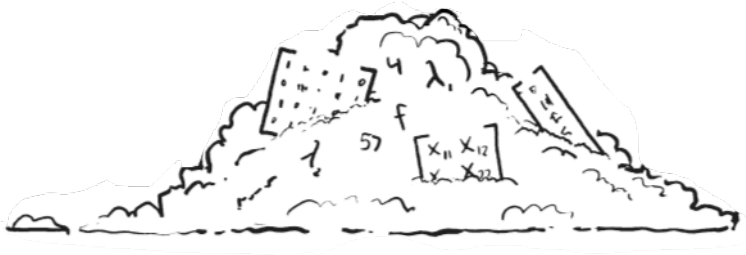
HARVARD
John A. Paulson
School of Engineering
and Applied Sciences

Berkeley EECS
ELECTRICAL ENGINEERING & COMPUTER SCIENCES

UCLA Samueli
Computer Science

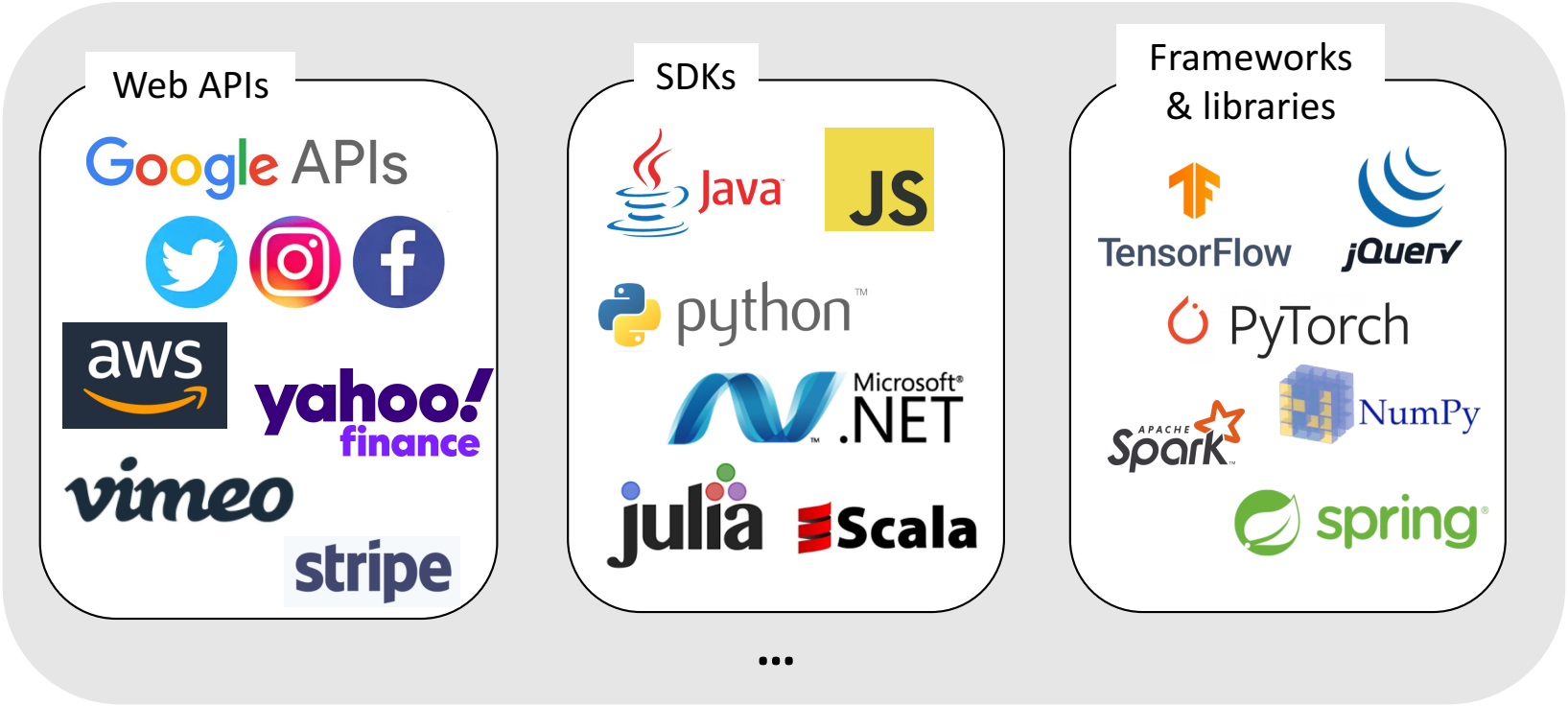
Enabling Data-Driven API Design with Community Usage Data: A Need-Finding Study



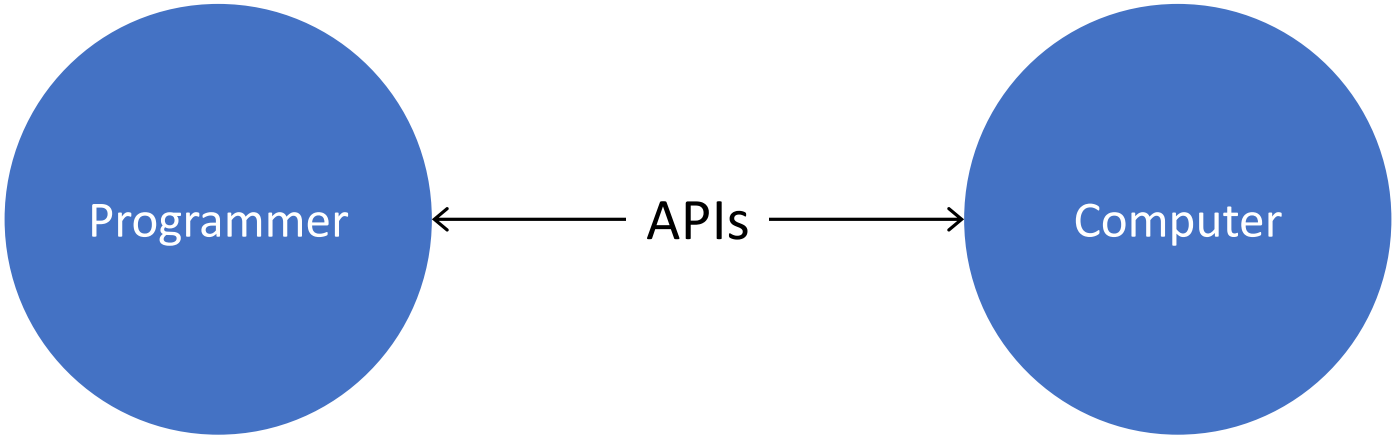
Tianyi Zhang[1], Björn Hartmann[2], Miryung Kim[3], Elena Glassman[1]

[1]Harvard University [2]UC Berkeley [3]UCLA

APIs are ubiquitous



APIs are a primary interface between programmers and computers



What Makes APIs Hard to Learn? Answers from Developers

Martin P. Robillard, *McGill University*

A study of obstacles that professional Microsoft developers faced when learning to use APIs uncovered challenges and resulting implications for API users and designers.

Most software projects reuse components exposed through APIs. In fact, current-day software development technologies are becoming inseparable from the large APIs they provide. To name two prominent examples, both the Java Software Development Kit and the .NET framework ship with APIs comprising thousands of classes supporting tasks that range from reading files to managing complex process workflows.

An API is the interface to implemented functionality that developers can access to perform various tasks. APIs support code reuse, provide high-level abstractions that facilitate programming tasks, and help unify the programming ex- and interviewing developers about the obstacles they faced learning APIs, I discovered many issues that complement those mentioned in API design textbooks and articles. In particular, I found that API learning resources are critically impor-

Human-Centered API Design

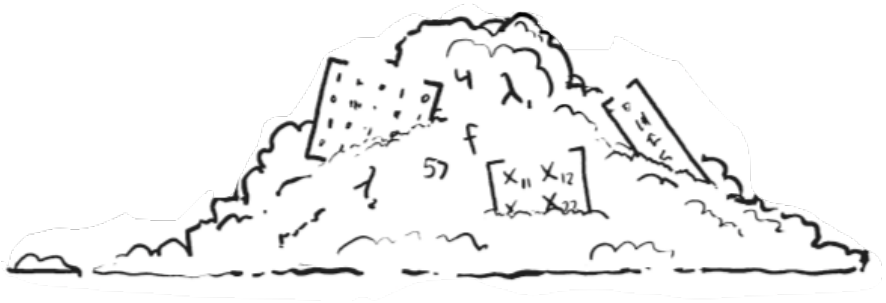
- Apply HCI methods to API design,

  e.g., A/B testing [1,2,3]

- But it is costly.
  - Too many APIs and usage scenarios
  - Participant recruitment

1. Ellis et al. The factory pattern in API design: A usability evaluation. ICSE 2007
2. Stylos et al. A case study of API design for improved usability. VL/HCC 2008.
3. Stylos et al. The implications of method placement on API learnability. FSE 2008.

A lot of API usage data has been generated from programmer communities…



open source initiative

stackoverflow

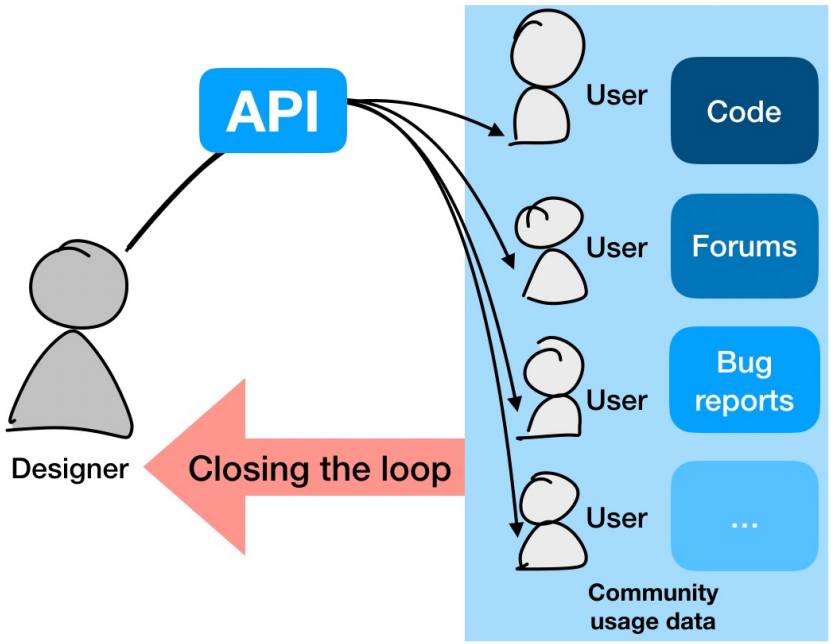
github

Atlassian Bitbucket

slack

GITTER

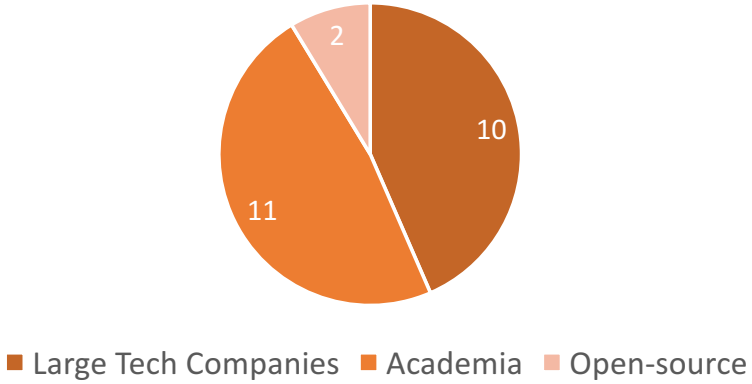
How can we leverage community data to inform better API design?

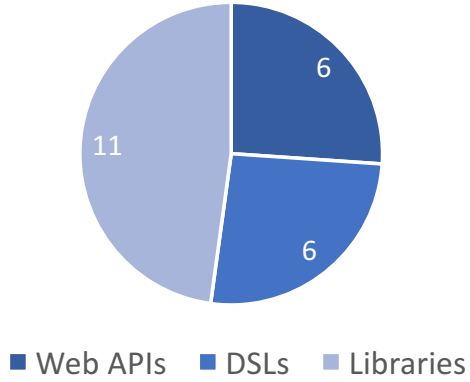


Contributions

- Semi-structured interviews with 23 API designers
- An in-depth analysis of their design styles, usability evaluation methods in practice, and unmet information needs
- Several tool design implications for leveraging community API usage data to inform API design

Interview with 23 API Designers





Caffe

mxnet

julia

CHISEL

Vega-Lite

Gen.jl

z3

Alloy

Partisan

Interview Questions

- What **design decisions and tradeoffs** have you made?
- How do you **evaluate** the usability of your APIs?
- What **challenges and frustrations** do you have?
- What **information** would you like to discover?
- What **tool support** do you need?

Finding 1. Designer Spectrum

User-driven

Self-driven

Visionary

Closed-world

User-Driven API Designer

- User-centered design process
- Survey user needs
- API stability

Self-Driven API Designer

- Make their own decisions
- Clear goals and priorities
- API expressiveness & extensibility

Visionary API Designer

- Lack communication channels to users
- Design with imagined use cases
- Eager to know API usage in the wild

Closed-World API Designer

- APIs used internally in a company
- Work closely with all stakeholders
- Least tension between API designers and users

Finding 1. Designer Spectrum

User-driven

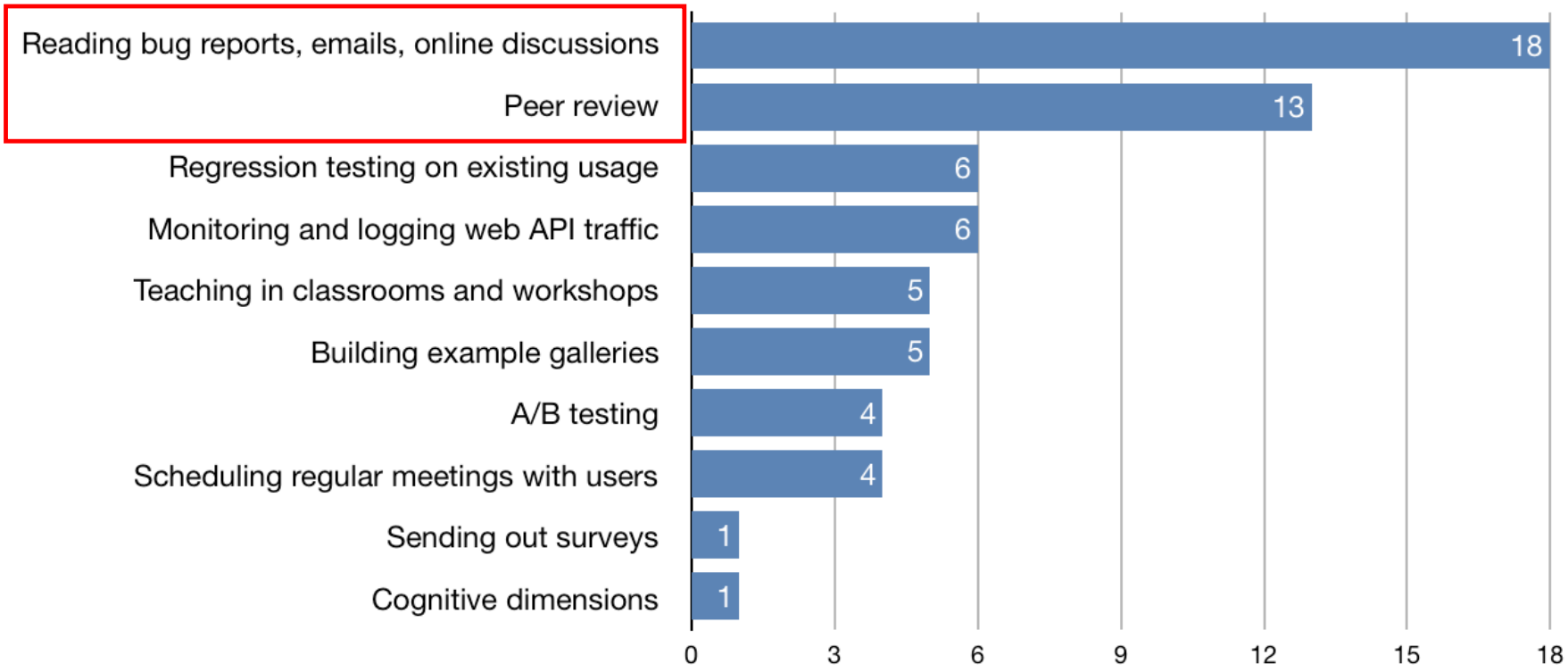
Self-driven

Visionary

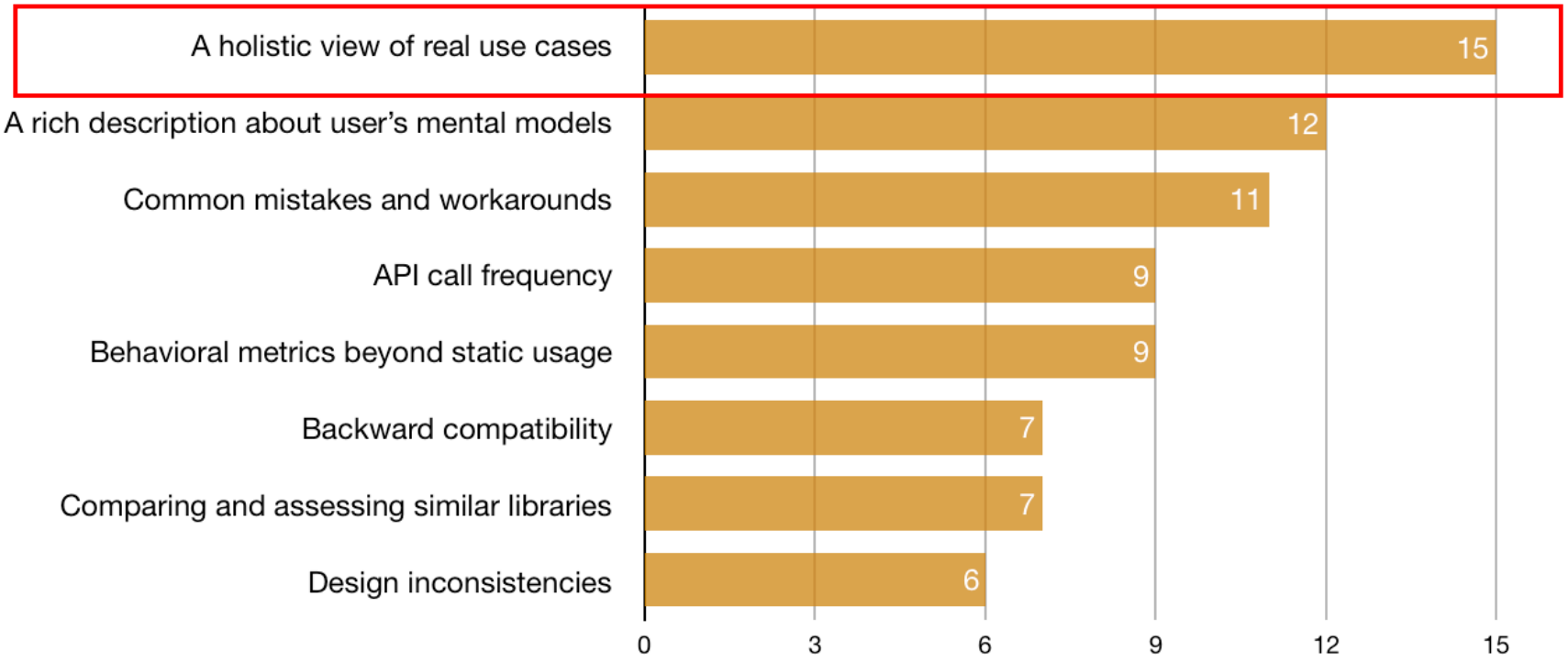
Closed-world

They all acknowledged the importance of keeping users in mind.

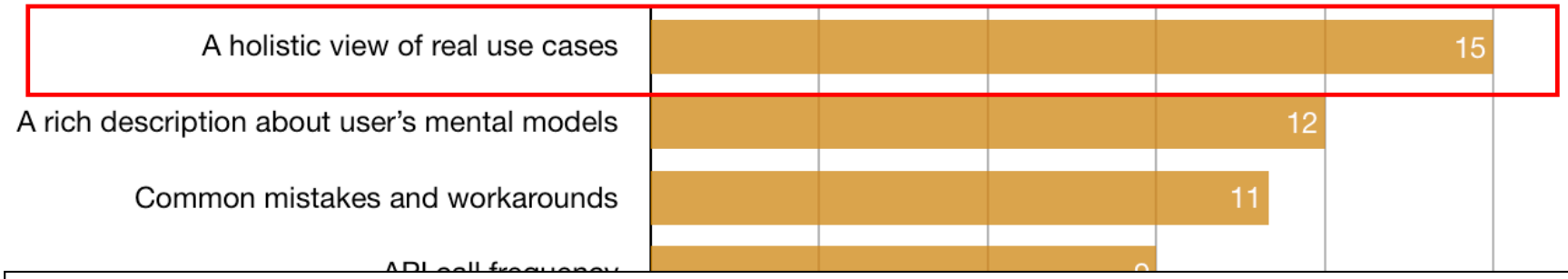
Finding 2. Usability Evaluation Methods



Finding 3. Unmet Information Needs

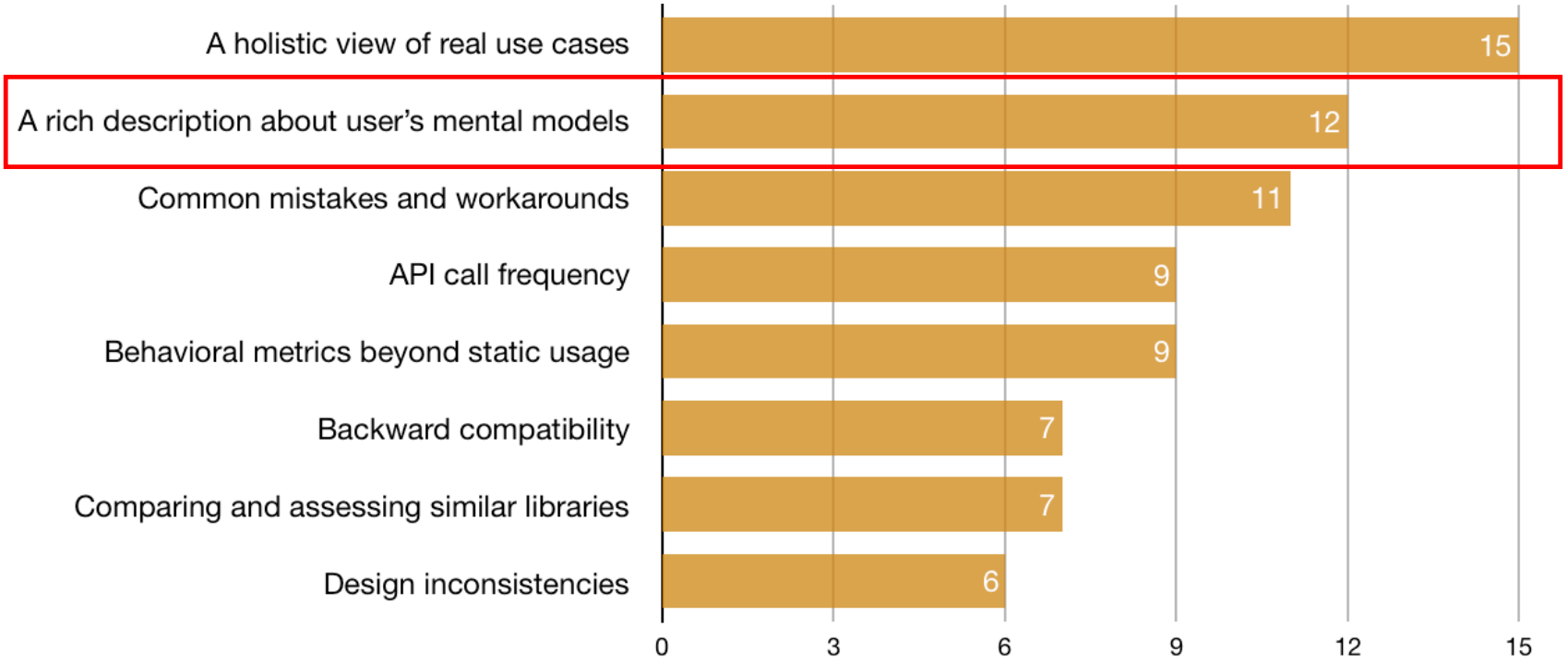


Finding 3. Unmet Information Needs



P13: "*I'd like to **look at their code** and see if they write code **in the ideal way we want them to write**. Because every API has its own purpose when they're being designed, and we have some use cases in mind. If not, we'll probably think if this API is designed in a proper way or we should **create some more obvious APIs to deal with this case**.*"

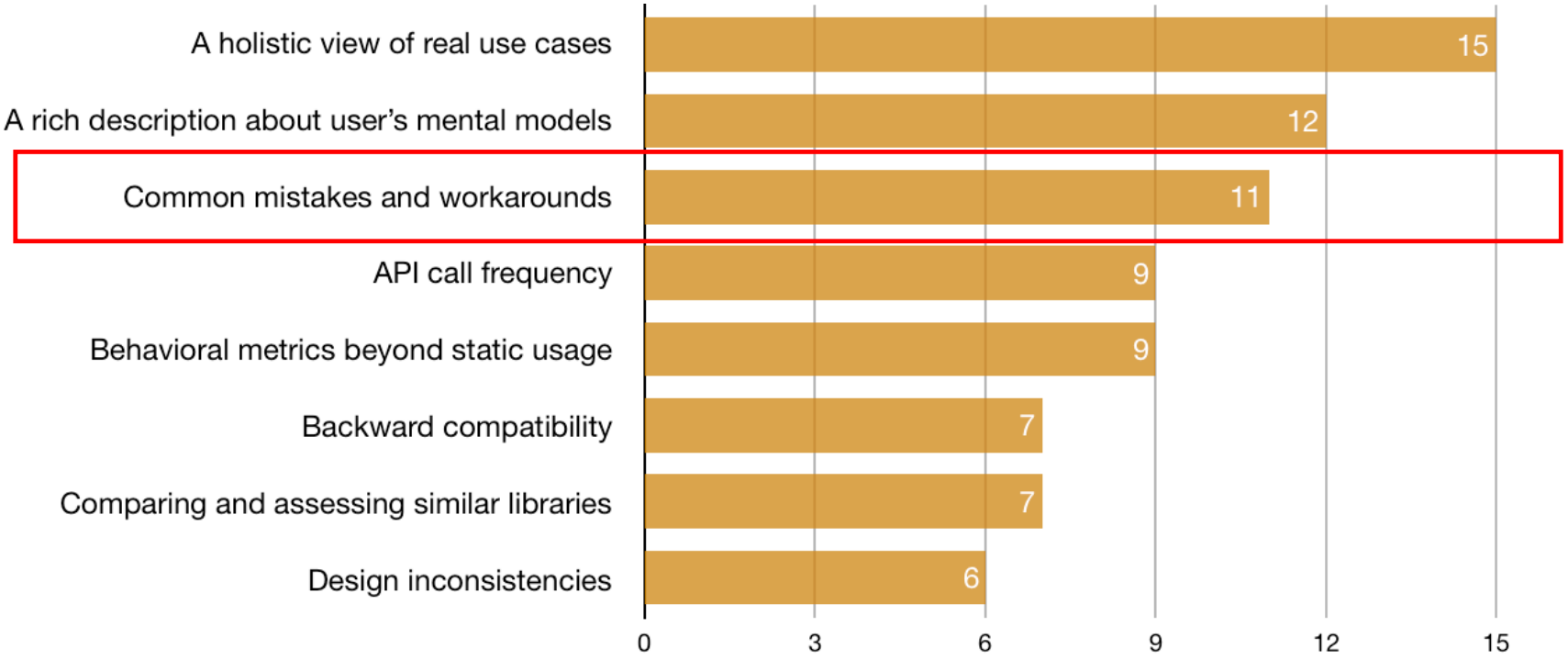
Finding 3. Unmet Information Needs



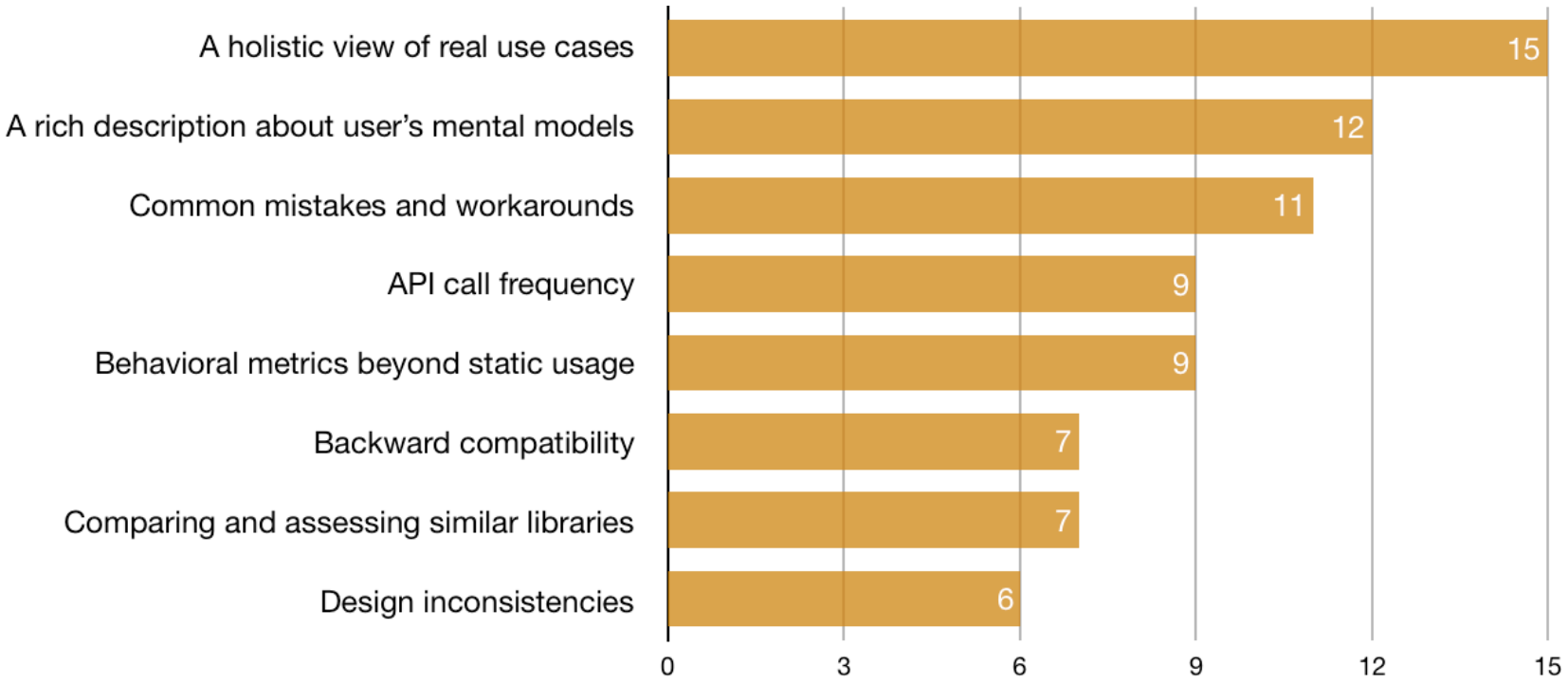
Finding 3. Unmet Information Needs

P6: "*I want to get what people are thinking, **not just whether they are able to use this API**, like that's what you would get from like mining GitHub repos. But what you are not getting is like this person still **spent three hours googling** how to use this API, and he **spent an hour on Stack Overflow** trying to figure out what was going on, in the end, he got that, but it was a **frustrating attempt**.*"

Finding 3. Unmet Information Needs



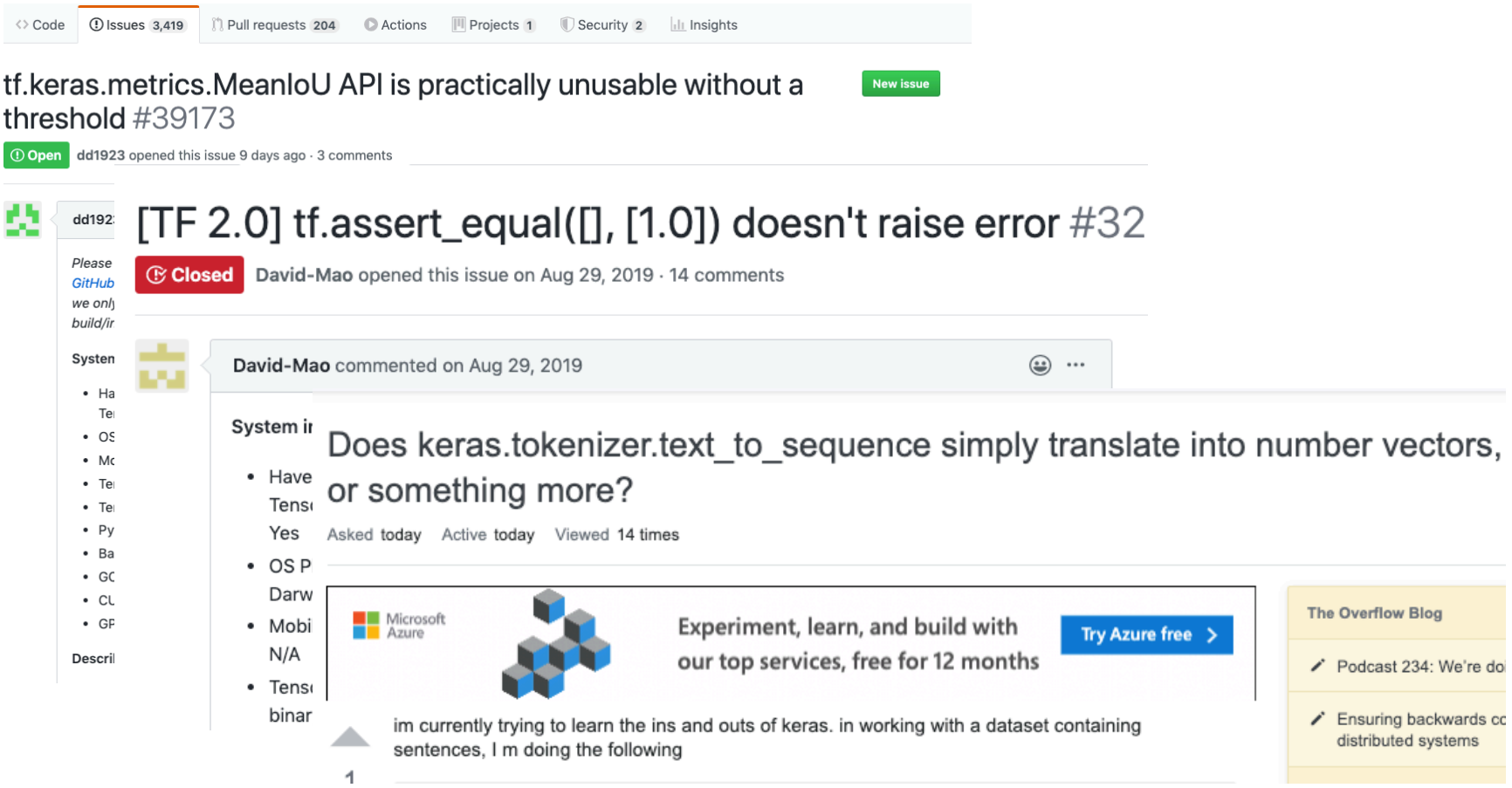
Finding 3. Unmet Information Needs



Finding 4. Opportunities for Tool Support

- Mining and visualizing API usage mistakes
- Interactively analyzing population-level API usage
- Adapting elicitation mechanisms to understand API users' mental models
- Exploring the design space of similar APIs
- Live API documentation

Mining and Visualizing **Documented** Mistakes



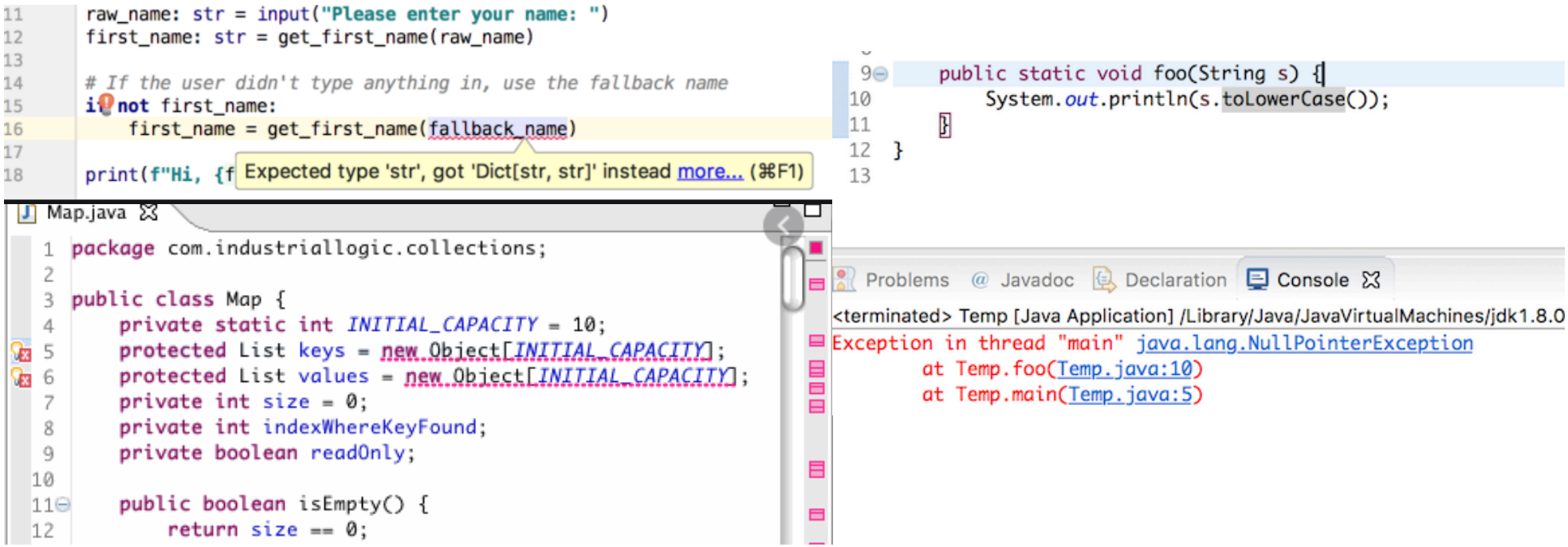
Capturing **Undocumented** Learning Barriers

- Participants suspect a lot of issues were not reported at all.

P9: "*I think the people that use the API with no prior experience perhaps hit the wall quickly. That's the real issue. But for the most part, I suspect that I* ***missed most of the easy problems*** *going on there because* ***they don't convey that first barrier*** *with their remote communication.*"

Capturing **Undocumented** Learning Barriers

- Compilation/runtime errors are good indicators of undocumented learning barriers.



Conclusion

- API designers desire to have a holistic view of real API use cases.
- Such real use cases are gathered in an informal way due to a lack of tool support.
- New interactive systems are needed to distill a variety of API usage insights from community data.