



AppMoD: Helping Older Adults Manage Mobile Security with Online Social Help

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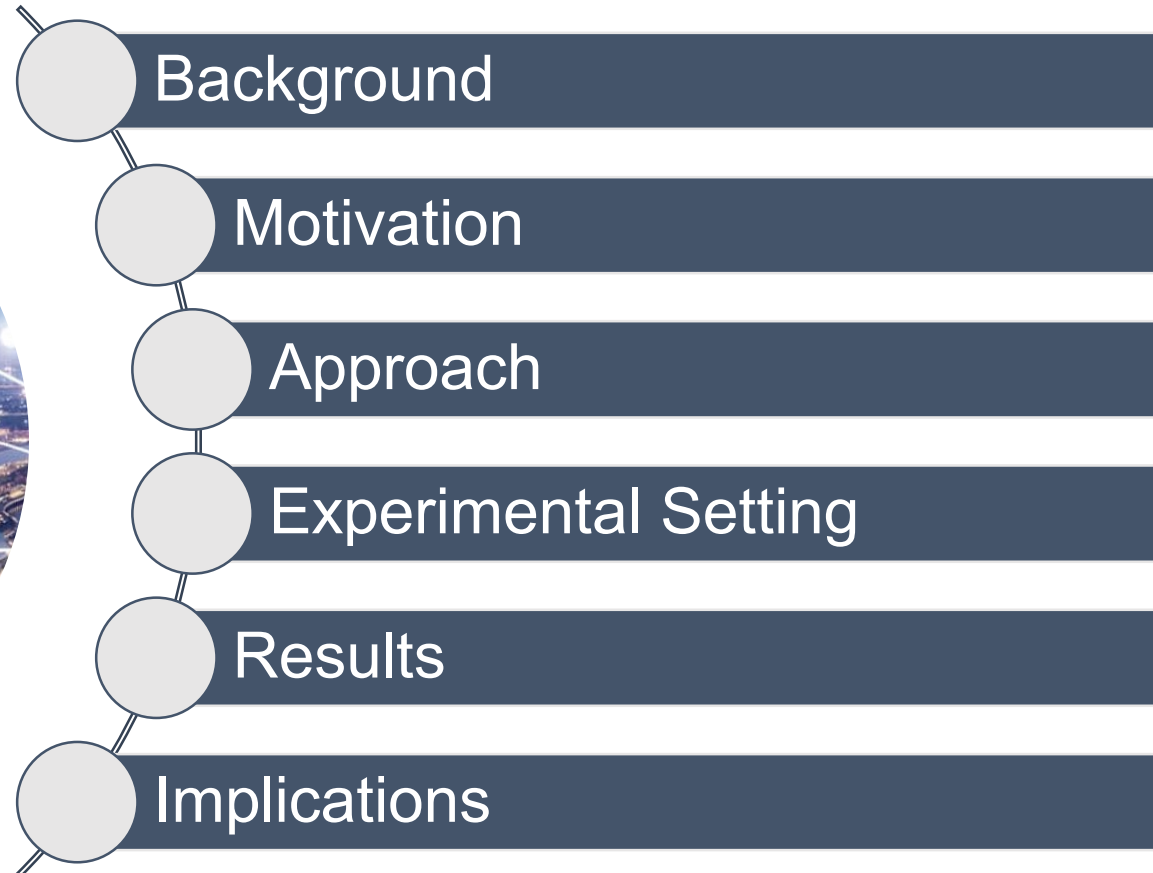
Zhejiang University

Mar 18, 2021

UBICOMP
ISWC **2020**



Outline



Background: Project

Project “*Safety and Privacy of Smart-City Mobile Applications through Model Inference*”

- ❑ A joint project by Singapore Management University and Tel Aviv University.
- ❑ Increase reliability of mobile platforms by detecting anomalies and allowing users to effectively respond to them.





Background: Objective

Design a system to detect anomalies potentially harmful behaviors in mobile apps and create suitable alerts

- ❑ A model that captures characteristics of an app's normal behavior

Adversaries will find it hard to penetrate and monitor citizens.

- ❑ A **user interaction model** that helps vulnerable population better make security decisions, e.g., elderly.

Users will get assurance of proper data collection and processing.
Trust can be established.

Motivation

Older adults are more vulnerable to security and privacy threats than the general population.

- ❑ 73% of older adults claimed that they need additional help to use smartphones [1].
- ❑ Older adults perceive security and privacy as important issues, but most of them feel that they have low self-efficacy in addressing them [2].
- ❑ Older adults have negative attitudes toward the risks involved in using new technologies, and tend to underuse those technologies [3].



[1] Anderson and Perrin. "Tech adoption climbs among older adults". Pew Research Center, 2017.

[2] Xie et al. "Understanding and changing older adults' perceptions and learning of social media". Educational Gerontology 38(4), 2012.

[3] Mitzner et al. "Older adults talk technology: Technology usage and attitudes". Computers in Human Behavior 26(6), 2010.

Approach

AppMoD: Application Mediate-on-Demand

- ☐ Community-based approach to enable older adults delegate mobile security decision.
- ☐ Challenge: reducing the obstacles due to the physical distance.

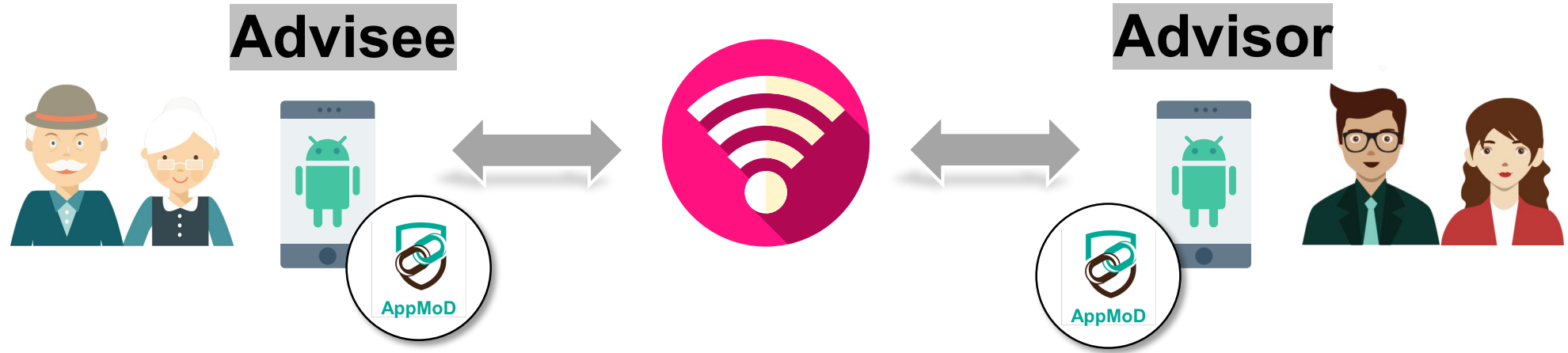
An Android App which takes into accounts

- ☐ Privacy concerns
- ☐ Cognitive and technical abilities of older adults



AppMoD

AppMoD: Two Roles



Older Adults $\text{age} > 50$

Younger Adults $18 \leq \text{age} < 40$

A trusted social connection, such as a family member or a close friend.

AppMoD: Usage Scenario

Advisee



Advisor



1

AppMod

Whatsapp is accessing the contacts of your device.
Please take action.

Ignore

View

AppMoD: Usage Scenario

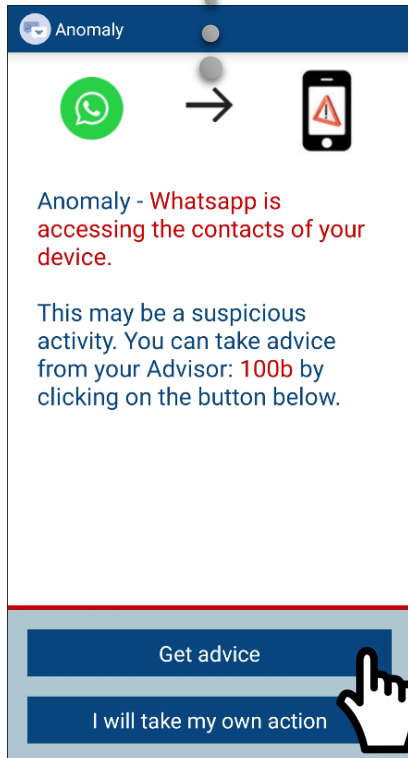
Advisee



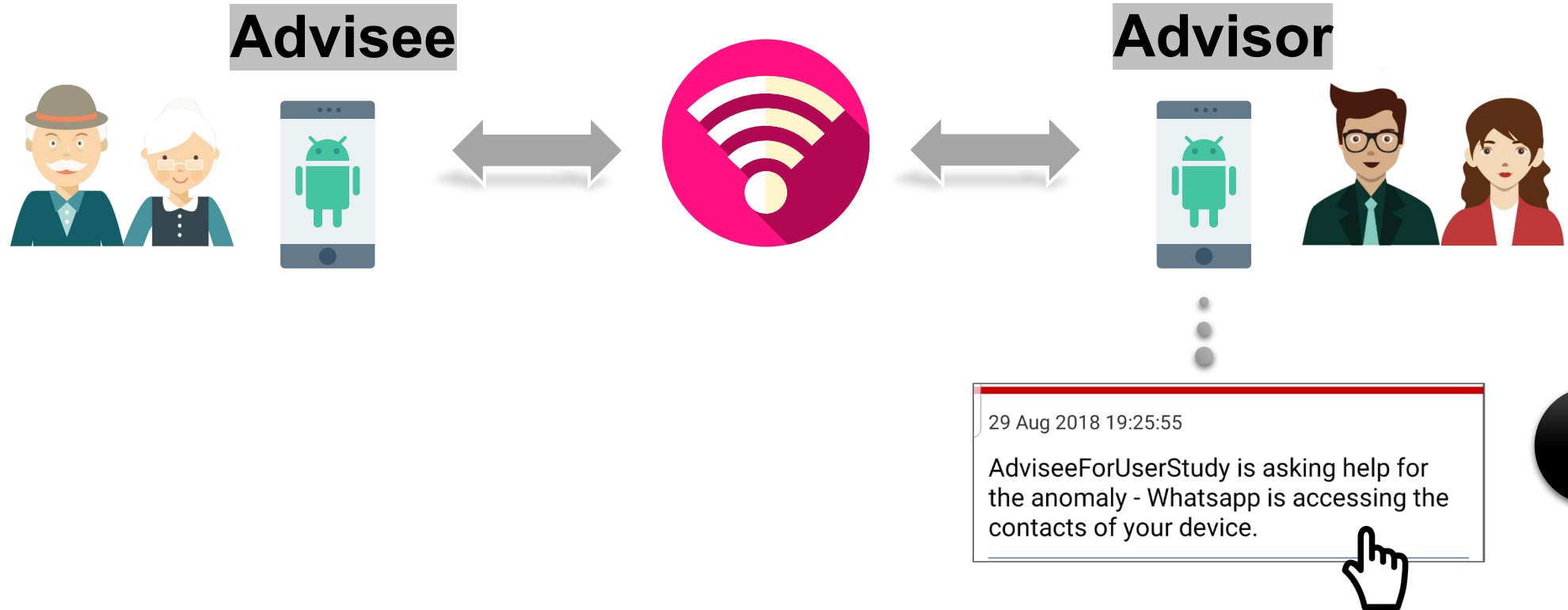
Advisor



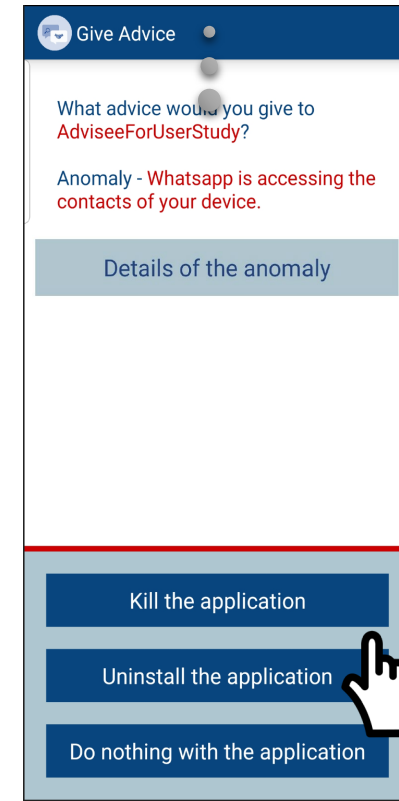
2



AppMoD: Usage Scenario



AppMoD: Usage Scenario

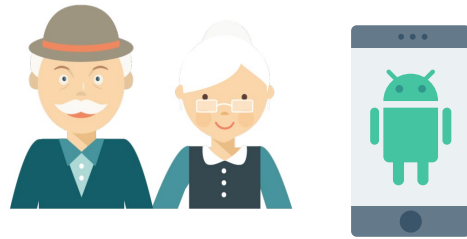


The screenshot shows the 'Give Advice' app interface. At the top, it says 'Give Advice'. Below that, it asks 'What advice would you give to AdviseeForUserStudy?'. An anomaly is reported: 'Anomaly - Whatsapp is accessing the contacts of your device.' Below this, there is a button labeled 'Details of the anomaly'. At the bottom, there are three buttons: 'Kill the application', 'Uninstall the application', and 'Do nothing with the application'. A hand icon is pointing at the 'Uninstall the application' button.

4

AppMoD: Usage Scenario

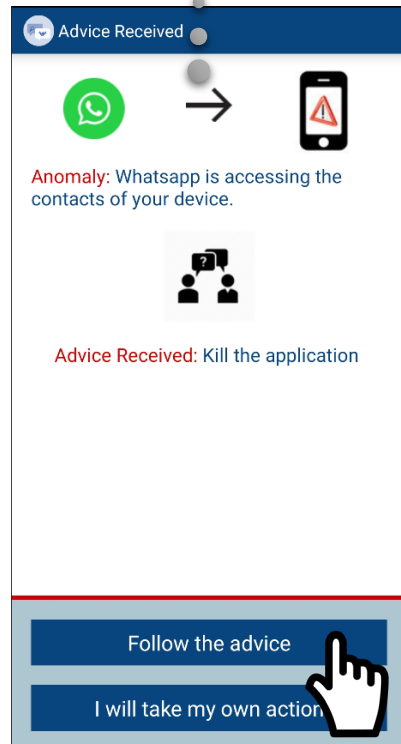
Advisee



Advisor

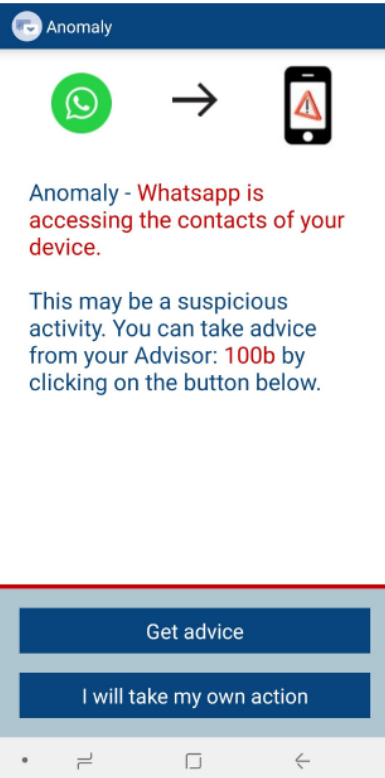


5

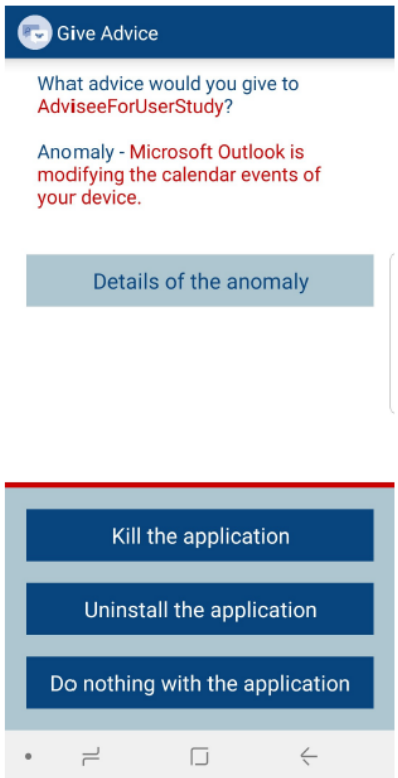


AppMoD: Two Modes

Non-crowdsourcing

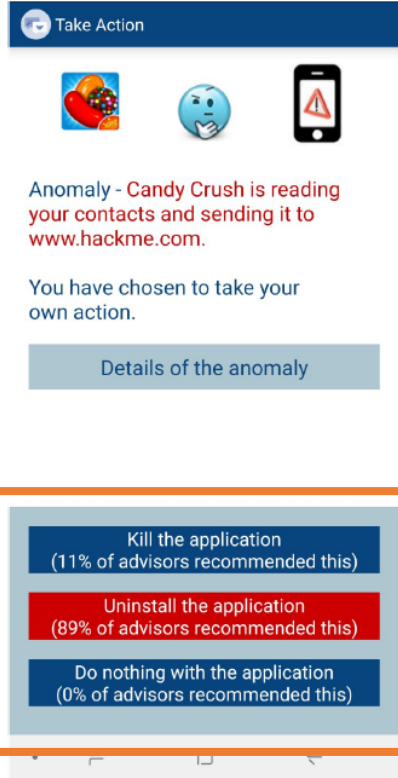


(a) Advisee

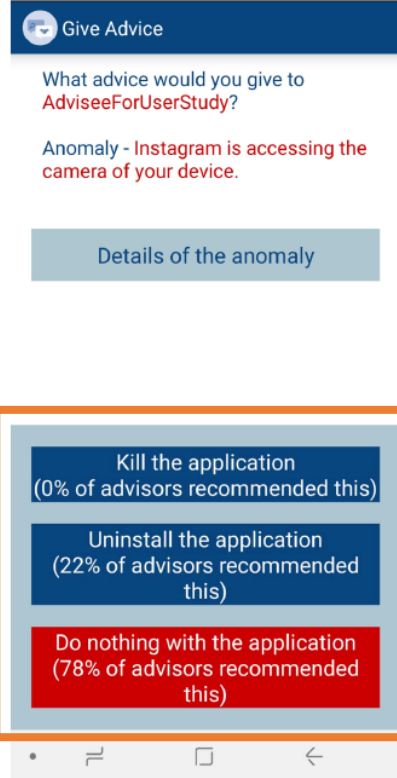


(b) Advisor

Crowdsourcing



(a) Advisee



(b) Advisor



Experimental Setting: User Studies

Study 1: Effect of Delegation

Does **delegation** of security and privacy decisions help older adults make correct decisions?

Study 2: Effect of Crowdsourcing

Does **crowdsourcing** facilitate security and privacy decision making?

Study 3: Learning Effect

Do older adults acquire security-related **knowledge** in the process of delegating decisions?

We use Experience Sampling Method (ESM) to capture responses.



Experimental Setting: Recruitment and Incentives

Recruitment and Incentives

We recruited paired participants in two age groups:

- (1) advisors** participants between the ages 18 and 40, and
- (2) advisees** participants above the age of 50.

We sent emails to our contacts in each school of Singapore Management University (SMU), and asked their help to disseminate our user study within the university.

All participants were at least 18 years old and located in Singapore.

Experimental Setting: Participants and Anomaly



50 pairs of
participants

Study 1	18 pairs
Study 2	16 pairs
Study 3	16 pairs



40 compiled security
and privacy anomalies



...



Experimental Setting: Data Analysis

Advisee “Seek Advice” Ratio

“Own Action” vs. “Ask for Advice”

- ☐ Figure out the preference of the participants between taking their own action and seeking advice.
- ☐ Measure the Own Action ratio and Advice ratio of a set of responses.

Advisee Accuracy of Response

“Correct Responses”

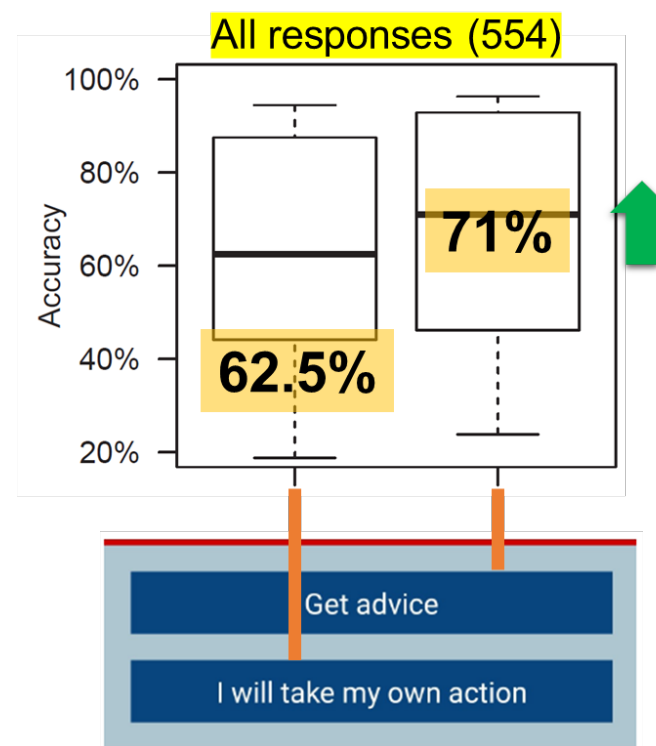
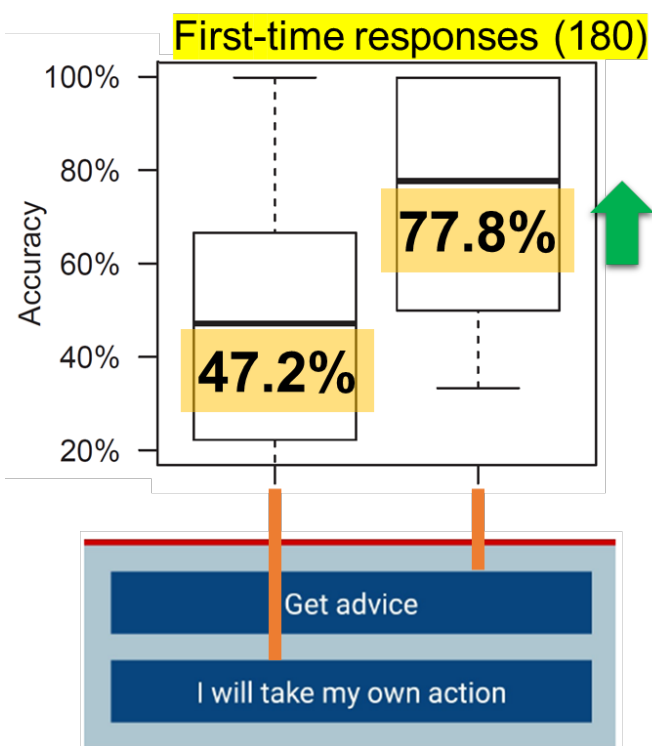
- ☐ “Kill” or “Uninstall” is the correct response for a real anomaly.
- ☐ “Do nothing” is the correct response for a false-positive anomaly.

$$\text{Response accuracy} = \frac{\# \text{ correct responses}}{\# \text{ all responses}}$$

Results: Effect of Delegation

1

Accuracy of Response



median

The accuracy of first-time Advice responses is 1.4x higher in comparison with first-time Own Action responses.

Results: Effect of Delegation

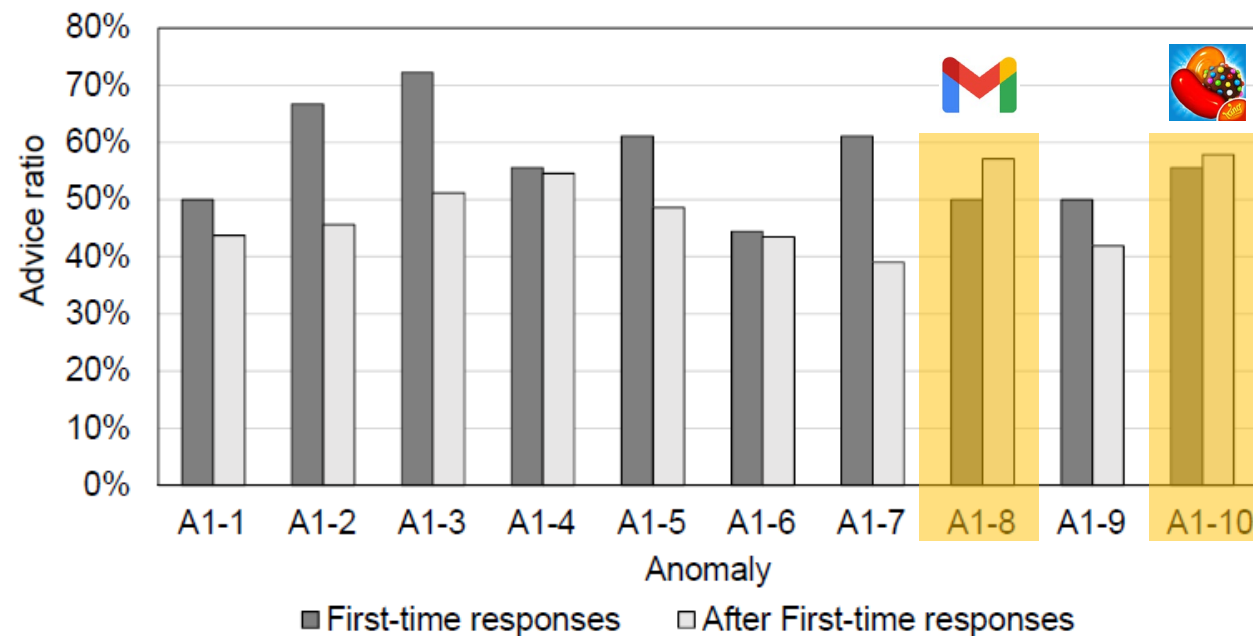
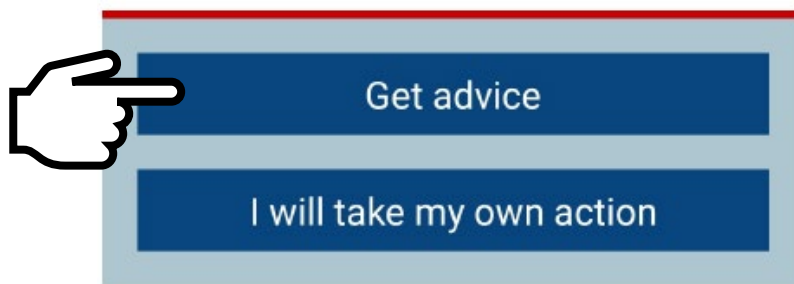
2 “Seek Advice” Ratio

First Time

56.7%

After First Time

47.1%

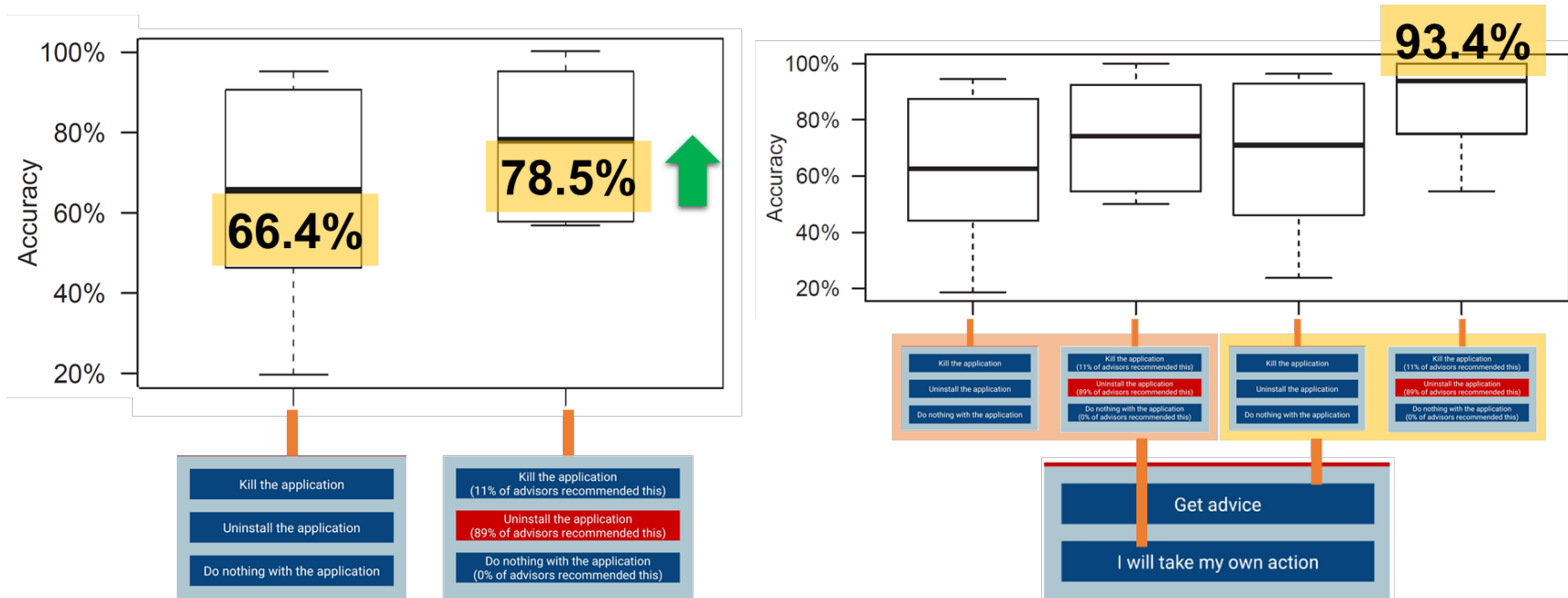


Participants tend to seek advice at the beginning: Own Action responses increase and Advice responses decrease as user study proceeds.

Results: Effect of Crowdsourcing

1

Accuracy of Response



median

Crowdsourcing information significantly improves the accuracy of both advisors and advisees across distinct anomalies; the accuracy of all responses with crowdsourcing information is 1.2x higher in comparison with the responses without crowdsourcing information.

Results: Effect of Crowdsourcing

2

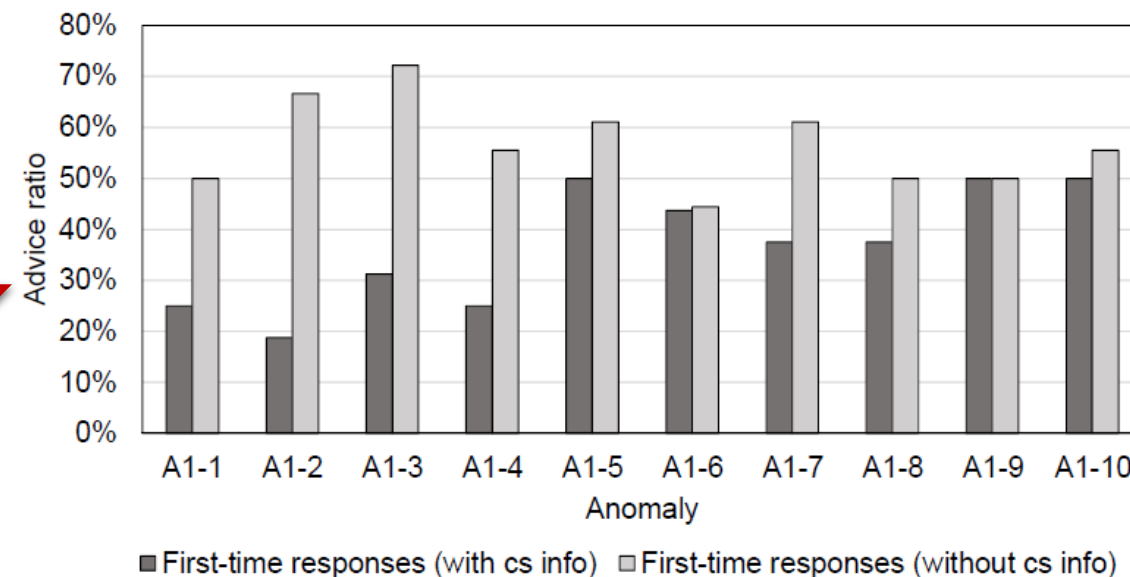
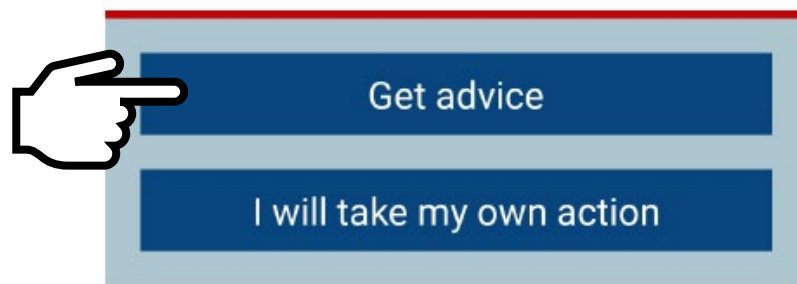
“Seek Advice” Ratio

First Time (Study 1)

56.7%

First Time (Study 2)

36.9%

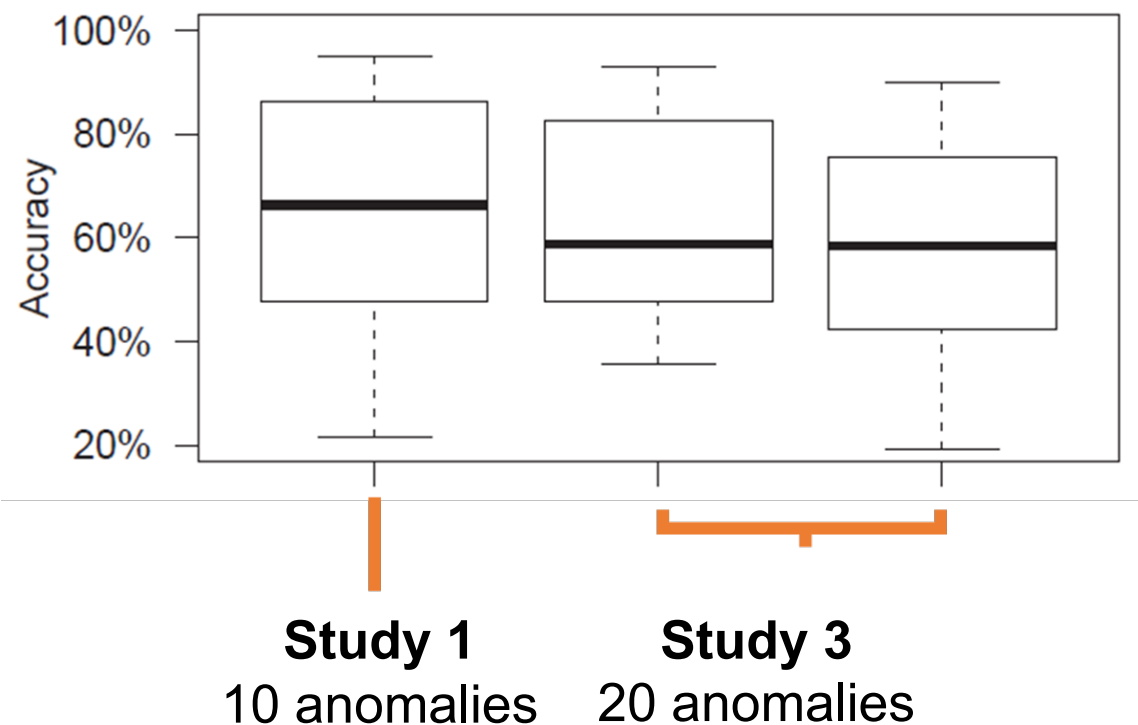


Advice ratios dramatically decreased when we provided notifications with crowdsourcing information.

Results: Learning Effect

1

Accuracy of Response



Participants did not achieve higher accuracy for the anomalies that are arisen by similarly popular apps after previous user study.



Implications

Delegation of Security and Privacy Decisions

- ☐ Delegation of security and privacy decisions had significantly helped our participants (older adults).
- ☐ Delegation of privacy and security management occurs frequently among older adults.



Implications

Delegation with Crowdsourcing

- ☐ Crowdsourcing significantly improved the accuracy of security and privacy decisions for our participants (older adults).
- ☐ The combination of delegation and crowdsourcing leverages delegation to prevent the potential issues of crowdsourcing.



Implications

Learning through Delegation

- ❑ We were not successful in showing a learning effect in the process of decision delegation.
- ❑ The particular concerns and misconceptions of older adults should be addressed through customized training and educational efforts for older adults.



Implications

Technology Design in Mobile Security and Privacy

- ☐ Potential of designing systems that include support built around existing social ties.
- ☐ Crowdsourcing can be effectively embedded in mobile applications.



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Thank you!



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AppMoD: Two Modes

Non-crowdsourcing



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