Android Permissions: User Attention, Comprehension, and Behavior

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Overview of work

• Study how application permissions are perceived by android users
• Two components:
  • Online survey
  • Laboratory study
• Measured:
  • Attention to permission
  • Permission comprehension
  • Influence on installation
• Conclusion – Not very clear for a lot of users, but does help a minority to make informed choices
What are some changes in the Android Application environment?

Then (2011 v 2.2)
- Android market
- Number of Apps – 270000
- During install time
- Less monitoring

Now
- Google play store
- 3 M
- Run time permissions
- More players and easy to publish Apps
How do you want the permission dialog to be?

• Not from the App – from the OS
  • Make out the difference that it is coming from OS
• Tell the reason – mention the task
• Simple and easy to scan –
  • Give additional details if someone wants to know
• Make dialog optional for certain permissions
• Risk score for permissions
Then

Now (Android 5 and above)
C-HIP, Westin Index

- Communication–Human Information Processing (C-HIP)
  - Steps between a warning shown and an action taken

- Westin Index
  - Privacy related questions used to segment users into three groups
  - Our class response: Privacy Fundamentalists - 2, Pragmatists – Most of us! , Unconcerned – 0 😊
Internet survey - Methodology

- Who? 308 Android users
- How? AdMob Advertisement

- Android usage information
- Android permissions
- Westin Index

Gender distribution:
- Male: 1%
- Female: 49%
- Combined: 50%

Age distribution:
- 18-28: 15%
- 29-39: 22%
- 40-50: 29%
- 51-61: 29%
- >62: 5%
Laboratory study

- Who? 25 Android users with latest Android Market
- How? Craigslist advertisement

Gender distribution
- Male: 48%
- Female: 52%

Age distribution
- 18-24: 16%
- 25-34: 12%
- 35-44: 20%
- 45-54: 32%
- >55: 20%
Limitations of the study methodologies?

- Bias in participants type
- Number of participants
- Response order should have been random
- Focus on particular permissions
- Overlap of participants
- Questions were not clear

- Good:
  - Filter duplicates
  - Filter based on completeness of responses
  - Have a consistent population
# Comparison with PGP study

<table>
<thead>
<tr>
<th>PGP</th>
<th>Android permissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>No survey</td>
<td>Avoided priming</td>
</tr>
<tr>
<td>Required priming</td>
<td>General population</td>
</tr>
<tr>
<td>Users selected if they didn’t use</td>
<td>More simplified tasks</td>
</tr>
<tr>
<td>Extensive tasks</td>
<td>Two different study methods to validate one another</td>
</tr>
<tr>
<td>PGP in practice</td>
<td>Scenario – more realistic</td>
</tr>
<tr>
<td>Scenario – artificial setup</td>
<td>More refined</td>
</tr>
<tr>
<td>Initial stages</td>
<td>Asked for thought process - explain</td>
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</tbody>
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Attention to permissions

- **Internet Survey:** 17 Privacy Fundamentalists 37 Non Privacy Fundamentalists cared about permissions (17% of the 308)
- **Laboratory Study:** 14 in lab study noticed permissions (58%)

Reviews

- **Internet Survey:** 71.1% looked at reviews
- **Laboratory Study:** 6 (24%) looked at reviews for details of permissions
How to improve attention to permission messages?

- May be it does not matter because user will grant it any way
- Runtime permissions
  - With context
  - Automatically analyze
- Some way to engage with the permissions list
- Reducing frequency of warnings
How can reviews be used to incorporate security concerns directly?

- Unbiased reviews which can be trusted
- Rating for permissions
- Rating of secure an App is
- Separate tag
- Standardized Q and A on security aspects
- Automated/Manual filtering of fake reviews
  - More attention to negative reviews
Comprehension

- Multiple-choice questions in internet survey
  - Only 2.6% in survey got all 3 questions correct
- Describe permission warning in laboratory studies
  - Meaning of permission
  - Why the App needed it
  - Is it necessary
  - Specific question on whether the permissions can send text messages
  - Only 6 got over 70%
How to improve comprehension of permissions?

- Labels for permission groups
  - Concise and descriptive
- Give a context of to what extent it can be misused
  - Tell exact tasks that permissions can perform
  - Relative nature
  - Less on resources and more on the risks
- Developers should answer - Why
What are other factors to consider?

- <could not discuss/>
Affecting APP install

- Not relevant today, since it does not ask for permissions during installation
- **Internet survey:** 57% responded they did not install
- **Laboratory study:** 20% responded they did not install
How can we improve permission environment?

Users

- <could not discuss/>
Security aspects beyond permissions

• <could not discuss/>
Thank you!