Characterizing the Use of Browser-Based Blocking Extensions To Prevent Online Tracking

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with Jessica Vitak, Arvind Narayanan, and Marshini Chetty
Online Tracking

Recent Site

The New York Times

The Telegraph
Online Tracking

124 third party sites!

The New York Times

The Telegraph
Blocking Extensions
Blocking Extensions

AdBlock Plus  AdBlock

Ad blockers
Blocking Extensions

Ad blockers
- AdBlock Plus
- AdBlock

Tracker blockers
- Ghostery
- Priv. Badger
- Disconnect
Blocking Extensions

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Content blockers
- uBlock
- uBlock Origin
Blocking Extensions

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- Disconnect

Content blockers
- uBlock
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Blocking Mechanism
- EasyList
- Internal lists
- Heuristics
- EasyList
- EasyPrivacy
- Misc. Lists
Blocking Extensions Are Effective!

~ 66% reduction in third-party requests
Missing Piece: Real-World Usage of Blocking Extensions

**Mental Models:** Does blocking extension use relate with a greater understanding of online tracking?

**Motivations:** What are the reasons behind users’ adoption of blocking extensions?

**Experiences:** What kind of user experiences result when blocking extensions break websites?
**Goal**: How can we improve defenses against online tracking?

**Mental Models**: Does blocking extension use relate with a greater understanding of online tracking?

**Intentions**: What are the reasons behind users' adoption of blocking extensions?

**Experiences**: What kind of user experiences result when blocking extensions break websites?
Method: Surveys + Measurement

Participants: Amazon Mechanical Turk (N = 1000)

Asks:
- Extensions used (Length of use, Learned about from, Reason behind adoption)
- Experiences with website breakage (Websites experienced, Subsequent action)

Measured:
- Blocking trackers?
- Blocking ads?
- Blocking third-party cookies?
- Set Do Not Track?
How prevalent are blocking extensions?
Reported Blocking Extension Usage

- Only Ad blockers: 42.2%
- Ad blockers: 51.2%
- Tracker blockers: 8.4%
- Content blockers: 20.5%
- No extensions: 33.6%
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Reported Blocking Extension Usage

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**Measured**: 9.95%

**Only Ad blockers**: 42.2%
Does blocking extension use relate with a greater understanding of online tracking?
Mental Models of Online Tracking

- Entities that Track
- Information Tracked
- Tracking Outcomes
- Tracking Mechanisms
- Comfort with Tracking
Mental Models of Online Tracking

- Entities that Track
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**Takeaway:** Blocking extension usage only weakly relates with an advanced understanding of online tracking
Mental Models of Online Tracking

Entities that Track
- Advertisers
- Websites Visited
- Government Agencies
  \( p = 0.02 \)
- Internet Service Provider
- Third-party Companies
  \( p = 0.01 \)

Information Tracked

Tracking Outcomes

Tracking Mechanisms

Comfort with Tracking

Users vs. Non-users

\( p = 0.02 \)
\( p = 0.01 \)
Mental Models of Online Tracking

Entities that Track
- Advertisers
- Websites Visited
- Government Agencies: p = 0.02
- Internet Service Provider
- Third-party Companies: p = 0.01

Information Tracked

Tracking Outcomes

Tracking Mechanisms

Comfort with Tracking

Users vs. Non-users

$p = 0.02$
Mental Models of Online Tracking

Entities that Track

Information Tracked

Tracking Outcomes

Tracking Mechanisms

Comfort with Tracking

Advertisers

Websites Visited

Government Agencies

Internet Service Provider

Third-party Companies

Users

Non-users

p = 0.02

p = 0.01

p = 0.01
Mental Models of Online Tracking

Entities that Track

Information Tracked

Tracking Outcomes

Tracking Mechanisms

Comfort with Tracking

Visible Outcomes
(e.g., targeted ads, personalization)

Invisible Outcomes
(e.g., increased revenue, price discrimination)

\[ p < 0.0001 \]
Mental Models of Online Tracking

- Entities that Track
- Information Tracked
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Visible Outcomes (e.g., targeted ads, personalization)

Invisible Outcomes (e.g., increased revenue, price discrimination)

$p < 0.0001$

0% 25% 50% 75% 100%

Users
Non-users

(e.g., targeted ads, personalization)
(e.g., increased revenue, price discrimination)
Mental Models of Online Tracking

**Visible Outcomes**
- (e.g., targeted ads, personalization)

**Invisible Outcomes**
- (e.g., increased revenue, price discrimination)

*p < 0.0001*
Mental Models of Online Tracking

Entities that Track

Information Tracked

Tracking Outcomes

Tracking Mechanisms

Comfort with Tracking

Uncomfortable
(suspicion of companies, data mining concerns)

Comfortable
(nothing to hide, nothing is free)

Users

Non-users

$p = 0.005$

$p = 0.011$
Mental Models of Online Tracking

- Entities that Track
- Information Tracked
- Tracking Outcomes
- Tracking Mechanisms
- Comfort with Tracking

**Uncomfortable**
(suspicion of companies, data mining concerns)

- p = 0.005

**Comfortable**
(nothing to hide, nothing is free)

- p = 0.011

Users vs. Non-users

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Users</th>
<th>Non-users</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>75%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

p = 0.005

p = 0.011
Mental Models of Online Tracking

Entities that Track

Information Tracked

Tracking Outcomes

Tracking Mechanisms

Comfort with Tracking

Uncomfortable (suspicion of companies, data mining concerns)

Comfortable (nothing to hide, nothing is free)

Uncomfortable:

- Users: 50%
- Non-users: 25%

Comfortable:

- Users: 25%
- Non-users: 33%

$p = 0.005$

$p = 0.011$
What are the reasons behind users’ adoption of blocking extensions?
Reasons Behind Adoption

Ad blockers

Takeaway: Each extension type has a primary reason behind adoption:

• **User Experience**: block pop-ups, reduce clutter on websites

Tracker blockers

• **Privacy**: block targeted ads and data mining

Content blockers

• **Security**: block harmful & malicious content
Reasons Behind Adoption

- Ad blockers
- Tracker blockers
- Content blockers

Bar chart showing:
- User Experience: 100%
- Privacy: 0%
- Security: 0%

AdBlock
AdBlock Plus
Reasons Behind Adoption

Ad blockers

Tracker blockers

Content blockers

User Exp.

Privacy

Security

AdBlock

AdBlock Plus
Reasons Behind Adoption

- Ad blockers
- Tracker blockers
- Content blockers

User Exp.:
- Privacy
- Security

AdBlock
AdBlock Plus
Reasons Behind Adoption

- Ad blockers
- Tracker blockers
- Content blockers

Graph showing reasons for adoption:

- User Exp.
- Privacy
- Security

Percentages:
- 0%
- 25%
- 50%
- 75%
- 100%

Logos for Ghostery, Priv. Badger, and Disconnect.
Reasons Behind Adoption

- Ad blockers
- Tracker blockers
- Content blockers

- Privacy
- Security
- User Exp.

Graph showing the adoption rates with percentages.
Reasons Behind Adoption

Ad blockers
Tracker blockers
Content blockers

Privacy
Security
User Exp.

0%
25%
50%
75%
100%
Reasons Behind Adoption

- Ad blockers
- Tracker blockers
- Content blockers

![Chart showing adoption reasons]

- User Exp.: 100%
- Privacy: 25%
- Security: 50%

Privacy
Security
User Exp.
Reasons Behind Adoption

Ad blockers
Tracker blockers
Content blockers

Bar chart showing:
- User Experience: 100%
- Privacy: 25%
- Security: 0%
Reasons Behind Adoption

- Ad blockers
- Tracker blockers
- Content blockers

![Graph showing User Experience, Privacy, and Security](image)

- uBlock
- uBlock Origin
What kind of user experiences result when blocking extensions break websites?
Experiences with Broken Websites

Takeaway: Browser extensions are effective in detecting trackers, and only rarely break websites.

Users’ subsequent reactions vary based on perceived value of content and trust in website.
Experiences with Broken Websites

Frequency:

- 40% of extension users experienced broken websites.
- 94.6% experienced broken websites either *rarely* or *sometimes* in any given week.
Experiences with Broken Websites

Reported Experiences:

Webpages failed to load completely and the content failed to appear 28.7%
Embedded videos failed to play 24.3%
Webpages appeared distorted, and the elements looked out of place 13.0%
Pop-ups that drove functionality failed to appear 8.1%
Images failed to load completely 7.5%
Summary

• **Prevalence:** ~1/3 of participants used no extensions; Ad blockers most prevalent but do not explicitly block trackers

• **Motivations:** Depends on extension type; primarily for user experience reasons

• **Mental Models:** Non-users and users of extensions had similar understandings of online tracking

• **Experiences:** Users rarely experience broken websites; When they do, make decisions based on trust and value of content
What can we do to better protect users from online tracking?

**Suggestion**: Offload tracking protection to the browser
Tracking Protection

Tracking generally refers to the collection of a person's browsing data across multiple sites. The Tracking Protection feature uses a list provided by Disconnect to identify and block trackers.

You can read more about tracking and the standards Disconnect uses to create its list here. Learn more about the lists used by Firefox for Tracking Protection.

A shield icon 🔄 will appear in your address bar whenever Firefox blocks tracking domains.
Intelligent Tracking Prevention 2.0

Today we’re happy to bring you Intelligent Tracking Prevention 2.0, or ITP 2.0. It builds upon ITP 1.0, which we released last year, and ITP 1.1, which was released in March, adding the Storage Access API.

Removal of the 24 Hour Cookie Access Window

ITP 2.0, as opposed to earlier versions, immediately partitions cookies for domains determined to have tracking abilities. The previous general cookie access window of 24 hours after user interaction has been removed. Instead, authenticated embeds can get access to their first-party cookies through the Storage Access API. The API requires that the user interacts with the embedded content.

Cookies are partitioned and not persisted in 3rd-party contexts.   Existing cookies are purged.   New cookies are blocked.
How can we better help users report breakage they see on websites?

**Suggestion**: Improving the reporting interfaces of browser extensions (e.g., Directly by pointing to elements)
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Bonus Slides
Blocking Extension Usage

- **Ad blockers**
- **Tracker blockers**
- **Content blockers**
- **Ad + Tracker blockers**
- **Ad + Content blockers**
- **Tracker + Content blockers**
- **Ad + Tracker + Content blockers**
- **No extensions**

<table>
<thead>
<tr>
<th>Blocking Trackers</th>
<th>Not Blocking Trackers</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>11.25%</td>
</tr>
<tr>
<td>11.25%</td>
<td>22.5%</td>
</tr>
<tr>
<td>22.5%</td>
<td>33.75%</td>
</tr>
<tr>
<td>33.75%</td>
<td>45%</td>
</tr>
</tbody>
</table>

Total users: 56
Mental Models of Online Tracking

Entities that Track

Information Tracked

Tracking Outcomes

Tracking Mechanisms

Comfort with Tracking

User Information (e.g., demographics, location)

Behavioral Activities (e.g., websites visited, products clicked)

Device Information (e.g., IP Addr, browser)

Chart showing distribution of users and non-users for tracked information.

- Users: 50%, 25%, 0%
- Non-users: 0%, 25%, 50%

57
Mental Models of Online Tracking

- Entities that Track
- Information Tracked
- Tracking Outcomes
- Tracking Mechanisms
- Comfort with Tracking

### User Activities (e.g., clicks, history)

- **Cookies**
  - Users: 50%
  - Non-users: 25%

### Graph:
- Users: 50%
- Non-users: 25%