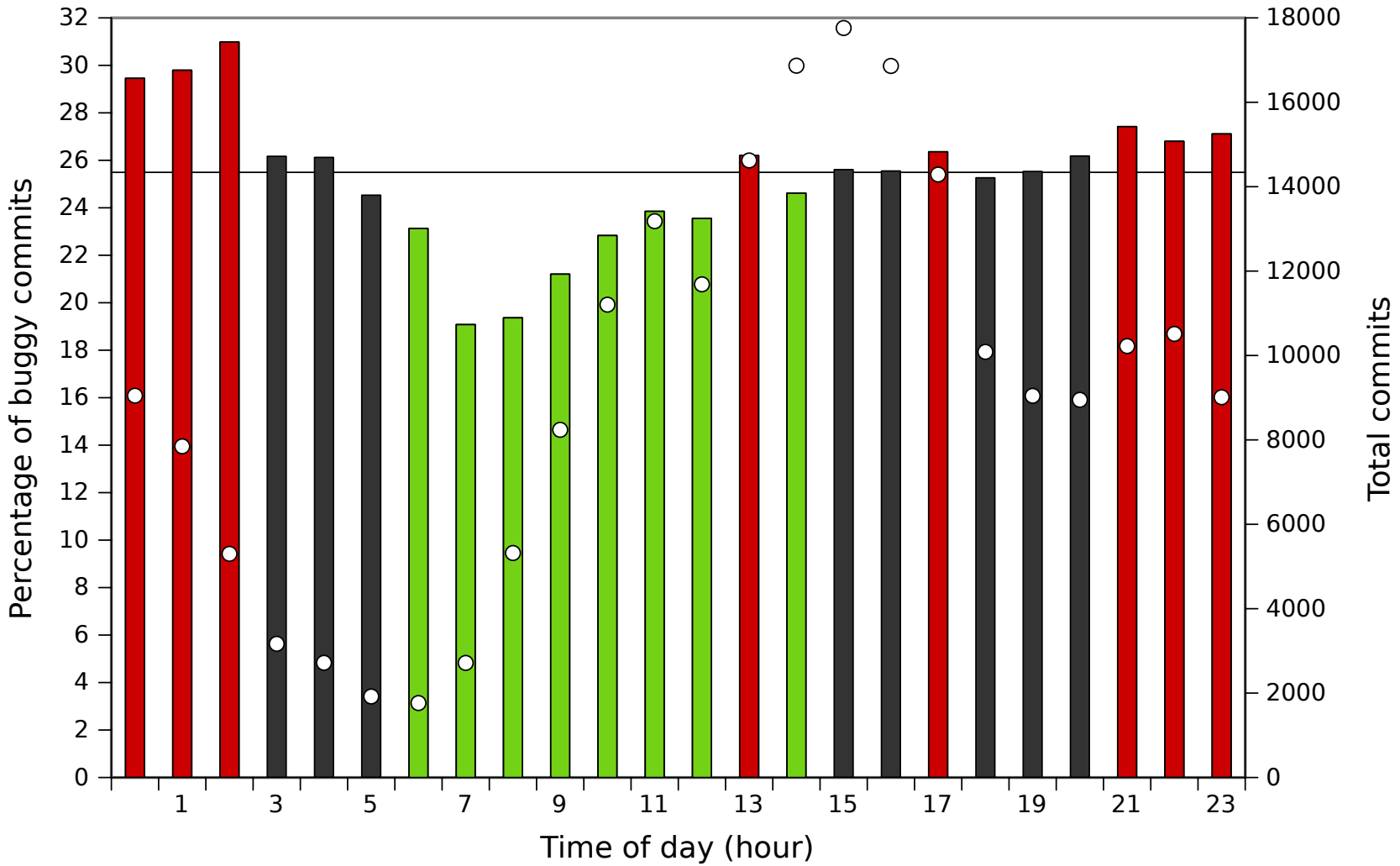
- Record the following
  - Commit times (local and UTC)
  - Authors merged by same name/email
  - Number of lines changed in code/comments/other in commit
- We can now determine
  - Whether a commit contains a bug and how many fixes were applied
  - Developer experience
  - Bug lifetime

Repositories

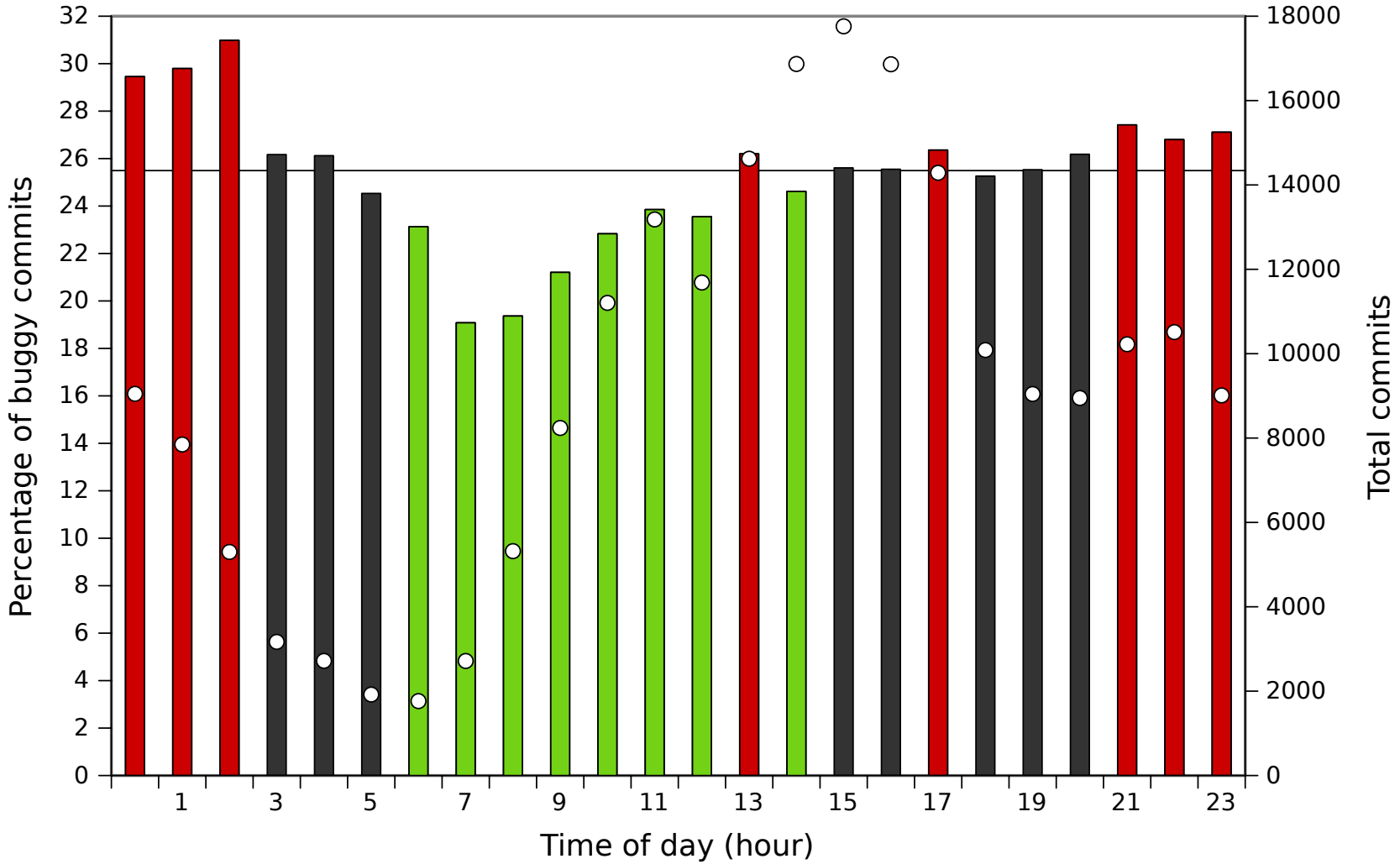
	Linux kernel	**PostgreSQL**
First commit	April 16, 2005	July 9, 1996
Last commit	Nov. 21, 2010	Jan. 24, 2011
Lines of code	over 5 million	over 750,000
Number of authors	6,504	34
Total commits	222,332	31,098
Introducing commits	56,590 (25.5%)	7,388 (23.8%)
Fixing commits	61,044	6,578

- Note: these are the up-to-date results at `http://www.eyolfson.com/scc/`

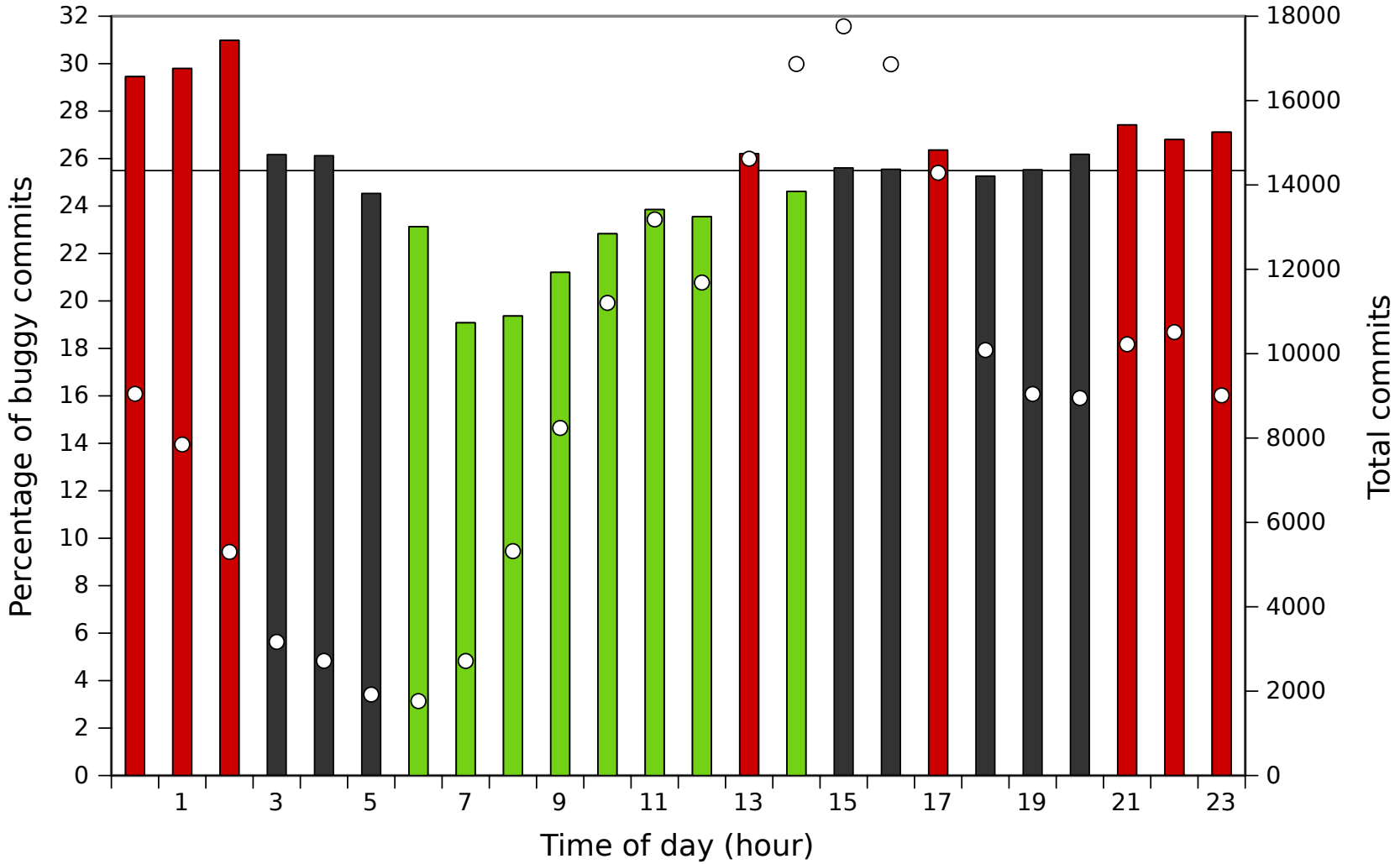
Linux - Most Commits Late Afternoon



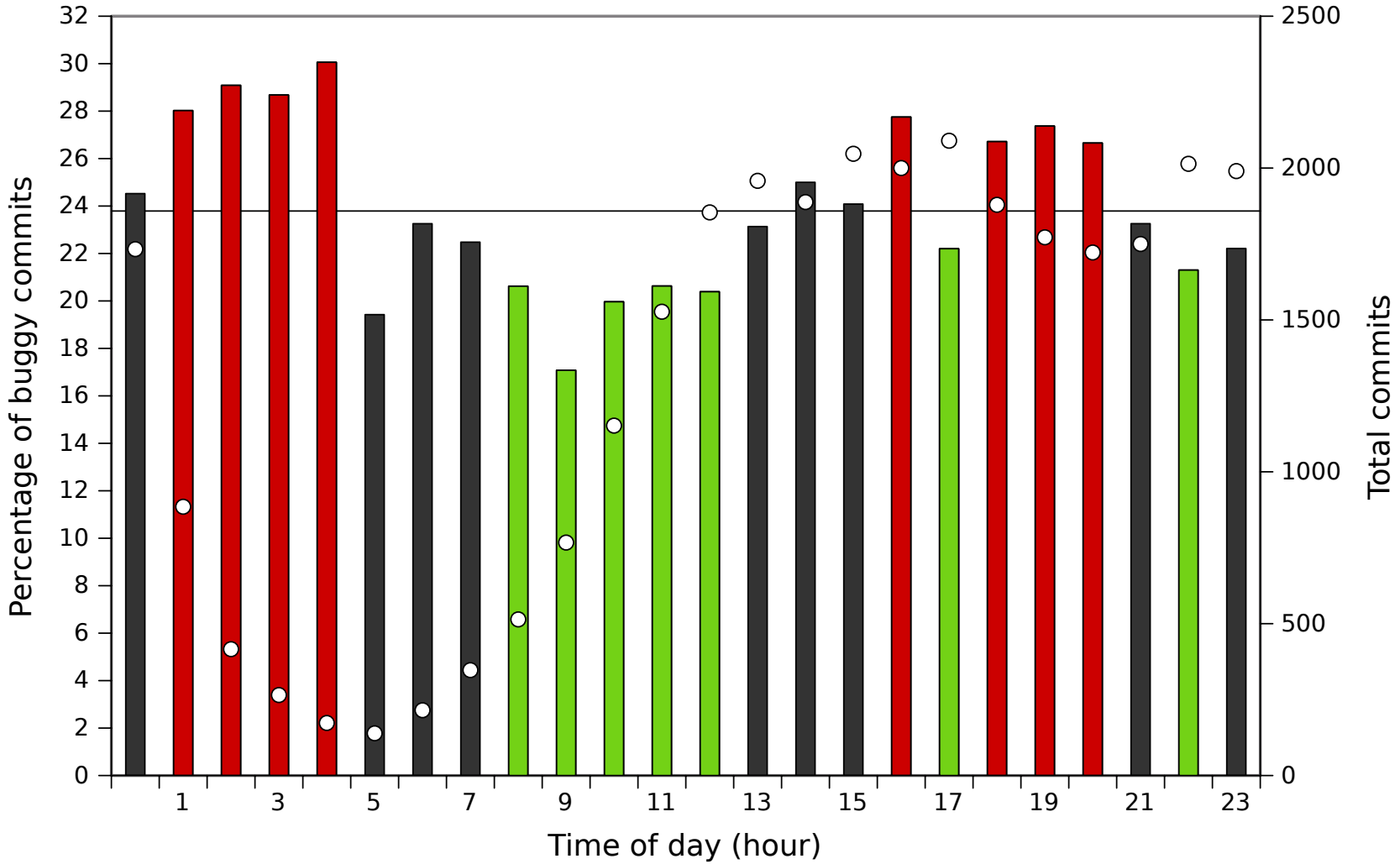
Linux - Late Night Commits are Up To 21% More Buggy



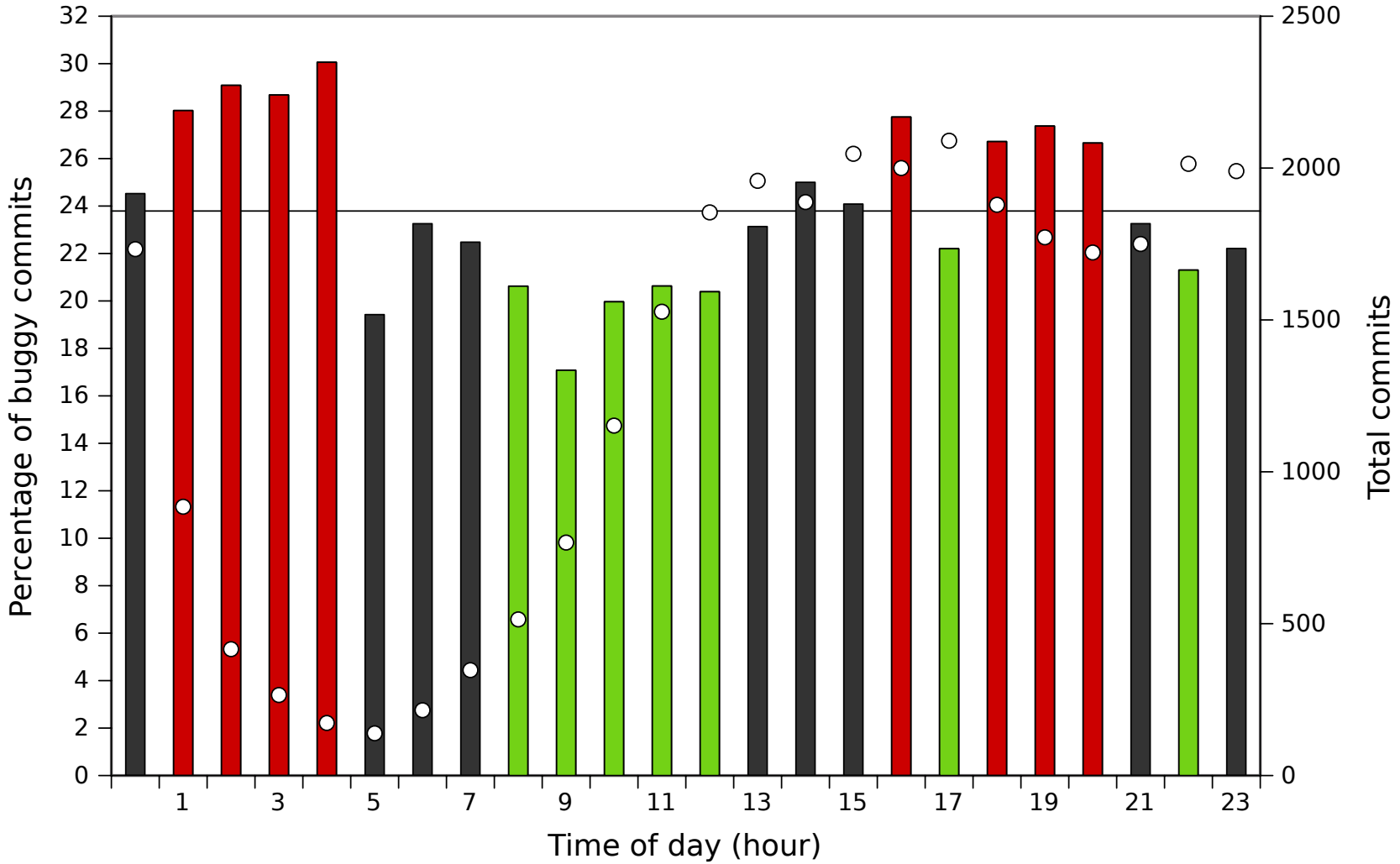
Linux - Early Morning Commits Produce Up To 25% Fewer Bugs



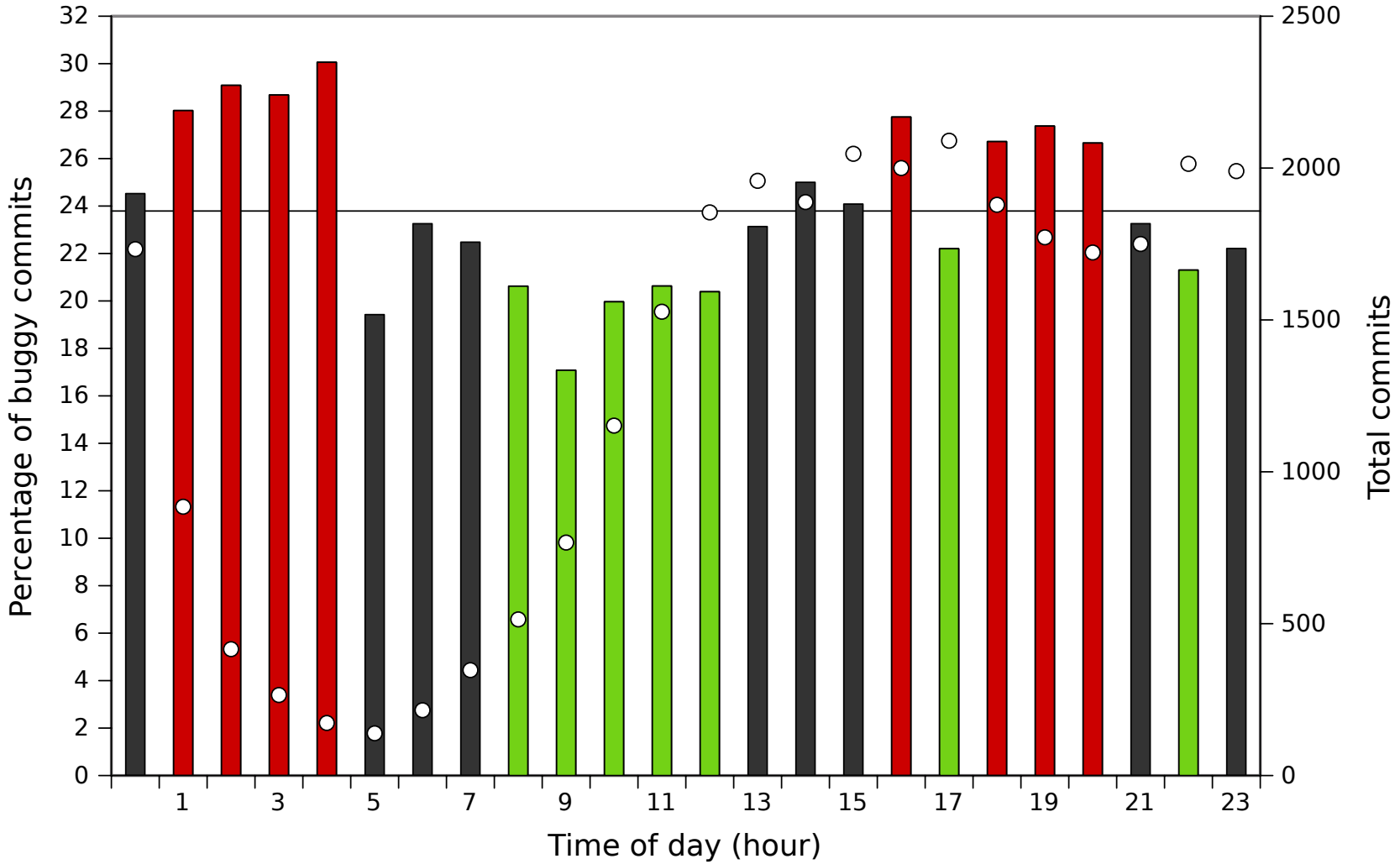
PostgreSQL - Most Commits In Evening



PostgreSQL - Late Night Commits are Up To 27% More Buggy



PostgreSQL - Early Morning Commits Produce Up To 28% Fewer Bugs



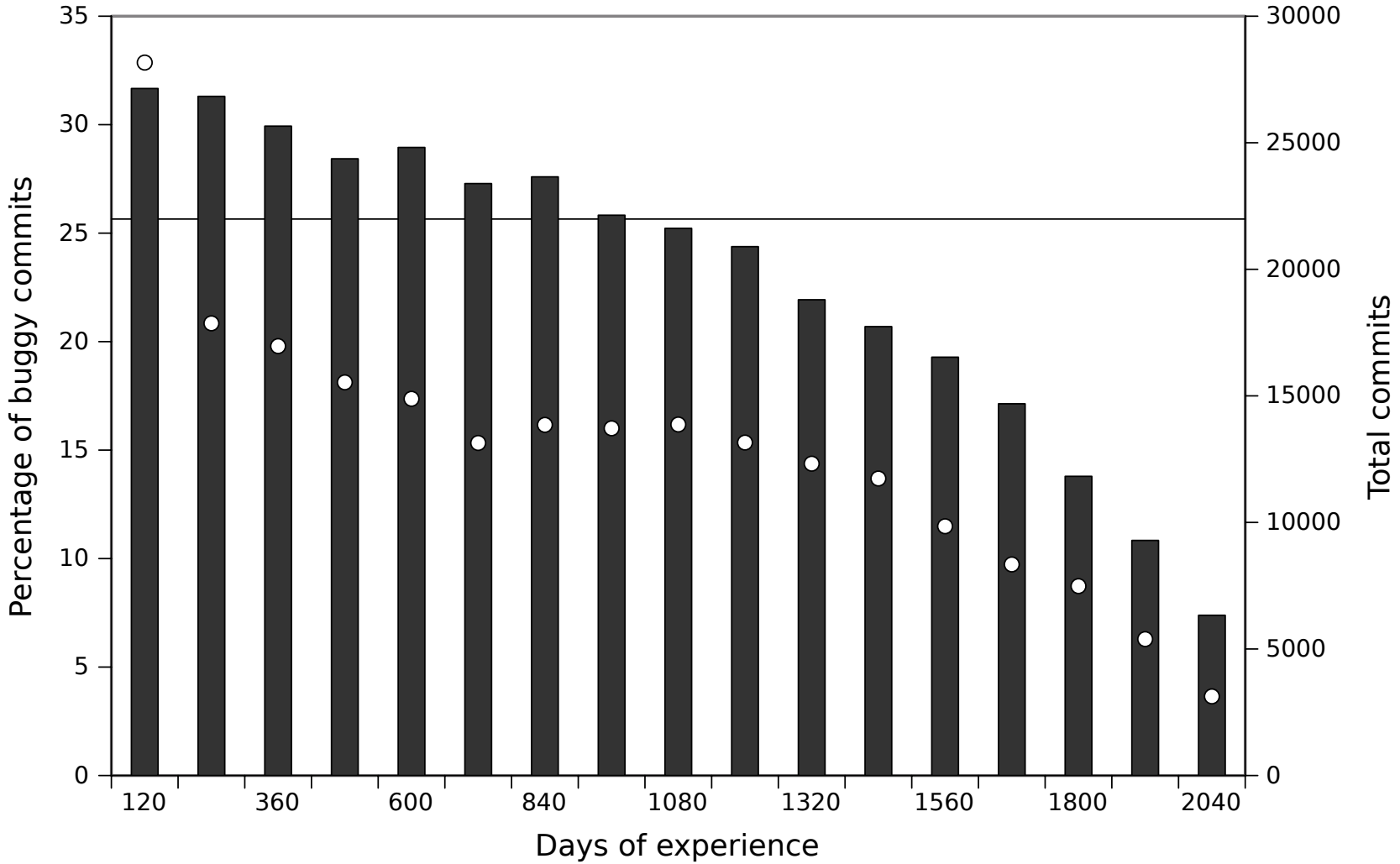
Our Definition of Experience

Definition

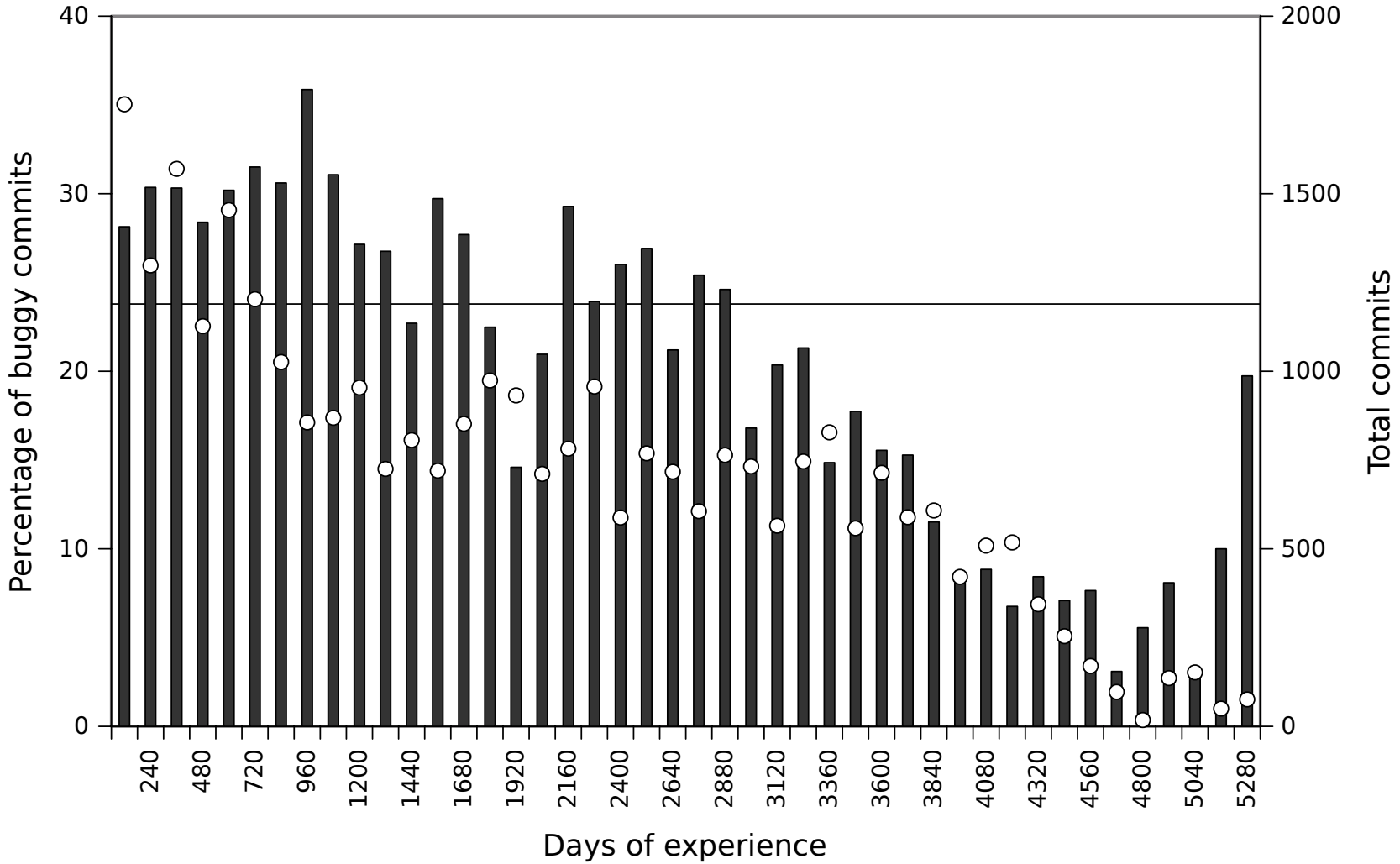
Experience is the number of days from the author's first commit to the current commit

- Consider two of an author's commits who started on May 1st
  - May 1st
  - May 22nd
- First commit would be 0 days experience and second 21 days

Linux - More Experienced Developers Commit Fewer Bugs



PostgreSQL - More Experienced Developers Commit Fewer Bugs



Our Frequency Classifications

- Based on frequency
- Daily, weekly, monthly, single

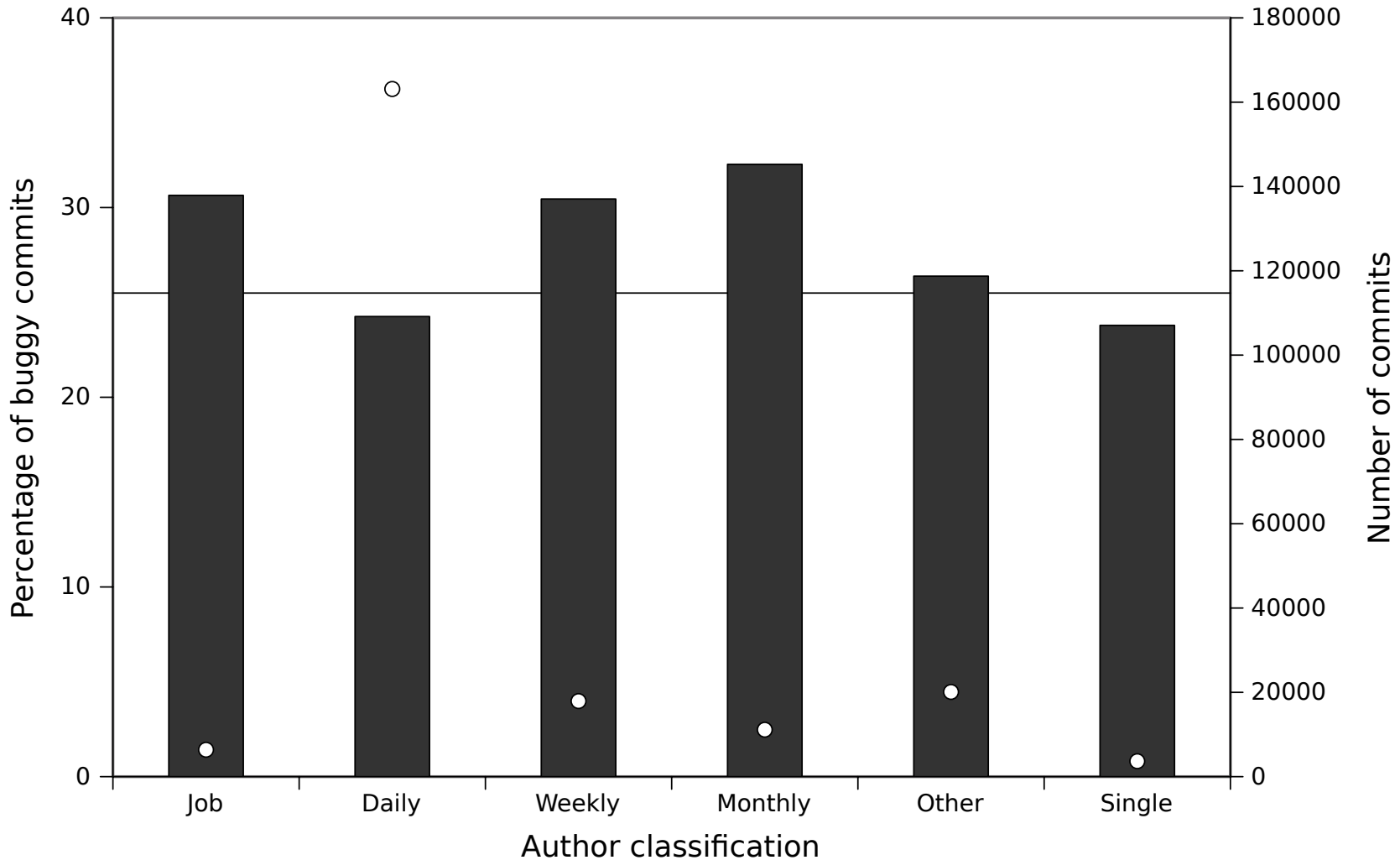
Definition

"Job" is a daily committer with the majority of commits between working hours

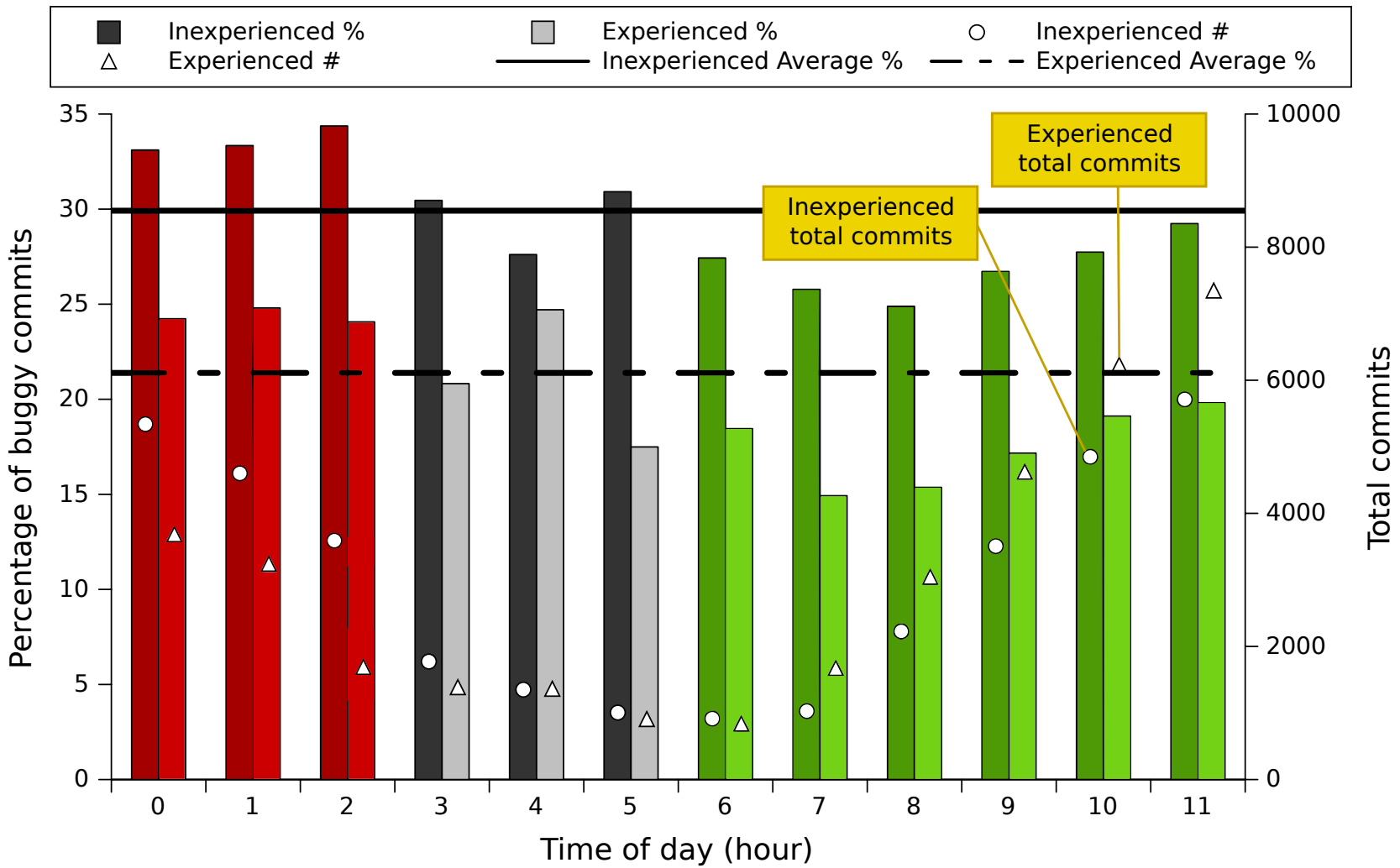
Definition

"Other" is a committer with fewer than 20 commits

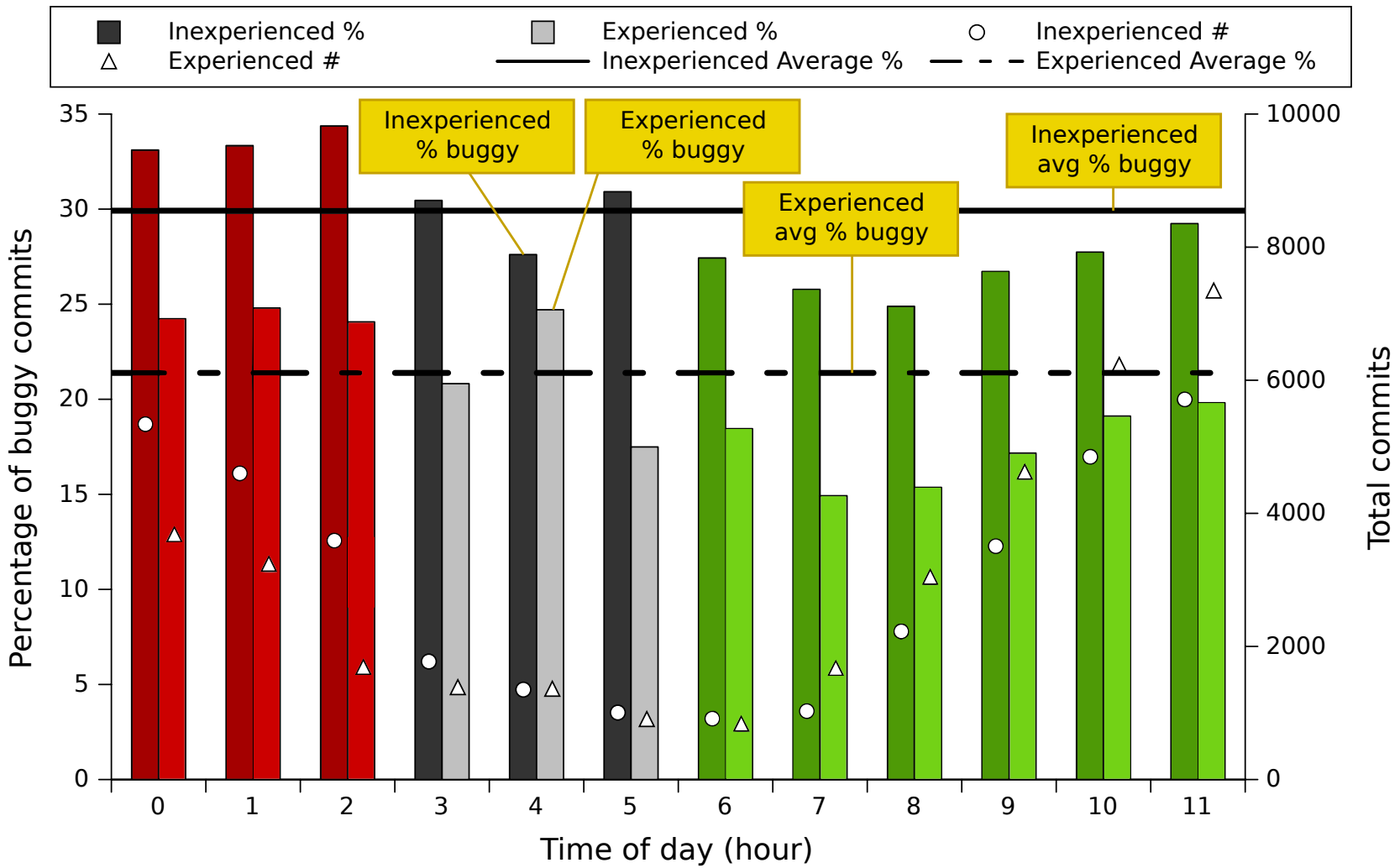
Linux - More Active Developers Commit Fewer Bugs



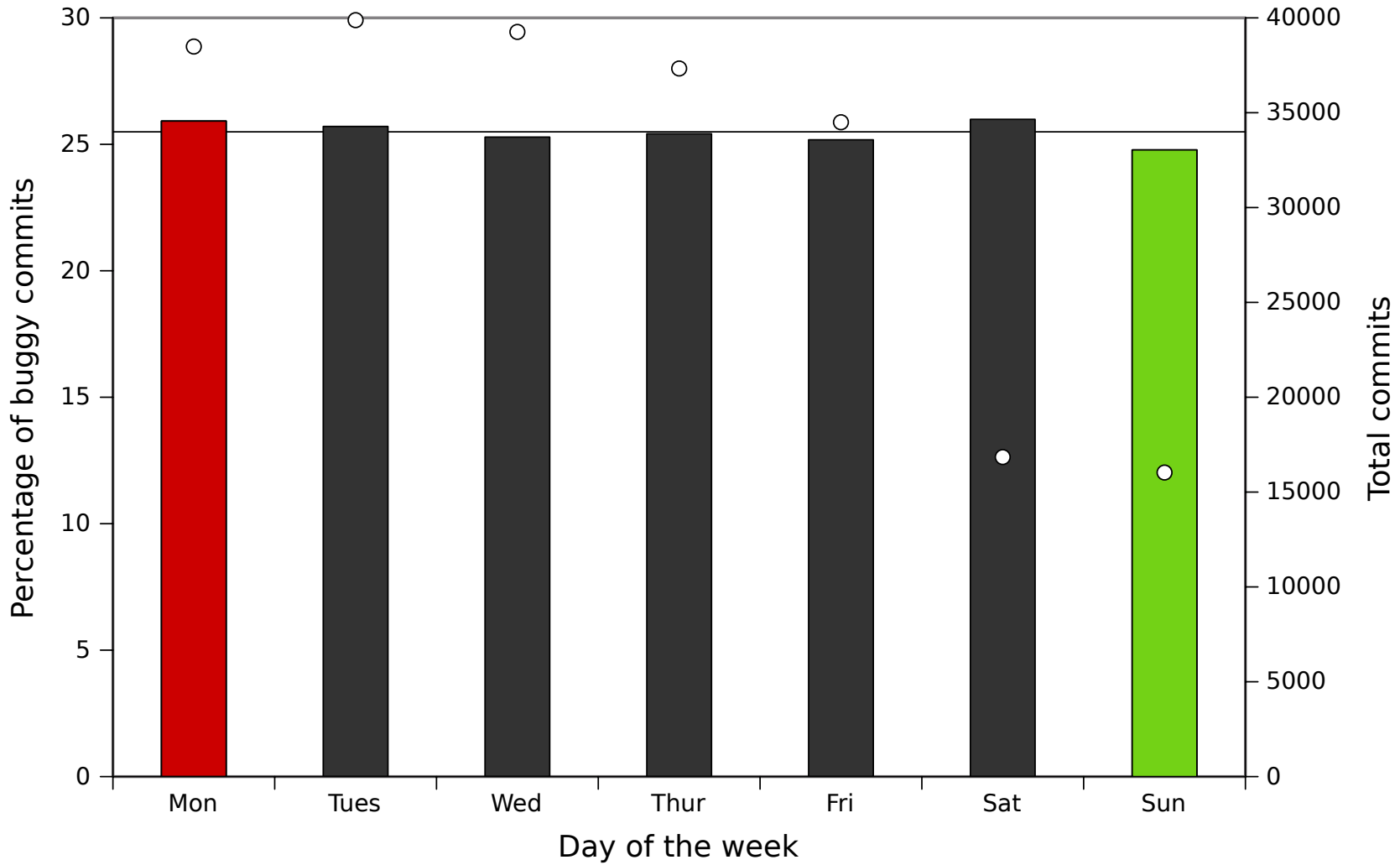
Linux - Inexperienced Developers Have More Late Night Commits



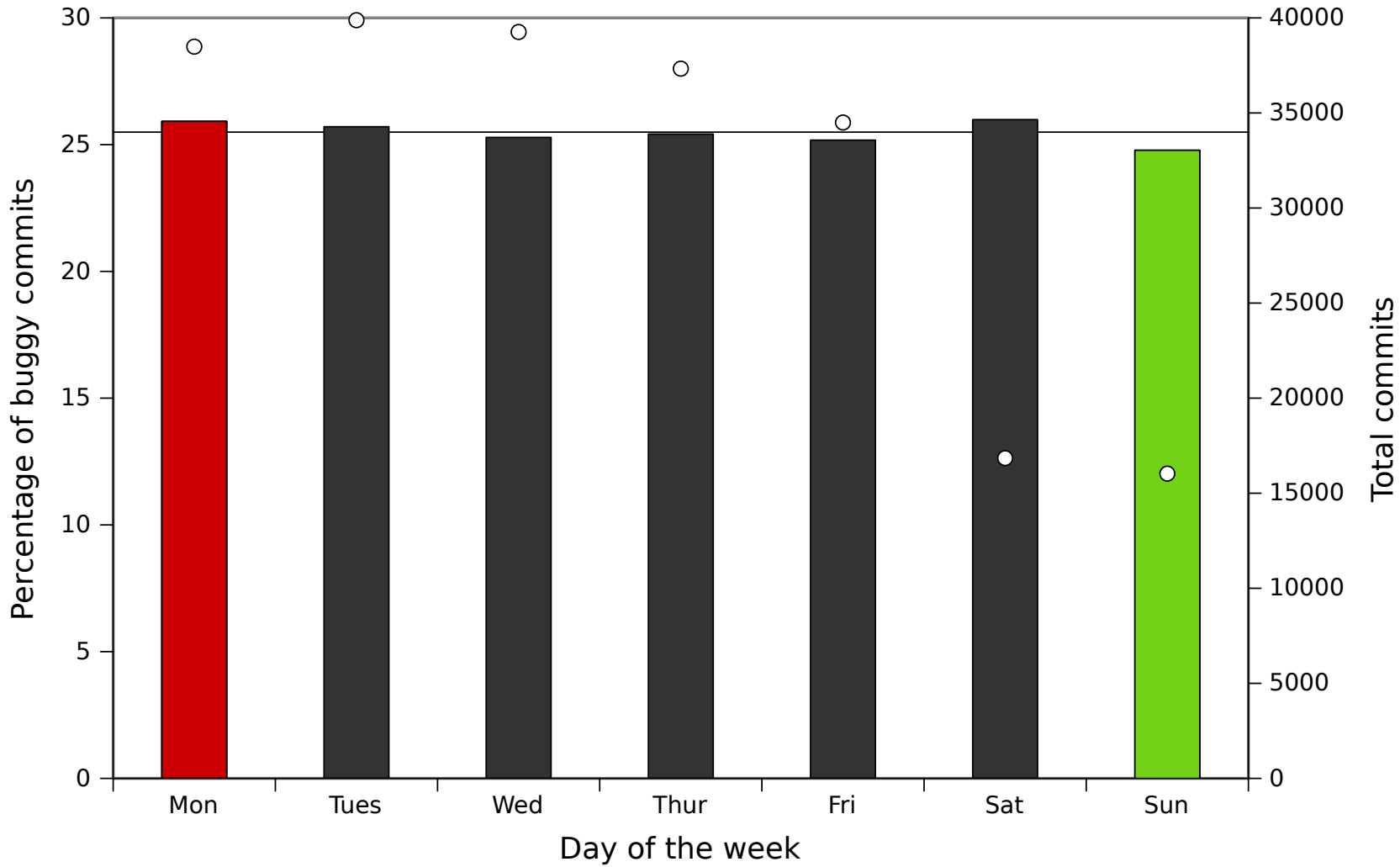
Linux - Both Sets of Developers Have Similar Good and Bad Hours



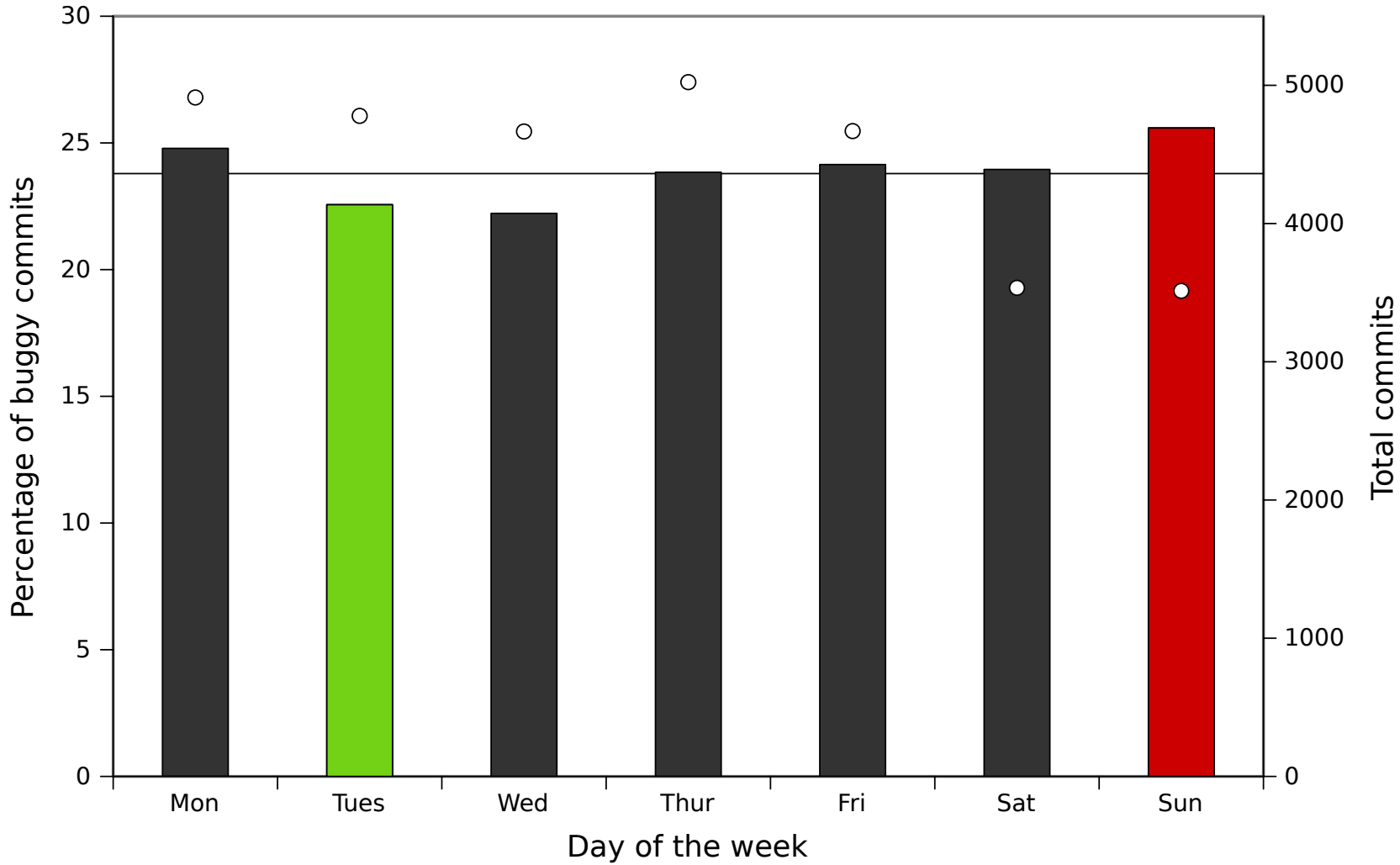
Linux - More Bugs Committed on Monday



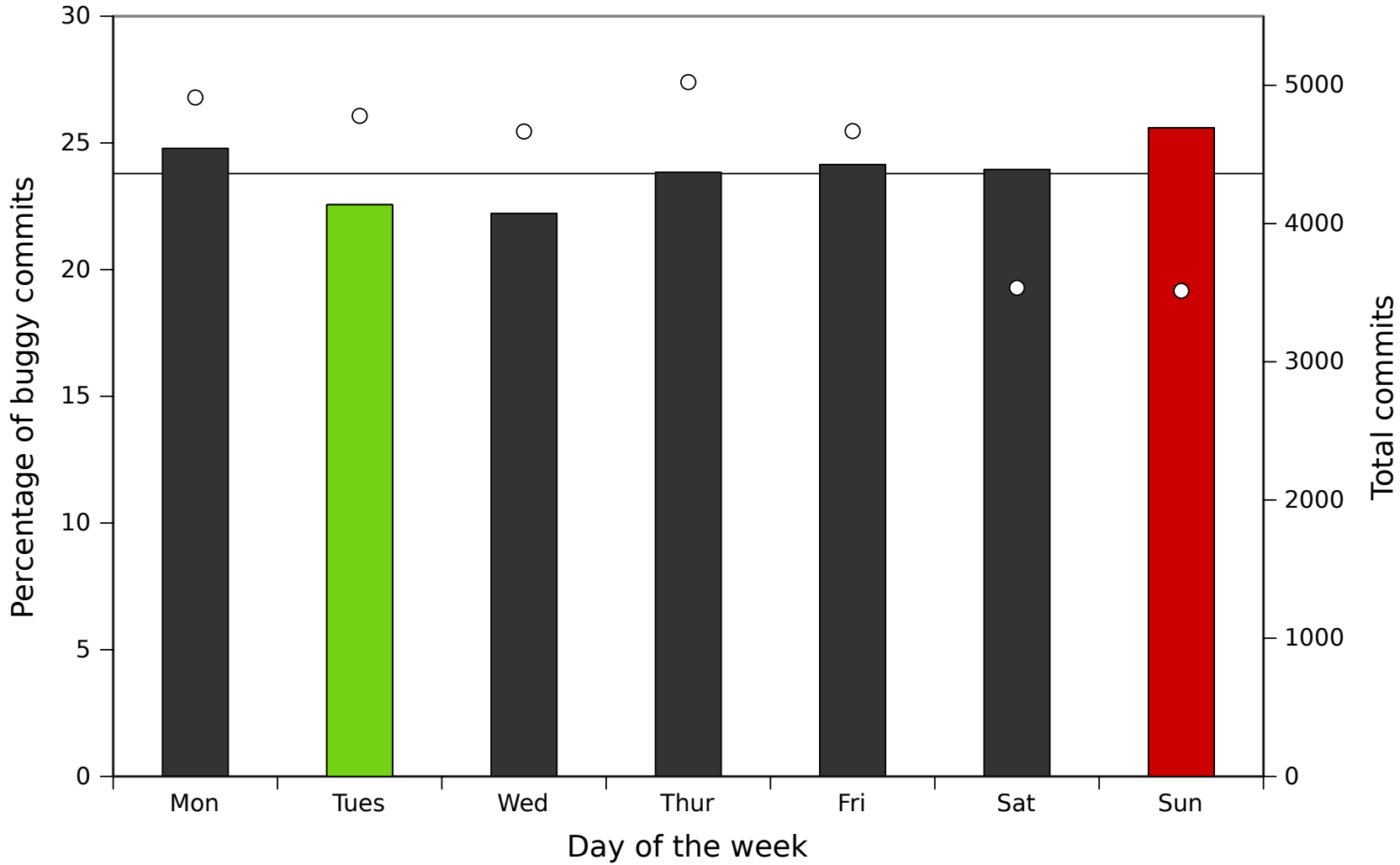
Linux - Fewer Bugs Commited on Sunday



PostgreSQL - More Bugs Committed on Sunday



PostgreSQL - Fewer Bugs Commited on Tuesday



Definition

Bug lifetime is the number of days from a fixing commit to the earliest bug introducing commit

- Found the average bug lifetime was
  - 1.38 years ($\sigma = 1.35$) for Linux
  - 3.07 years ($\sigma = 3.19$) for PostgreSQL

Previous Studies

- Commits for Eclipse and Mozilla were found to be buggiest on Fridays [Śliwerski et al., 2005, MSR]
- Classification of commits into different categories [Hindle et al., 2008, MSR]
- Bug lifetimes for PostgreSQL [Kim and Whitehead Jr, 2006, MSR]
  - Average of 2 years

For the Future

- Study individual developers
  - Are commits outside their normal schedule worse?
  - Experience including other open-source projects?
- More software projects
- Correlations involving code quality
- Prediction models

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References


Hindle, A., German, D. M., and Holt, R. (2008).
What do large commits tell us?: A taxonomical study of large commits.
In *MSR*, pages 99–108.


Kim, S. and Whitehead Jr, E. (2006).
How long did it take to fix bugs?
In *MSR*, pages 173–174.


Śliwerski, J., Zimmermann, T., and Zeller, A. (2005).
When do changes induce fixes?
In *MSR*, pages 24–28.

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