# **Follow My Recommendations : A Personalized Privacy Assistant** for Mobile App Permissions

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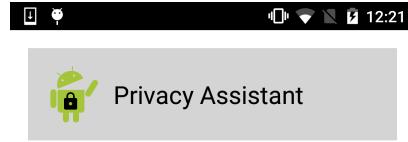
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## Motivations

- Smartphone users need app privacy controls
- The number of permissions can be so **overwhelming** that many users are unable to adequately manage their permission settings
- Users' app privacy preferences are quite **diverse**.
- A personalized privacy assitant could help by recommending permission settings to the users.

## **Interactive Profile Assignment Dialog**

- We generate questions for users in order to capture their app privacy preference and estimate their privacy profile assignment.
- The questions are generated on-the-fly by context, which is the installed apps on the specific device.
- There are 3 types of questions about users' aggregated preferences on app permissions.



Hi! The Privacy Assistant is now ready to help you configure your privacy settings. This should not take more than a few minutes of your time.

It will first ask you a few simple questions to determine your privacy preferences. Then it will recommend possible changes to your settings. You will see all its suggestions and edit them, if you want to.

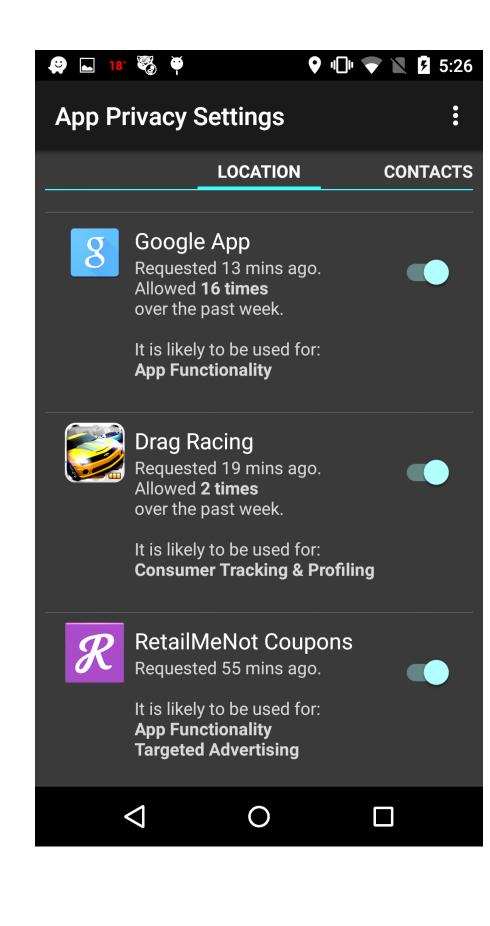
**OK, LET'S GET STARTED!** 

**REMIND ME IN AN HOUR** 

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## **Privacy Settings Data Collection**

- We conducted a field study (n=84) to collect privacy preferences.
- We modified and extended the Android permission manager App Ops. The manager additionally shows actual frequency and the potential purposes of permission accessed by an app.
- We designed an enhanced privacy nudge to increase privacy awareness and motivate users to review and adjust their privacy settings



These <b>SOCIAL</b> apps accessed your L <b>OCATION</b> 16 TIMES over the past 2 days:	These apps accessed you <i>MESSAGES</i> <i>2 TIMES</i> over the past 2 days:	These apps accessed your <b>CONTACTS</b> <b>18 TIMES</b> over the past 2 days;
Snapchat Facebook Facebook In general, are you OK with SOCIAL apps accessing your LOCATION?	Hangouts	Iikely used for APP FUNCTIONALITY         Image: Hangouts         Image: Google Keyboard         Image: Contacts+         Image: Google App         In general, are you OK with apps accessing your CONTACTS for APP FUNCTIONALITY?
YES	YES	YES
ΝΟ	ΝΟ	ΝΟ

### **Recommendation Screen**

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- Thank you! Based on your answers, we recommend restricting the following 12 app(s):
- Click category to view/change recommendations
- Deny 1 app(s) access to Calendar Deny 8 app(s) access to Location

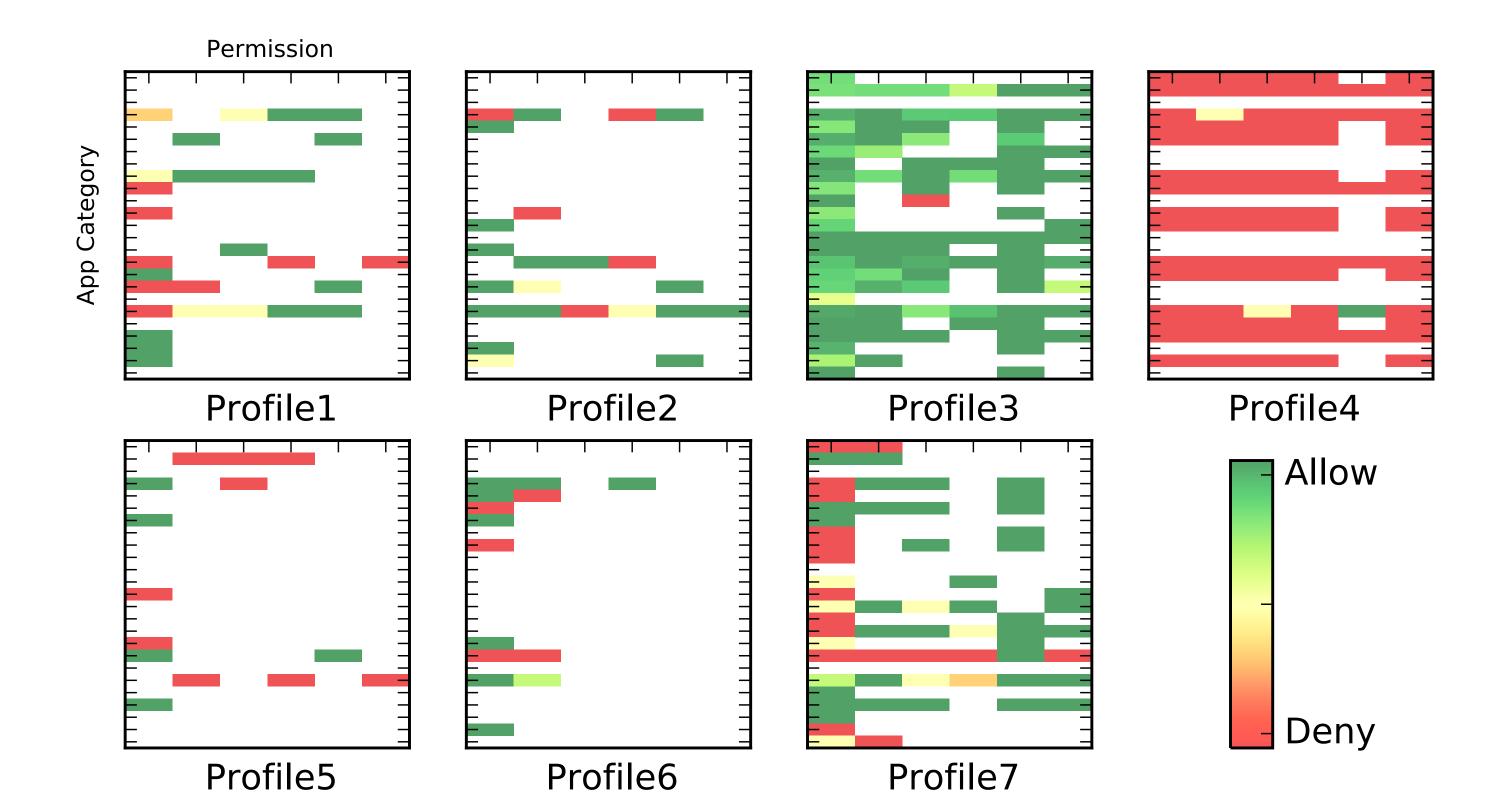
### **Field Study**

We conducted a second field study (n=72) with android users to evaluate the effectiveness of our privacy profiles and the PPA.

## **Personalized Privacy Assistant**

## **Generating Privacy Profiles from the training data**

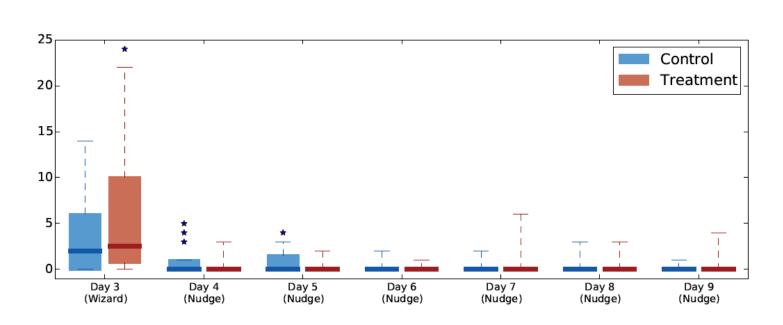
• We quantify each users' preference as a 3-dimensional tensor of aggregated preferences (app category, permission, purpose). We applied weighted PARAFAC Tensor factorization to impute the tensor using know data. Then we generated the profiles using hierarchical clustering (K=7, Complete Linkage, Cosine distance)



Facebook	P Deny
News & Weather	Peny
Messenger	Allow
Snapchat	? Deny
Why denv? This Social ann accesso	
Why deny? This Social app accesse Functionality and Consumer Trackir	
Functionality and Consumer Trackir	ng & Profiling.

Do you want to make these changes?

### YES, DENY THE 11 APP(S) SELECTED **NO. DO NOT MAKE ANY CHANGES** $\leq$ $\bigcirc$



We found that **78.7%** of the recommendations are accepted. After further interactions with PPA to further review and modify their settings with daily nudges, participants only modified **5.1%** of the accepted recommendations.

