Ubiquitous and Mobile Computing CS 528: *The Effect of Developer-Specified Explanations for Permission Requests on Smartphone User Behavior*

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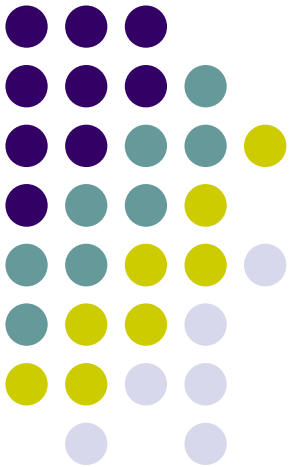
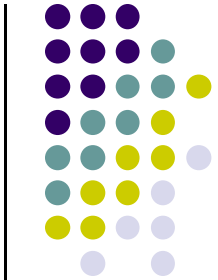
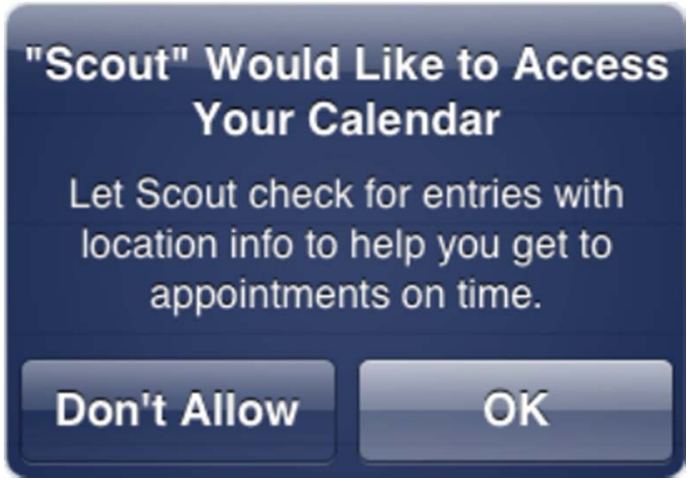


Introduction/Motivation

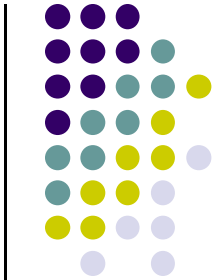


- Permission request dialog on iOS.
- Optional explanation, purpose string.



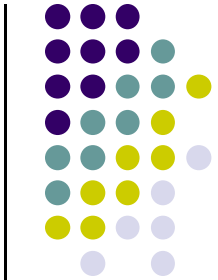
- Allow or don’t allow, that is the question.

Introduction/Motivation



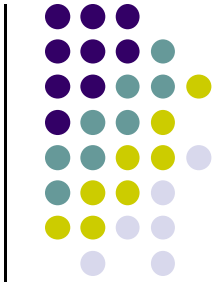
- User Behavior
  - 700 smartphone users
- How many apps with permission request dialog had purpose strings
  - 4000 apps
- Why developers would like to add purpose string or not
  - 30 developers

Related Work



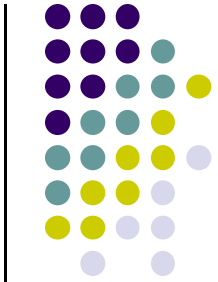
- Threats
  - Malicious app
  - Unintentional access to personal data
- How to present request
  - iOS, WP: Runtime warning
    - Habituated to warnings
  - Android: Install-time warning
    - Few users read

Methodology: User Behavior



- Task 1:
  - Screenshot of request with explanation
- Task 2:
  - Screenshot of request without explanation
- Task 3:
  - Request of a fake app, Party Planner, with purpose string of a pool of 14

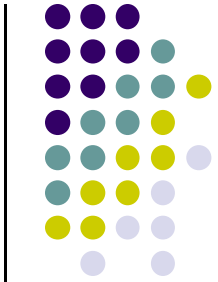
Methodology: User Behavior



Purpose String	Approval Rate
Control: "Contact access is required for this app to work properly."	52.5% of 59
"Let Party Planner use your contacts to autocomplete email addresses."	70.2% of 47
"To find friends, we'll need to upload your contacts to Party Planner. Don't worry, we're not storing them."	69.5% of 59
"Party Planner would like to access your address book to show you the cheapest attractions by your contacts' location. We won't use your contact information for any other purposes."	66.7% of 48
"Your contacts will be used to find your friends."	65.5% of 58
"In order to find your friends, we need to send address book information to Party Planner's servers."	62.5% of 48
"Have more fun with your friends on Party Planner."	58.7% of 46
"Easily search for and share event information with the people who matter most to you."	57.5% of 40
"Your contacts will be uploaded to our secure server. This data is maintained securely and is not shared with another party."	52.9% of 34
"Your contacts will be used to find your friends. They won't leave your phone."	51.5% of 33
"In order to find your friends, we need to send address book information to Party Planner's servers using a secure connection."	51.0% of 51
"Your contacts will be transmitted to our servers and used to find your friends."	46.2% of 39
"Party Planner would like to access your address book to show you the cheapest attractions by your contacts' location."	45.5% of 55
"Party Planner would like to access your address book to show you the cheapest attractions by your contacts' location and other purposes."	38.8% of 49
Total:	56.8% of 666

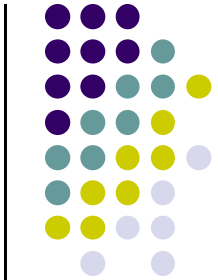
Table 4. Pool of app purpose strings for the fictitious Party Planner app, as well as their associated approval rates. The first purpose string was used as a control condition because it conveys no information about why the app is requesting access.

Methodology: User Behavior



- Question 1:
  - Name of app? Previously used?
- Question 2:
  - Open-ended questions
    - What information would be accessed if “OK”?
- Question 3:
  - Rate the purpose strings of Party Planner from “strongly agree” to “strongly disagree”

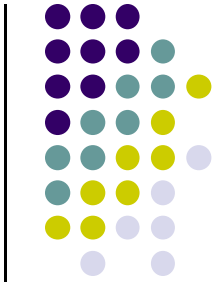
Methodology: User Behavior



1. *It helps me make a more effective decision about the sharing of my information.*
2. *It is useful.*
3. *It gives me more control over the sharing of my information.*
4. *It makes it easier to decide on the sharing of my information.*
5. *It allows me to quickly decide on whether to share my information.*
6. *It allows me to efficiently decide on whether to share my information.*
7. *It addresses my concerns over the sharing of my information.*
8. *I am satisfied with it.*
9. *It makes me more comfortable deciding on whether to share my information.*
10. *It is clear and easy to understand.*
11. *The language used is simple and natural.*
12. *I feel like it is necessary for me to make an effective decision about the sharing of my information.*

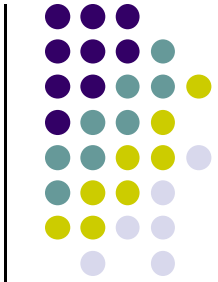
Table 2. Each participant answered 12 questions on a 7-point Likert scale ("strongly agree" to "strongly disagree"). We took the average of these 12 responses to create a "satisfaction score."

Result: User Behavior



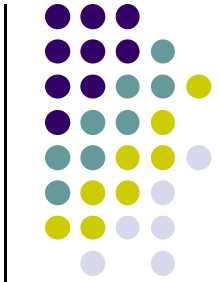
- Purpose and Control
  - 568 participant approved 74% of request with purpose string and 66% of request without
  - Statistically significant by Wilcoxon Signed Rank
- People are more likely to allow request with a purpose string.

Result: User Behavior



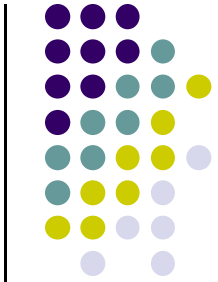
- Choice of Text
  - Scores varied but no significant approval rate
- People are more likely to allow request with a purpose string but usually they don’t care or understand the content of the strings.

Methodology: Adoption

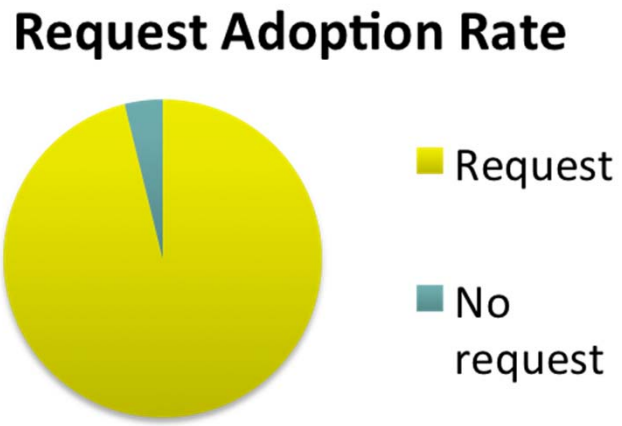


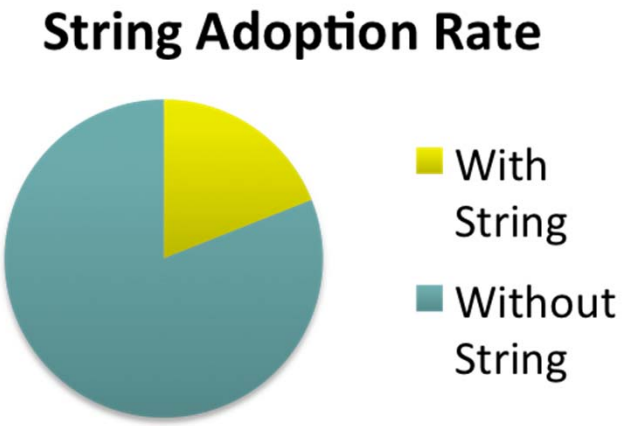
- 4,400 free apps from App Store
- Number of apps with purpose string
  - From app's plaintext metadata file
- Number of apps with request
  - By static analysis on decrypted binaries
- Manual Testing
  - Manually find those numbers of 140 app to prove the accuracy

Result: Adoption

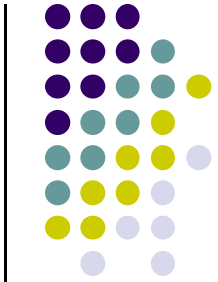


- Adoption rate
  - 80% of apps request access
  - Only 19% of them have purpose strings
  - Manual adoption rate is 17.5%



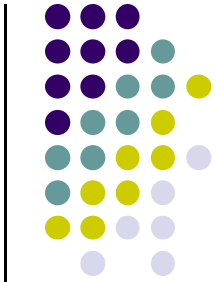


Methodology: Developer Opinions



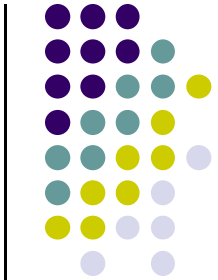
- 30 iOS developers and two popular apps
  - Description of Vine and Scout
  - Whether the apps need permission request
  - If yes, write a purpose string for it

Result: Developer Opinions



- Developer Awareness
  - 28 think permission request necessary, 17 claimed to be aware of purpose string, 7 did use purpose string
  - No relationship with years of developing experience
- Developer Attitudes
  - User benefit works
- Developers use few purpose strings due to lack of awareness and this is because Apple's poor documentation of this feature

Conclusion



- Apple need to improve the document of purpose string to let developers be aware and use it
- Developers can used purpose strings to let users know why
- User need to read and make a trade-off between privacy and functionality

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