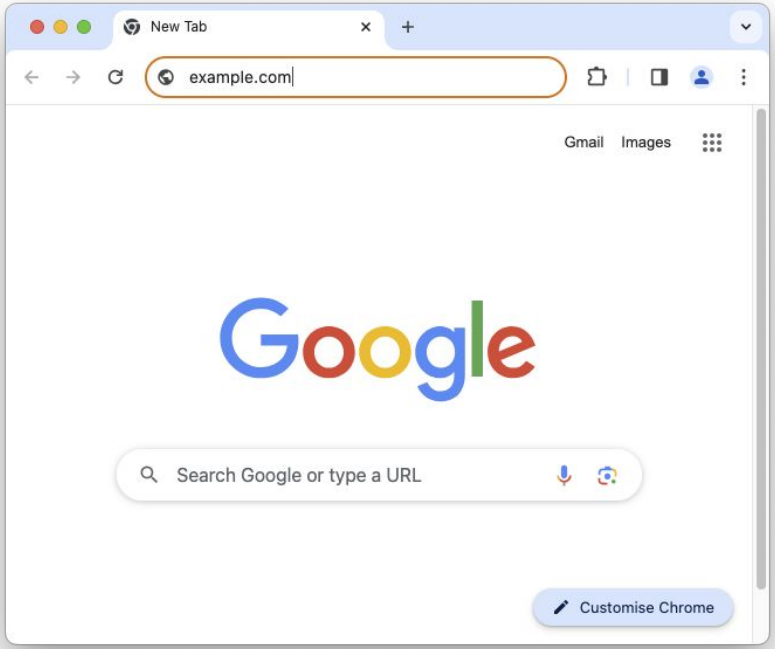
“Don’t Interrupt Me”

A Large-Scale Study of On-Device Permission Prompt Quieting in Chrome

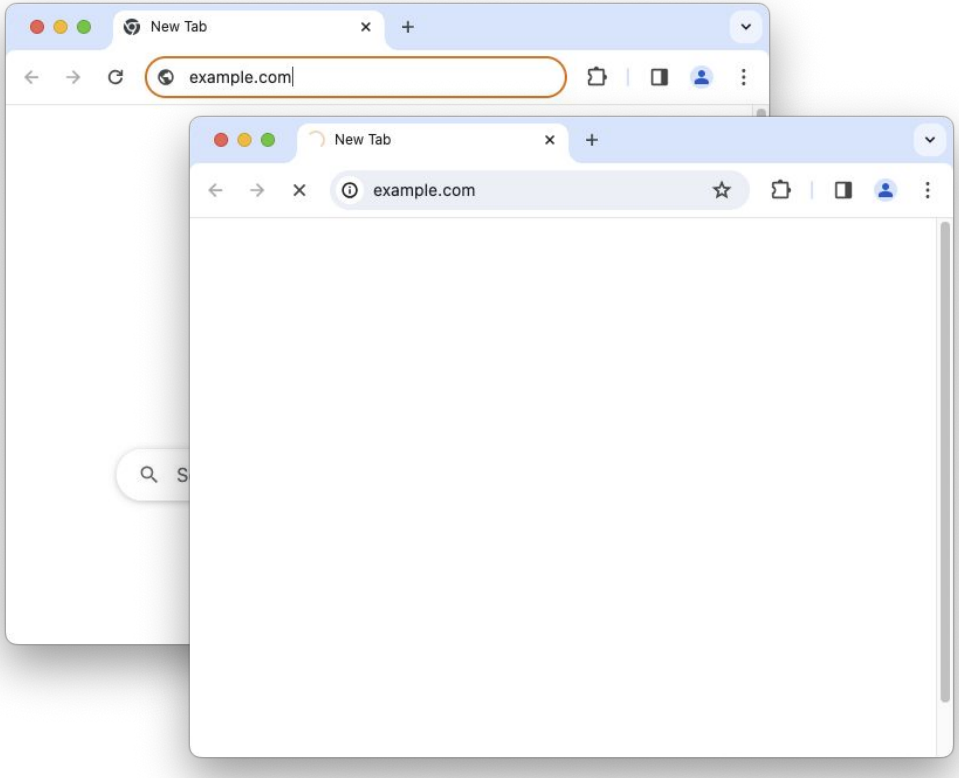
Marian Harbach, Igor Bilogrevic, Enrico Bacis, Serena Chen, Ravjit Uppal, Andy Paicu, Elias Klim, Meggyn Watkins, and Balazs Engedy

Google Chrome

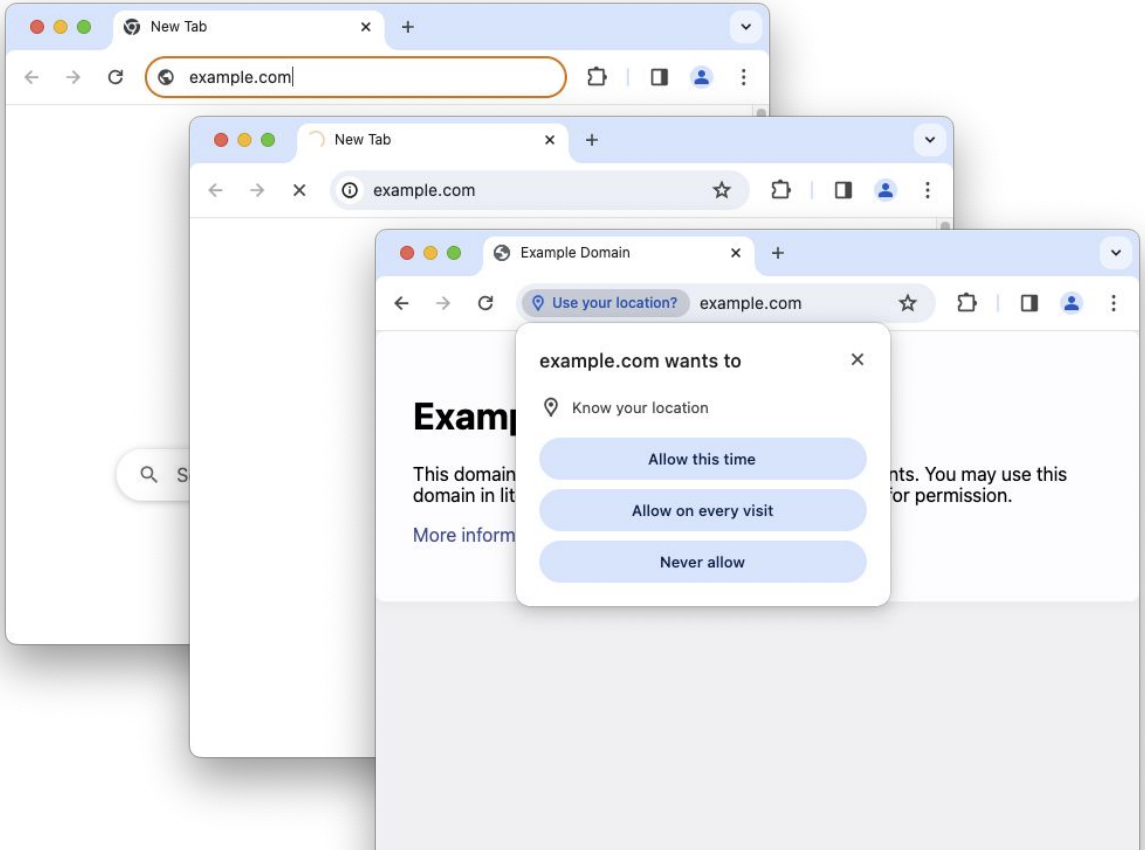
Motivation


New Tab
example.com
Gmail
Images
Google
Search Google or type a URL
Customise Chrome

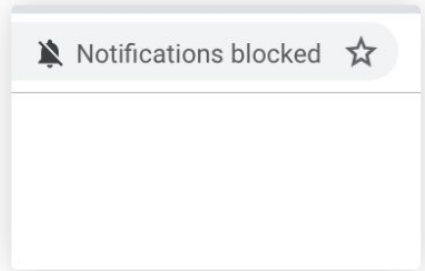
Motivation

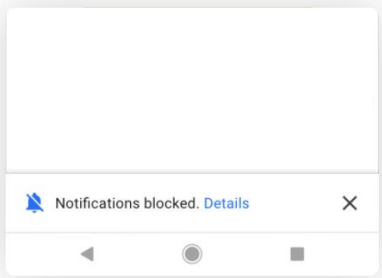


Motivation


New Tab
example.com
New Tab
example.com
Example Domain
Use your location?
example.com
example.com wants to
Know your location
Allow this time
Allow on every visit
Never allow

Prior Work



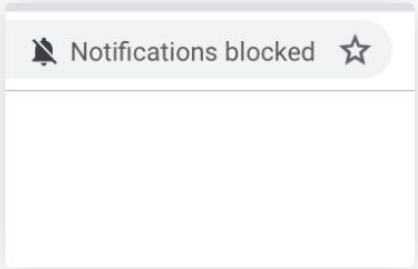


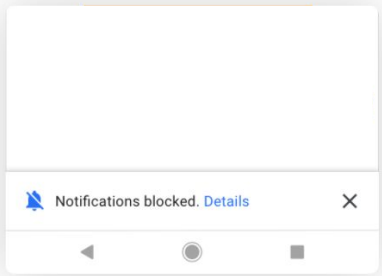
Triggered if any of the below is true:

- Site in bottom 5% by grant rate
- User denied 3 consecutive prompts in 28d
- Settings opt-in

Bilogrevic et al., “Shhh…be quiet!” – Reducing the Unwanted Interruptions of Notification Permission Prompts on Chrome, Usenix Security 2021

Prior Work





Triggered if any of the below is true:

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-30% 🎉
avg. **deny** rate

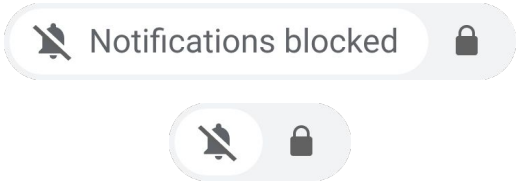
-5% 👍
avg. **grant** rate

3% ⚠️
Notification **prompts quietable**

14% 😕
Users eligible for quieting

Bilogrevic et al., "Shhh…be quiet!" – Reducing the Unwanted Interruptions of Notification Permission Prompts on Chrome, Usenix Security 2021

This Work



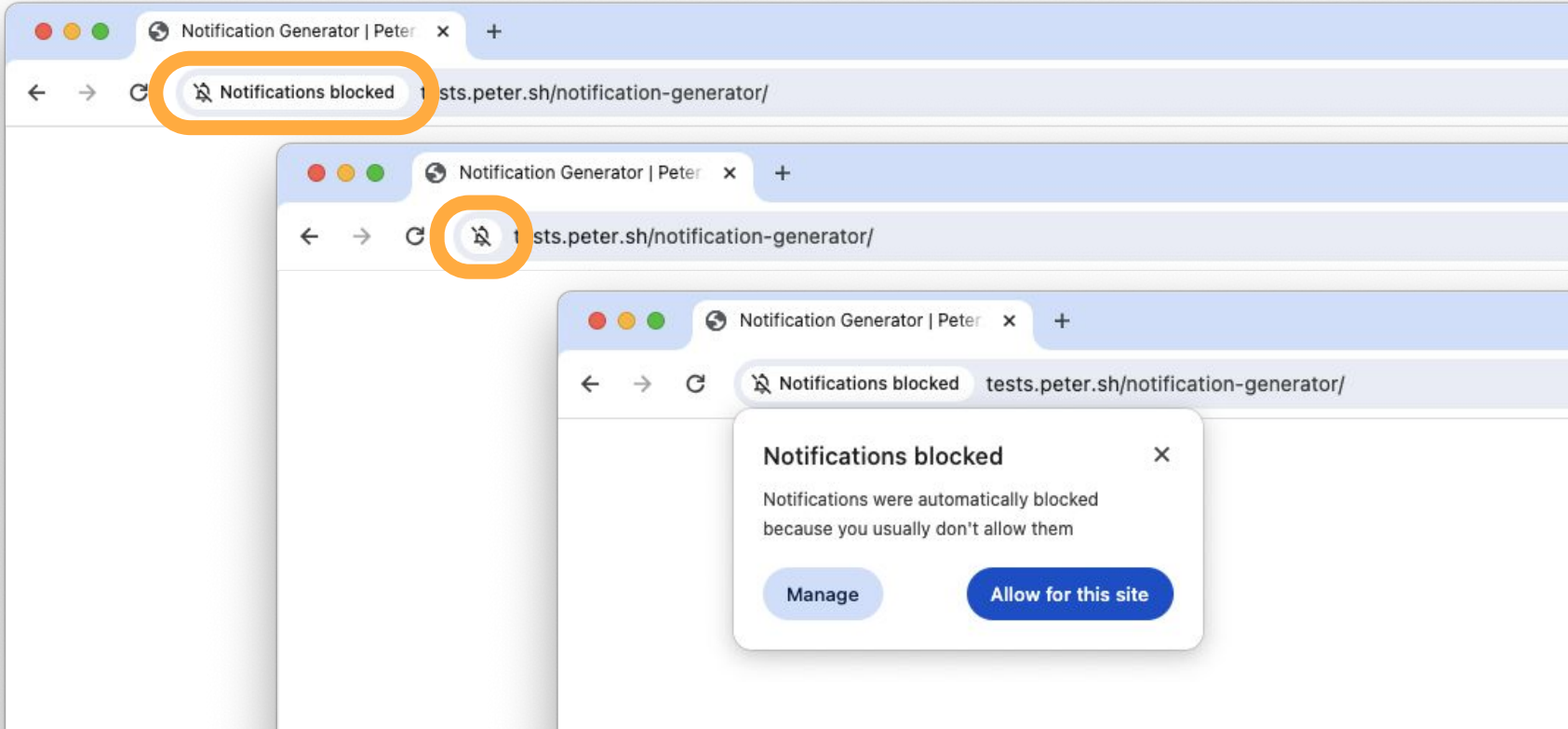
Current
quiet prompt UI

ML-based activation

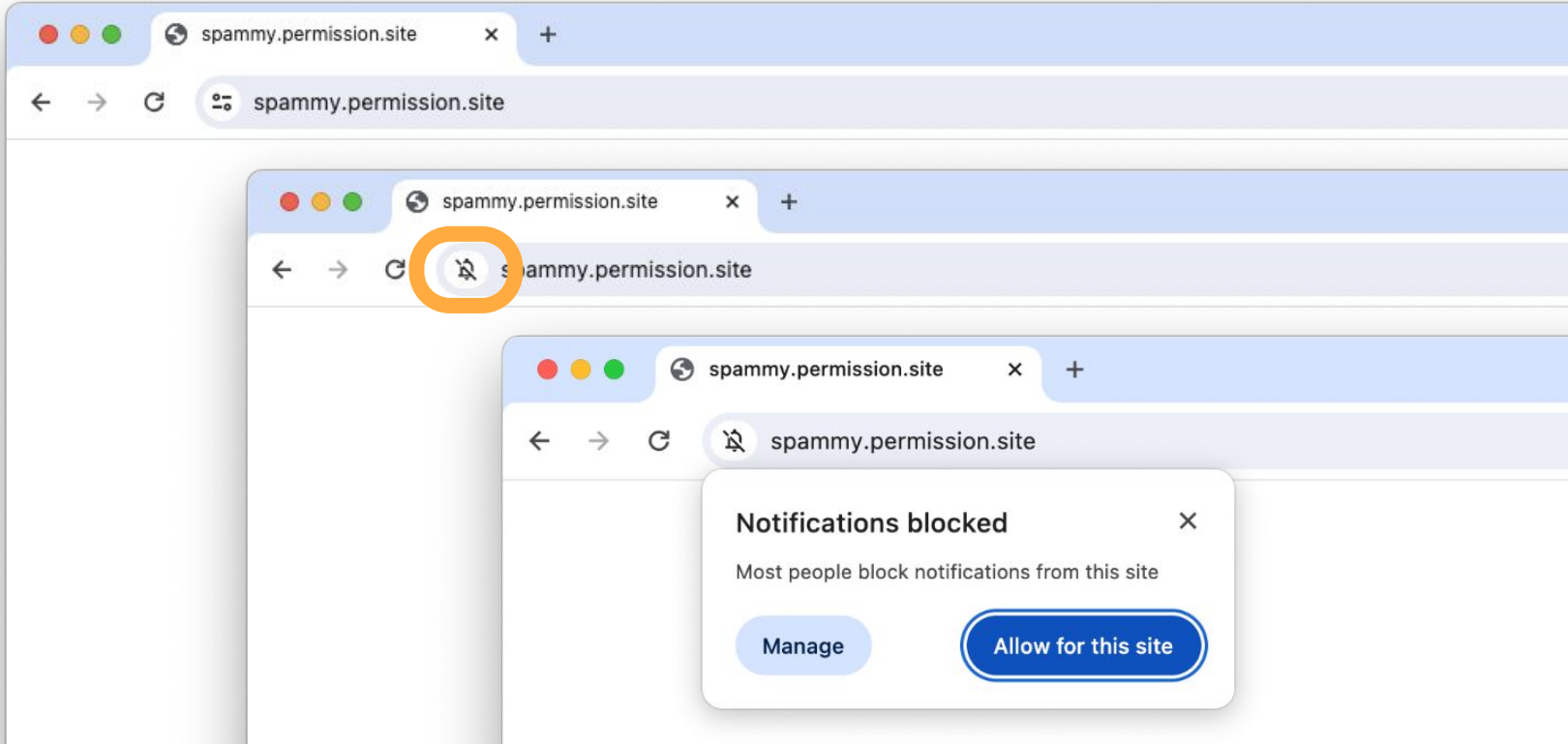
User experience

Current Quiet Prompt UI

Quiet Chip

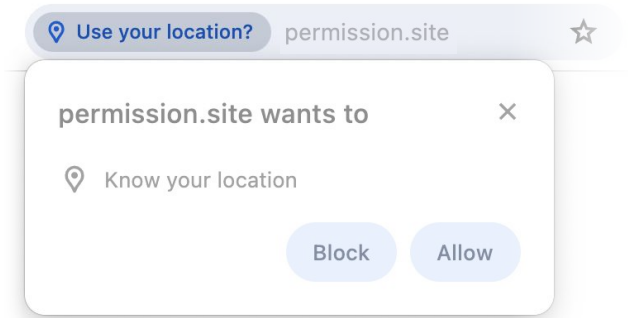

Notification Generator | Peter
Notifications blocked
sts.peter.sh/notification-generator/
Notification Generator | Peter
sts.peter.sh/notification-generator/
Notification Generator | Peter
Notifications blocked
tests.peter.sh/notification-generator/
Notifications blocked
Notifications were automatically blocked because you usually don't allow them
Manage
Allow for this site

Quietest Chip

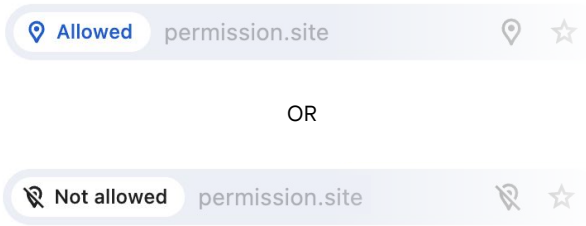


Chip Pattern

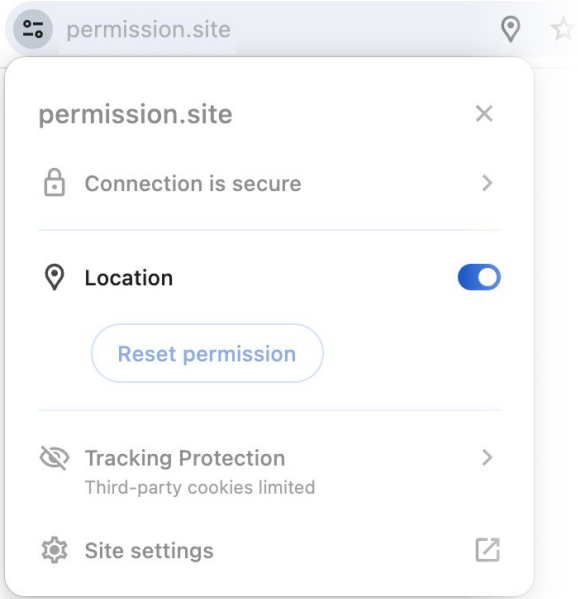
Request Chip



Confirmation Chip

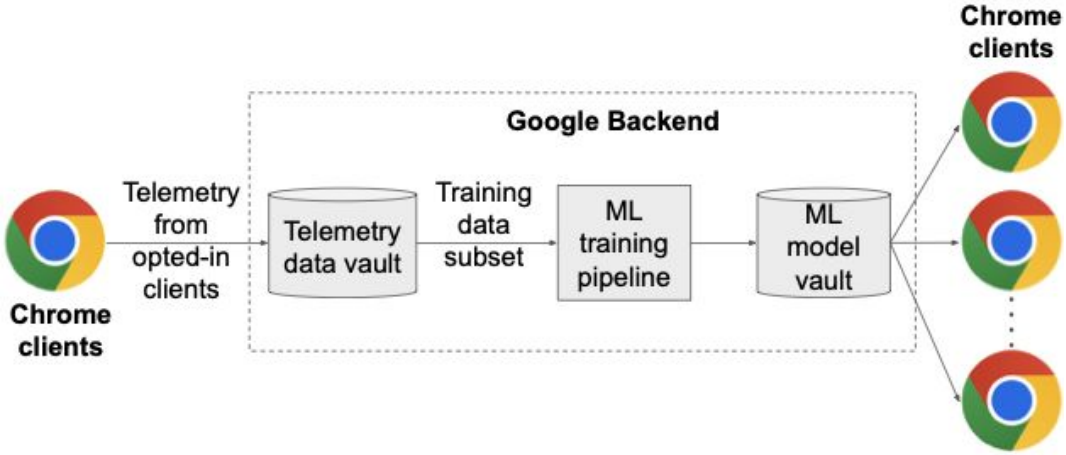


Site Controls



ML-based Activation

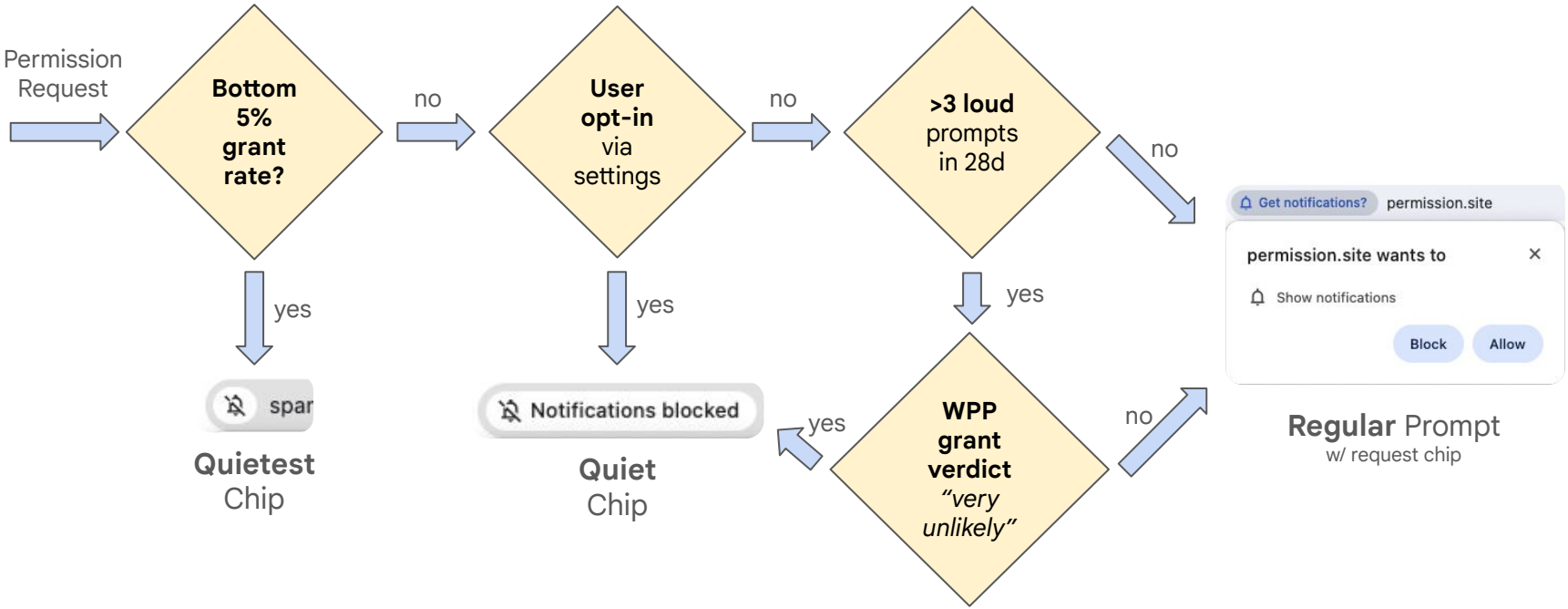
Web Permissions Predictions (WPP)



Features used for training:

- Permission type
- 28d average action rates across all permissions
- 28d average per-permission action rates
- 28d number of loud permission prompts
- User gesture prior to prompt?
- Desktop vs. mobile

Decision Logic



Improved quieting efficacy

Metric	Notifications Permission	Geolocation Permission
# of prompts	> 10 million	> 10 million
% of prompts for which WPP was the UI selector	43%	24%
% of quieted prompts (over all prompts for which WPP was the UI selector)	96%	81%
Post-hoc precision	99%	99%
Post-hoc recall	96%	83%

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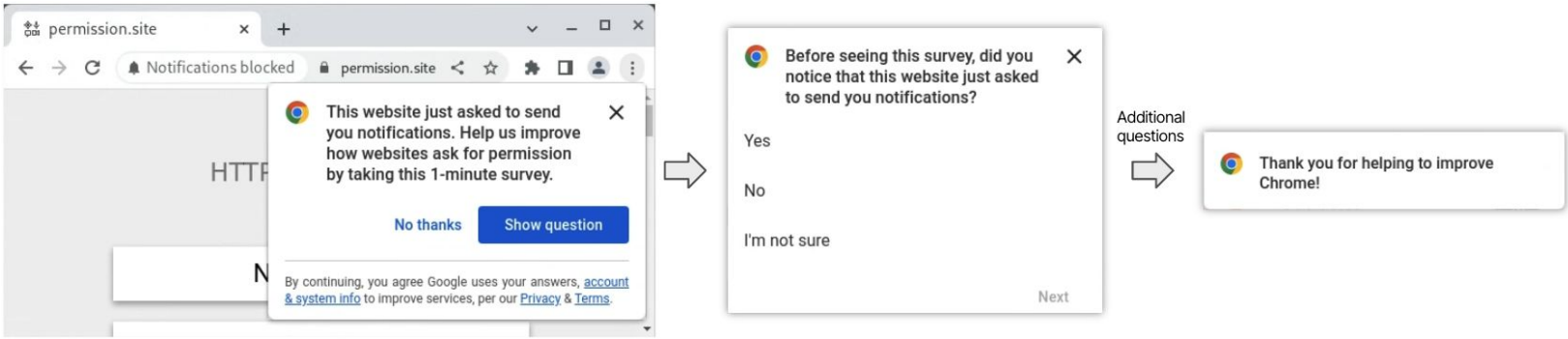
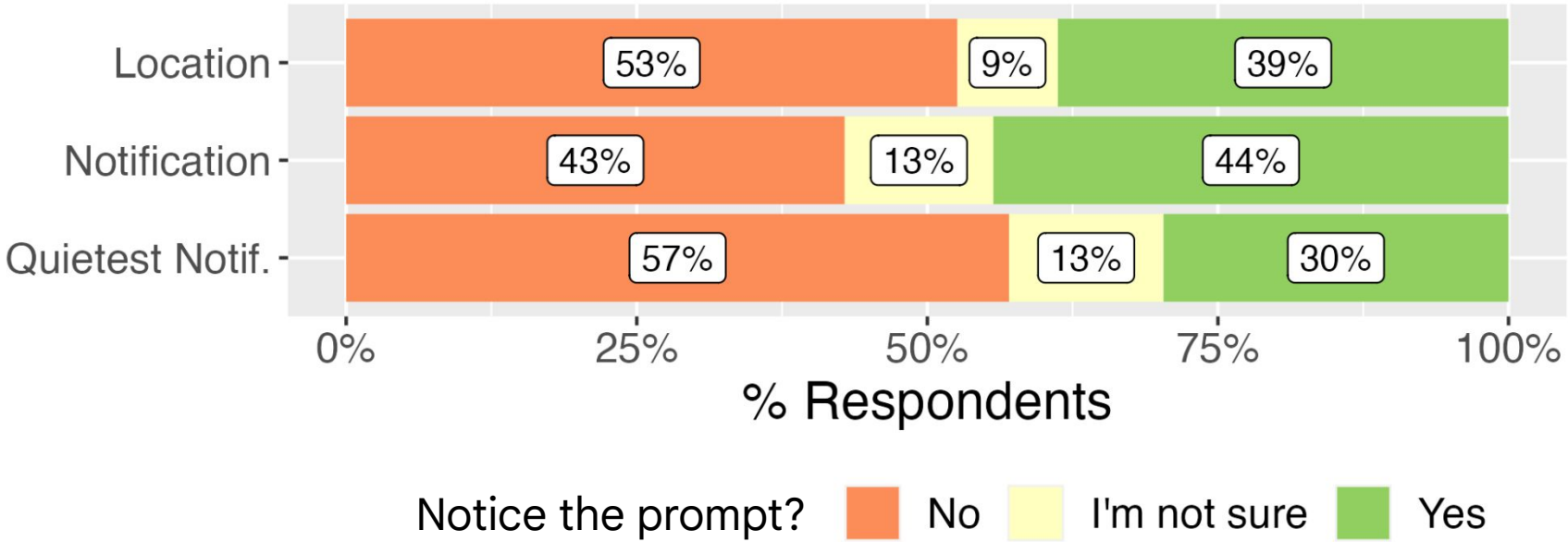
User Experience

Method



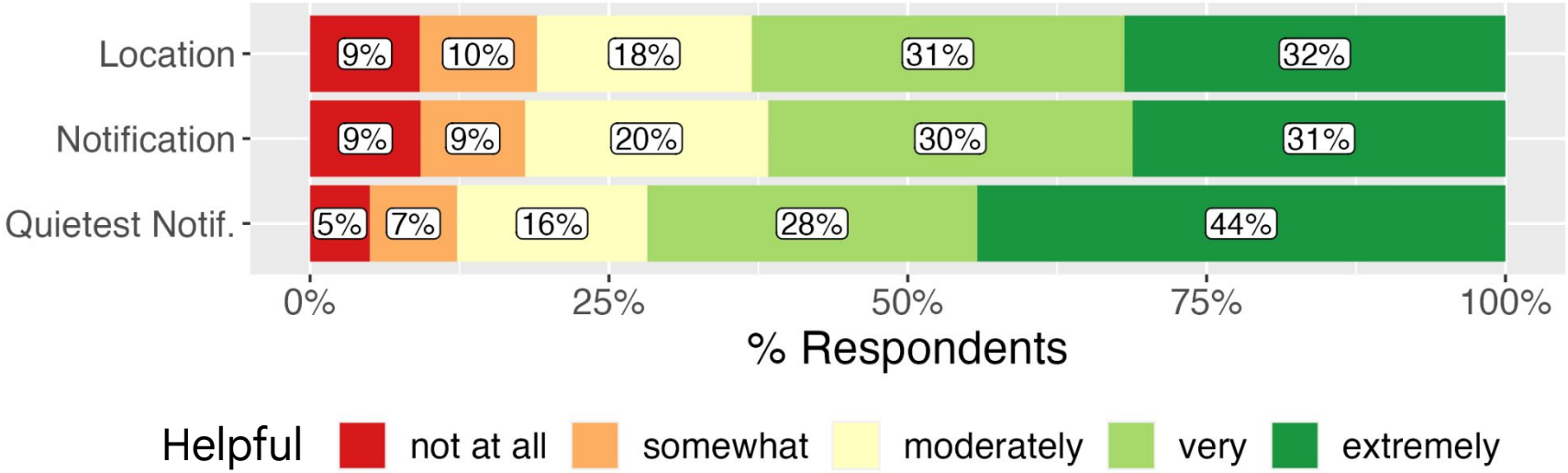
- **2.9M** survey invitations shown
- **13,109** complete responses
  - 7 languages, 156 countries, 66s median response time
  - Caveat: self-selection bias

How noticeable is the chip?



Q: Before seeing this survey, **did you notice** that this website asked to [send you notifications / see your location]?

How helpful is prompt quieting?



Q: Chrome automatically blocked this website's request, [based on your past choices / because most people block it or notifications from this site may be disruptive].
How helpful do you find Chrome's action?

Why do respondents feel uneasy about quieting?

Reason Category	Example	Geolocation	Notification	Quietest Notif.	Total
Want more control	*should ask first, make recommendation instead, feels like censorship*	51 (29%)	47 (19%)	41 (24%)	139 (23%)
Unsure what is happening	*general confusion / want to know more*	20 (11%)	28 (11%)	15 (9%)	63 (11%)
Inappropriate blocking in this case	*doesn't make sense on the this site, can't be perfect*	11 (6%)	33 (13%)	14 (8%)	58 (10%)
Fear of missing out	*afraid to miss something, may change their mind*	10 (6%)	25 (10%)	12 (7%)	47 (8%)
Privacy	*Chrome knows too much*	10 (6%)	18 (7%)	9 (5%)	37 (6%)
Concerned about malware/hackers	*site is not safe*	6 (3%)	16 (7%)	1 (1%)	23 (4%)
Unclear or off topic		29 (17%)	40 (16%)	34 (20%)	103 (17%)
No concern/probably OK		13 (7%)	18 (7%)	26 (15%)	57 (10%)
Answered unease question in reverse		8 (5%)	6 (2%)	4 (2%)	18 (3%)
Total		175	246	173	594

Q: Please briefly describe what makes you feel uneasy about Chrome blocking requests [based on your past choices / that most people block or because notifications from the site may be disruptive].

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Upcoming improvements

- Reduced false positive rate by adding per-site signals to the WPP model
- Change the string in the chip to increase perceived control

Summary

- ML-based activation **increases the reach and efficacy** of prompt quieting.
  This will reduce interruptions and prompt blindness.
- Most respondents **found quieting helpful** while identifying room for improvement.

Additional findings in the paper

- Mental model of why Chrome quiets prompts
- Subjective false positive rates
- Override efficacy

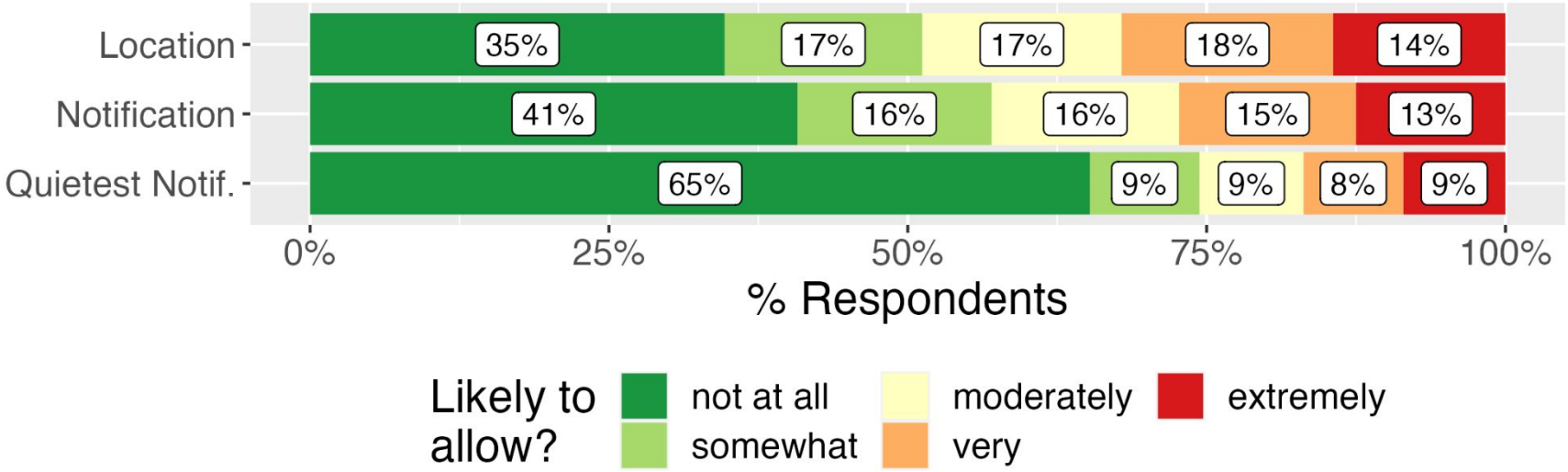
Appendix

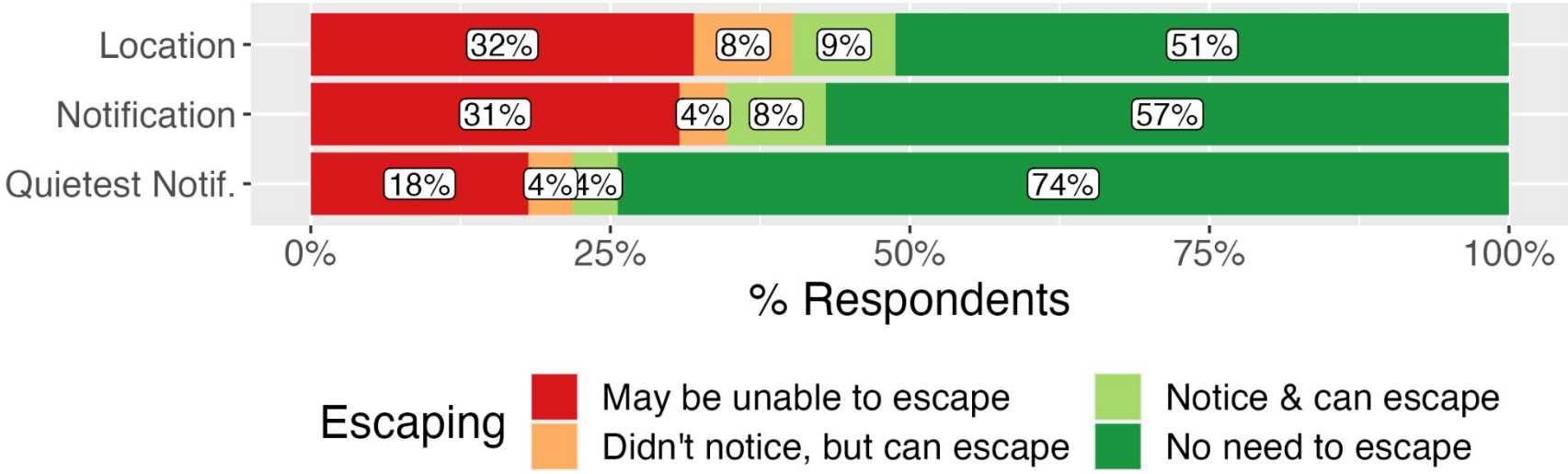
Quieting mental model

Reason	Geolocation	Notif.	Quietest Notif.	Total
Chrome thinks that this website is dangerous	15.1%	13.4%	14.9%	14.4%
Chrome thinks that I'm not interested in this website	4.2%	8.0%	9.7%	7.3%
I don't know	50.0%	46.3%	40.1%	45.5%
Previously denied request	16.2%	17.9%	19.0%	17.7%
Told Chrome to block website	9.4%	10.4%	12.6%	10.8%
Other	3.6%	2.1%	2.4%	2.7%
This website has a technical issue	1.6%	2.0%	1.3%	1.6%

Q: This website was blocked from $request_type. Why do you think that is?

Subjective false positives



Q: How likely are you to want to allow this website to $request_type?

Override efficacy