

# Privacy by Design in Software Development

Mohammad Tahaei @Uni Bristol & Edinburgh

Lead researcher

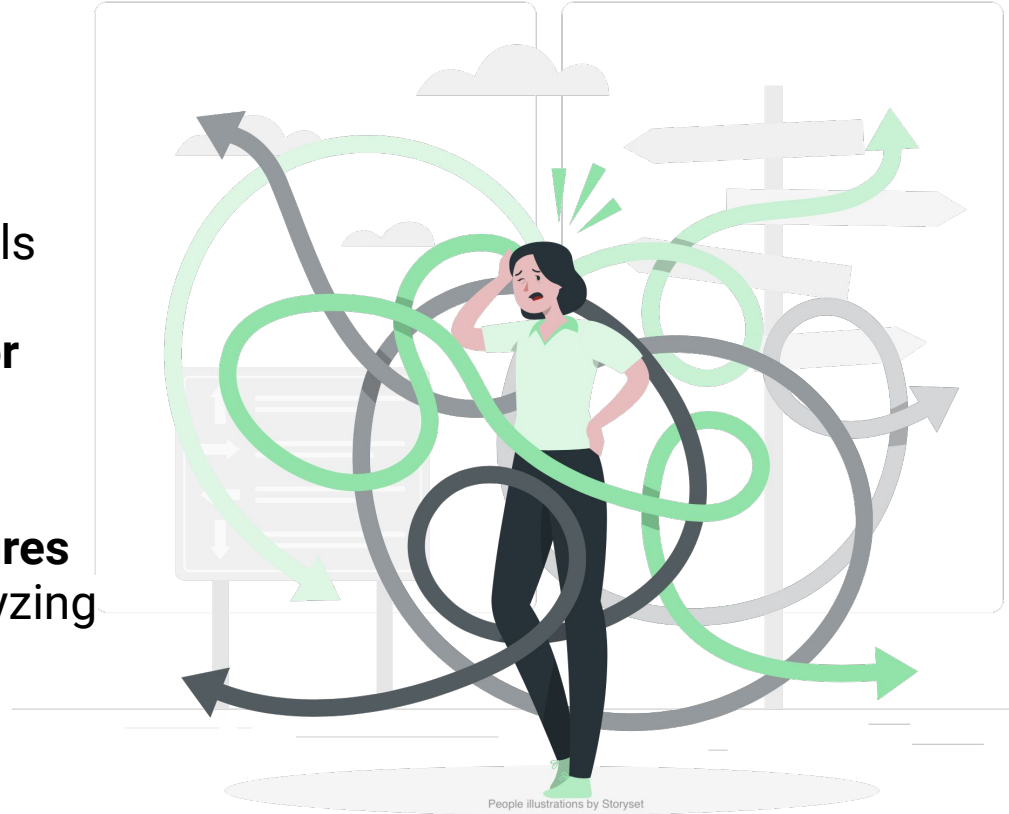
Mixed methods: Interviews, API documentation analysis, survey, experimental design

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# Overview

Problem Statement: Increasingly **prevalent data collection**; individuals left unsure how to navigate, while **developers often lack awareness or concern for privacy**.

Research Idea: **Facilitate** developer support in integrating **privacy features** by understanding **pain points**, analyzing relevant **artifacts**, and **delivering practical assistance (Privacy by Design)**.



# Scoping Privacy Research

Why? Unclear what's going on in privacy research; **explore & organize** knowledge

Method: **literature review**

Impact: Identified **missing gaps** from **49 papers**

TABLE II  
LIST OF ALL REVIEWED PUBLICATIONS GROUPED BY THEME.

Publication/Theme	Study Method	Participants	N	Research Question	Pilot Case	Context	Recruitment	Demographics	Ethics	Mixed Methods	Data Analysis	Quotes	Compare with Literature	Limitations	Study Materials
<b>Organisations and Context</b>															
[29]	Semi structured interviews	Developers	15	○	○	○	○	○	○	○	○	○	○	○	○
[30]	Semi structured interviews	Software professionals	42	○	○	○	○	○	○	○	○	○	○	○	○
[31]	Interviews	Developers	42	○	○	○	○	○	○	○	○	○	○	○	○
[32]	Survey, Survey	Developers	14, 61	○	○	○	○	○	○	○	○	○	○	○	○
[33]	Survey, Survey, Observations, Interviews	Mix (With crypto background)	15, 12, 23, 13	○	○	○	○	○	○	○	○	○	○	○	○
[34]	Interviews	App security experts	12	○	○	○	○	○	○	○	○	○	○	○	○
[35]	Survey, Survey, Observations, Interviews	Mix	15, 12, 23, 15	○	○	○	○	○	○	○	○	○	○	○	○
[36]	Semi structured interviews	Mix (With crypto background)	21	○	○	○	○	○	○	○	○	○	○	○	○
[37]	Semi structured interviews	Developers	13	○	○	○	○	○	○	○	○	○	○	○	○
[38]	Semi structured interviews	Security experts	32	○	○	○	○	○	○	○	○	○	○	○	○
<b>Structuring Software Development</b>															
[39]	Semi structured interviews	Mix (70% Developers)	10	○	○	○	○	○	○	○	○	○	○	○	○
[40]	Lab experiment (Architectural design task)	Students	90	○	○	○	○	○	○	○	○	○	○	○	○
[41]	Online tasks	Developers	30	○	○	○	○	○	○	○	○	○	○	○	○
[42]	Lab experiment (Architectural design task)	Students	64	○	○	○	○	○	○	○	○	○	○	○	○
[111]	Survey, Lab experiment	Developers	293, 54	○	○	○	○	○	○	○	○	○	○	○	○
[43]	Survey	Software practitioners	9	○	○	○	○	○	○	○	○	○	○	○	○
[44]	Semi structured interviews, Survey, Survey	Developers	16, 51, 532	○	○	○	○	○	○	○	○	○	○	○	○
<b>Privacy and Data</b>															
[45]	Semi structured interviews, Online survey	Developers, Mix (58% Developers)	13, 228	○	○	○	○	○	○	○	○	○	○	○	○
[46]	Survey	Developers, Users	408 (207, 141)	○	○	○	○	○	○	○	○	○	○	○	○
<b>Third Party Updates</b>															
[47]	Survey	Developers	203	○	○	○	○	○	○	○	○	○	○	○	○
<b>Security Tools Adoption</b>															
[48]	Survey, Interviews, Lab study	FindBug users, FindBug users, Students	400, 12, 12	○	○	○	○	○	○	○	○	○	○	○	○
[49]	Survey	Developers	252	○	○	○	○	○	○	○	○	○	○	○	○
[50]	Lab experiment	Students	9	○	○	○	○	○	○	○	○	○	○	○	○
[51]	Lab experiment	Students, Developers	18, 9	○	○	○	○	○	○	○	○	○	○	○	○
[52]	Lab study	Developers	20	○	○	○	○	○	○	○	○	○	○	○	○
[53]	Lab study (Programming)	Students	20	○	○	○	○	○	○	○	○	○	○	○	○
[54]	Think aloud	Students	8	○	○	○	○	○	○	○	○	○	○	○	○
[55]	Lab experiment	Students	28	○	○	○	○	○	○	○	○	○	○	○	○
[56]	Lab study	Developers, Students	10 (5, 5)	○	○	○	○	○	○	○	○	○	○	○	○
[57]	Field studies	Students	72	○	○	○	○	○	○	○	○	○	○	○	○
[58]	Interviews, Survey	Developers	5, 375	○	○	○	○	○	○	○	○	○	○	○	○
[59]	Cognitive walkthrough (CW), CW	Security experts, Developers	4, 4	○	○	○	○	○	○	○	○	○	○	○	○
[60]	Observations	Developers	13	○	○	○	○	○	○	○	○	○	○	○	○
[61]	Task based	Developers (Academics, Professionals)	18 (9, 9)	○	○	○	○	○	○	○	○	○	○	○	○
[62]	Online programming task	Developers, Students	40 (16, 24)	○	○	○	○	○	○	○	○	○	○	○	○
[63]	Lab experiment (Programming)	Students	23	○	○	○	○	○	○	○	○	○	○	○	○
[64]	Online between subject	Developers	53	○	○	○	○	○	○	○	○	○	○	○	○
<b>Application Programming Interfaces</b>															
[65]	Interviews	Developers	14	○	○	○	○	○	○	○	○	○	○	○	○
[66]	Lab experiment, Programming tasks	Students	25	○	○	○	○	○	○	○	○	○	○	○	○
[67]	Survey	Developers	47	○	○	○	○	○	○	○	○	○	○	○	○
[68]	Survey	Developers	45	○	○	○	○	○	○	○	○	○	○	○	○
[69]	Survey, Survey	Developers	11, 37	○	○	○	○	○	○	○	○	○	○	○	○
[70]	Survey	Developers	55	○	○	○	○	○	○	○	○	○	○	○	○
[71]	Online between subject	Developers	256	○	○	○	○	○	○	○	○	○	○	○	○
[72]	Lab experiment (Programming)	Students	20	○	○	○	○	○	○	○	○	○	○	○	○
[73]	Online programming task	Developers (Professionals, Students)	109 (70, 39)	○	○	○	○	○	○	○	○	○	○	○	○
<b>Programming Languages</b>															
[74]	Lab experiment	Developers	27	○	○	○	○	○	○	○	○	○	○	○	○
<b>Testing Assumptions</b>															
[75]	Online between subject	Developers	307	○	○	○	○	○	○	○	○	○	○	○	○
[76]	Lab study (Programming)	Students	40	○	○	○	○	○	○	○	○	○	○	○	○

A full circle means that the paper has an explicit and clear statement for that criteria, a half circle means that there are some efforts to cover the metric (implied or partially covered), and an empty circle means the paper does not contain information on the specified criteria.

# Insights From Developer Forums

Why? Privacy is often **neglected** based on the scoping

Method: **Mixed, qualitative coding & topic modeling of Stack Overflow posts**; a **cheap, quick** way of understanding **real world practices** of developers

Impact: Documented **developer practices and pain points** around privacy: Privacy policies, **tools, third parties**

How to disable Google asking permission to regularly check installed apps on my phone?

Asked 5 years, 11 months ago · Active 1 year, 5 months ago · Viewed 103k times

▲ I'm developing an Android app, which I therefore endlessly build and install on my test device. Since a couple days I get with every build/install a question asking

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▼ Google may regularly check installed apps for potentially harmful behaviour. Learn more in Google Settings > Verify apps.

★ I get the option to Accept or Decline. I've declined about a hundred times now, but it seems to be Google's policy to keep on asking until I get sick of the message and finally click Accept. But I don't want that!

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So my question: how do I let Google know once and for all that I do not want them regularly checking installed apps on my phone?

android permissions privacy policy

Sample privacy-related Q&A from Stack Overflow

Particularly need a solution for this to support automated UI testing, e.g. with Espresso, because the APK can't even be installed on a new emulator instance unless the Accept/Decline button is clicked. Is there a @Rule like GrantPermissionRule ([developer.android.com/reference/android/support/test/rule/...](https://developer.android.com/reference/android/support/test/rule/)) for this? – Michael Osafsky Apr 4 '18 at 19:23

10 Answers

▲ On Android prior to 4.2, go to **Google Settings**, tap **Verify apps** and uncheck the option **Verify apps**.

98

▼ On Android 4.2+, uncheck the option **Settings > Security > Verify apps** and/or **Settings > Developer options > Verify apps over USB**.



edited Apr 3 '14 at 11:14

 Helen  
39k 5 95 150

answered Oct 9 '13 at 7:42

 Sunny  
9,397 7 47 804

23 Ah! I just now see it under Settings > Developer Options > Verify apps over USB. Sorry, I just got so sick of this

# Expert Interviews

Why? **Dig deeper** into prior findings from lit review and content analysis

Method: **Interviews with privacy advocates, identified by peers**

Impact: Best practices of **promoting privacy** and what **prevents** privacy to become a first-class citizen



# Analyzing Ad Networks' Documentation

Why? Known **privacy consequences of ad networks** on users, **trade-off** between **privacy vs. revenue** from prior studies

Method: **Usability testing - Qualitative**

Impact: Need for a **dedicated** privacy section, making **configurations accessible** (graphical and code), & adding **multimedia resources**. Uneven presentation of choices (**dark patterns**).

How EU user consent affects you

Under [Google's EU user consent policy](#), you need to ask your users in the European Economic Area (EEA) and the UK for consent when showing personalised or non-personalised ads, for cookies and for analytics, and provide certain information about the way your app uses data. The requirements reflect the EU ePrivacy Directive, GDPR and equivalent UK legislation.

To collect consent, you can use our [IAB GDPR message](#) or an alternative consent solution.

Choose the type of ads that you want to show ⓘ

You can choose from [two ad options for your account](#) for your users



#### Personalised ads

Personalised ads are more relevant to your users as they're based on their previous activity. You should turn on personalised ads if you're using a GDPR message



#### Non-personalised ads

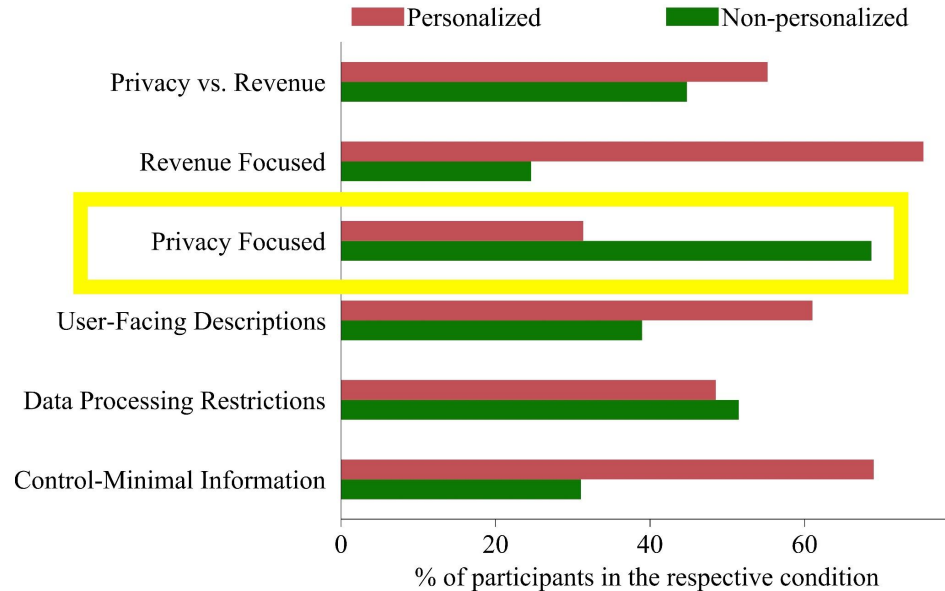
Non-personalised ads are not as relevant to your users as they're not based on their previous activity and rely on contextual information

# Saliience's Influence on Privacy Choices

Why? Hypothesis driven to check prior findings: do **interfaces** have an **impact** on developers' **decisions**?

Method: **Survey - Mixed**

Impact: **11X** more privacy choices with privacy emphasis!



# What Do Former Teammates Have to Say?

[Quotes from LinkedIn recommendations]

“efficient in **time management**, allowing him to keep the research projects **on track** and **deliver** the results **on time**, without losing the quality.” [Alisa Frik, Senior UXR]

“**highly professional and amiable** colleague . . . was involved in a number of projects, **worked with a colleagues at varying levels of seniority** and experience, and **acted as a mentor** for junior colleagues.” [Louise Evans, Research Manager]

“easily one of my **most productive** students. He has an **excellent eye for interesting research problems** and the **attention to detail** needed to realize them.”

[Kami Vaniea, Associate Professor]

## Contact

<https://mohammad.tahaei.com/>

<https://www.linkedin.com/in/tahaei/>

[mohammad@tahaei.com](mailto:mohammad@tahaei.com)