Valuating Friends’ Privacy: Does Anonymity of Sharing Personal Data Matter?

Yu Pu
SPIEL
The Pennsylvania State University

Jens Grossklags
Chair for Cyber Trust
Technical University of Munich
Interdependent Privacy

• To which degree do SNS users care about friends’ privacy? Are we good stewards of others’ data?
  – Many decisions on SNS involve data of “friends”

• Our scenario: Third-party Apps
Decision to adopt app

1 User

Data of 250 - 300 friends made accessible as well

Data of user made accessible

Third-Party Company

Direct decision-making path

Only very limited influence over decision
Approach

• Quantify the monetary value app users place on friends’ personal profiles on SNS
  – Measured with *conjoint analysis* method

• Survey constructs to develop behavioral model to explain valuations
  – Model built with *Structural Equation Modeling*
Measure Privacy Value

• Conjoint analysis (Krasnova 2009, Han 2007)
  – Measure preferences in a trade-off scenario
  – Breaking a product down into its constituent parts ({\it attributes and levels})
  – Test the preference combinations of attributes ({\it profiles})
  – Use statistical analysis to quantify the value of each part of the product
## Attributes and Levels

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Attribute Descriptions</th>
<th>Attribute Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>Price of the app</td>
<td>$0.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$1.99</td>
</tr>
<tr>
<td>Network Popularity</td>
<td>Percentage of a user’s friends who installed the app</td>
<td>5%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25%</td>
</tr>
<tr>
<td>Own Privacy</td>
<td>Information the app collects about the user</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Basic Profile</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Full Profile</td>
</tr>
<tr>
<td>Friends’ Privacy</td>
<td>Information the app collects about user’s friends</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Basic Profile</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Full Profile</td>
</tr>
</tbody>
</table>

**FRIENDS’ PRIVACY:**

**Basic Profile:**
Friends’ names, profile pictures, gender, user IDs, number of friends’ friends, any public profile info

**Full Profile:**
Friends’ basic profile, email-addresses, birthdays, all photos, location information
Conjoint Analysis Choice Task

If these are the third-party apps that are available for you to install, which one will you choose?

<table>
<thead>
<tr>
<th>Price:</th>
<th>$1.99</th>
<th>Price:</th>
<th>$0.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Popularity:</td>
<td>5%</td>
<td>Popularity:</td>
<td>5%</td>
</tr>
<tr>
<td>Own Privacy:</td>
<td>None</td>
<td>Own Privacy:</td>
<td>None</td>
</tr>
<tr>
<td>Friends’ Privacy:</td>
<td>None</td>
<td>Friends’ Privacy:</td>
<td>Full Profile</td>
</tr>
</tbody>
</table>
Experimental Treatments

Sharing
- Anonymous Sharing
- Identifiable Sharing

Anonymity

Context
- Irrelevant Context
- Relevant Context

Relevance
Participants

• Recruit from Amazon Mechanical Turk
• Total number of participants: 1007
  – ~250 in each treatment
• Female: 47.6%, male: 53.4%
Effects of Sharing Anonymity and Context Relevance

Sharing Anonymity:
\[ p = 0.025 \]

Context Relevance:
\[ p = 0.002 \]

Detect the same effects for:
- Friends’ basic profile information
- Friends’ valuable information
Value of Single Friend’s Data

Privacy Egoist

Data aggregated across treatments (same effects for different treatment groups)
Explain Interdependent Privacy Values

- Measure factors using survey questions with same subject pool
- Establish hypotheses for a SEM model based on interviews and previous literature

**Diagram:**
- PastPrivacy Invasion
  - DispositionToValuePrivacy
  - TrustInApp
  - Privacy Knowledge
  - OtherRegarding Preference
- OwnPrivacy Concern
  - Sharing Anonymity
  - Context Relevance
  - FriendPrivacy Concern
- OwnPrivacy Value
  - FriendPrivacy Value

* p < 0.05, ** p < 0.01, *** p < 0.001
Factors Driving Concern Towards Own Privacy

- PastPrivacy Invasion
- DispositionTo ValuePrivacy
- Perceived Control
- TrustInApp
- Privacy Knowledge
- OtherRegarding Preference
- FriendPrivacy Concern
- OwnPrivacy Concern
- OwnPrivacy Value
- Sharing Anonymity
- Context Relevance

*p < 0.05, ** p < 0.01, *** p < 0.001
Factors Driving Concern Towards Friends’ Privacy

![Diagram showing relationships between factors driving concern towards friends' privacy]

- PastPrivacy Invasion
- TrustInApp
- DispositionToValuePrivacy
- PerceivedControl
- PrivacyKnowledge
- OtherRegardingPreference
- FriendPrivacyConcern
- OwnPrivacyConcern
- OwnPrivacyValue
- SharingAnonymity
- ContextRelevance
- FriendPrivacyValue

Correlation Coefficients:

- PastPrivacy Invasion: -0.21***
- TrustInApp: -0.27***
- DispositionToValuePrivacy: 0.36***
- PerceivedControl: -0.05*
- PrivacyKnowledge: 0.18***
- OtherRegardingPreference: 0.53***
- FriendPrivacyConcern: 0.58**
- OwnPrivacyConcern: 0.18
- OwnPrivacyValue: -0.41
- SharingAnonymity: -1.34*
- ContextRelevance: -1.82**

Significance Levels:

* p < 0.05, ** p < 0.01, *** p < 0.001
Factors Driving Privacy Valuation

- PastPrivacy Invasion
- TrustInApp
- DispositionTo ValuePrivacy
- Perceived Control
- Privacy Knowledge
- OtherRegarding Preference
- OwnPrivacy Concern
- Sharing Anonymity
- Context Relevance
- OwnPrivacy Value
- FriendPrivacy Value

Coefficients:
- 0.36***
- -0.21***
- -0.27***
- 0.18***
- 0.25***
- 0.53***
- 0.18
- -0.41
- -1.34*
- -1.16**
- -1.82**
- -0.05*
- 0.58**

*p <0.05, ** p < 0.01, *** p < 0.001
Lessons Learned - Policy

• App users are “privacy egoists”
  --> *Limit the collection of friends’ data*
    - What interventions are suitable?
    - Can app platforms (SNS) self-regulate interdependence?

• Privacy knowledge impacts interdependent privacy valuations
  --> *Consider introducing policies which integrate interdependent privacy in educational programs*
Lessons Learned – Privacy by ReDesign

• Data collection contexts affect how users value their friends’ information
  --> Call for mechanisms that inform users of apps’ data practices

• Sharing anonymity plays an important role in interdependent privacy valuations
  --> Suggests designs that inform users of whether sharing friends’ information will be later discoverable
Questions?
Related Publications

