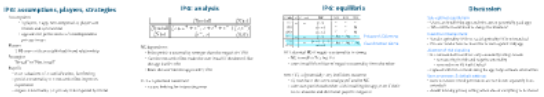
Interdependent Privacy

Facebook App Platform* June 2012

Interdependent Privacy Game



Financial Cryptography and Data Security 2013

Interdependent Privacy: Let Me Share Your Data

Gergely Biczók and Pern Hui Chia

NTNU – Trondheim
Norwegian University of
Science and Technology

Summary

Online privacy interdependence is very much existing

Example: Facebook App platform

Simple GT modell exposes uncertain outcomes and potential issues both for users and vendors

FW: modeling (e.g., n users and m apps), mechanism design, measurements on other platforms (e.g., mobile)

Interdependent Privacy

Online privacy

Privacy is the interest that individuals have in sustaining a 'personal space', free from interference by other people and organizations. [Clarke]

Categories: bodily, behavioral, communication, data

Online privacy risks

- personal: potential loss of user and behavioral data
- relational: revelation of how user relate to and communicate with others
- spatial: invasion of user's virtual space (blog, social nw)

Privacy interdependence

Online privacy depends not only on a user's action

- but others' actions: interdependence!

Example: embarassing photos of you taken and shared by others

Externality: someone influences the well-being of a bystander and yet neither pays nor receives any compensation [Mankiw]

Sharing someone else's information can be at the same time

- beneficial (better user experience): positive externality
- harmful (loss of privacy): negative externality

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Facebook App Platform* June 2012

Facebook: a "vetenarian horse" for privacy

- widely studied: complexity, control, inferring private from public data, user awareness, ...
- now: app install & interdependent privacy

Facebook app platform

Permission-based platform security
- least privilege for 3rd party apps <-> maximize user experience
- 65 permissions in 5 groups: basic, user & friend info, extended, opengraph, page

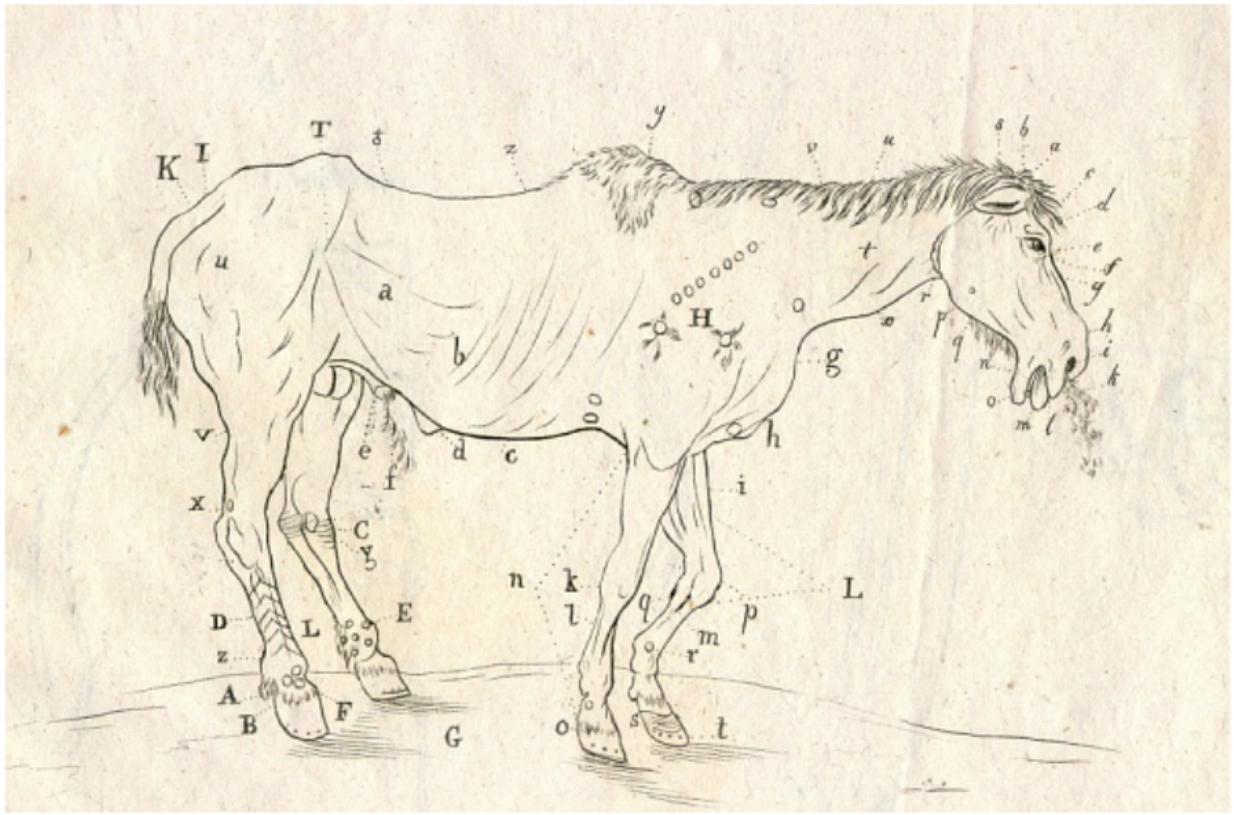
FB Help Center: "apps are not allowed to
- use personal info for ads
- transfer information without user consent"

App data collection

- 27029 apps, list from socialbakers.com
- visiting all to get install-time permissions
- data from [ChiaWWW12] but focusing on privacy interdependence
- friend info is non-extended!

Measurement results

Facebook: a "vetenarian horse" for privacy



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[redacted]

Danielle is giving away Gold pieces in FarmVille to celebrate St. Patrick's Day!

Danielle is getting rich and wanted to spread the wealth! Gold pieces can be traded in for limited edition items in FarmVille!

2 hours ago via FarmVille · Comment · Like · Get some Gold

[redacted]

Danielle found some White Mystery Eggs to share with their friends!

Danielle was just feeding Greg Jackson's chickens and made them so happy that they laid an extra batch of White Mystery Eggs!

2 hours ago via FarmVille · Comment · Like · Hatch an egg

[redacted]

Danielle could really use some help fertilizing their crops in FarmVille!

Danielle noticed their crops are a bit on the puny side because they haven't been fertilized yet...

2 hours ago via FarmVille · Comment · Like · Fertilize their crops

Facebook app platform

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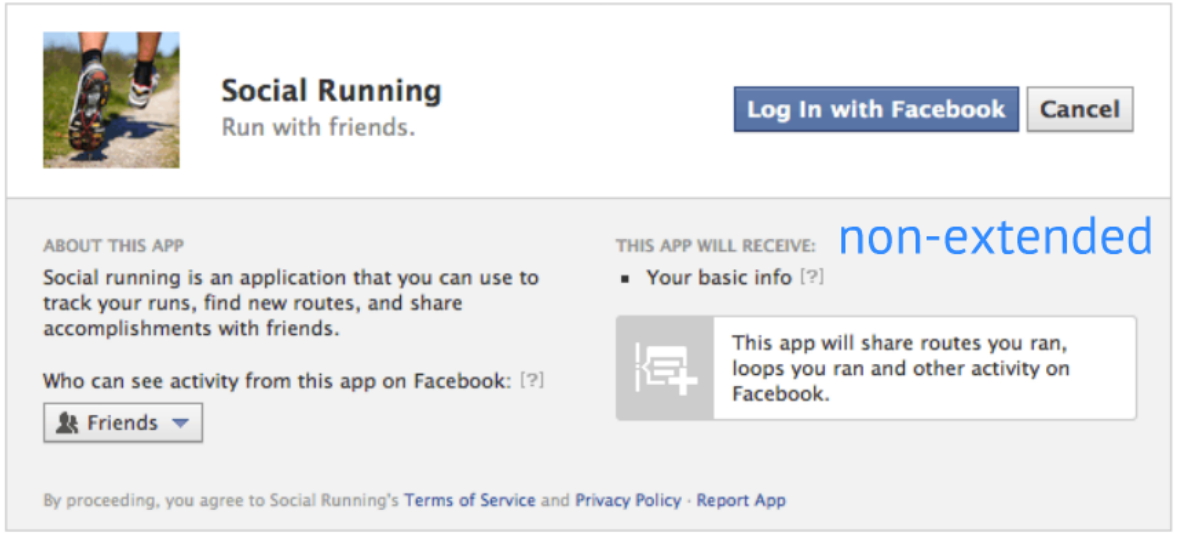

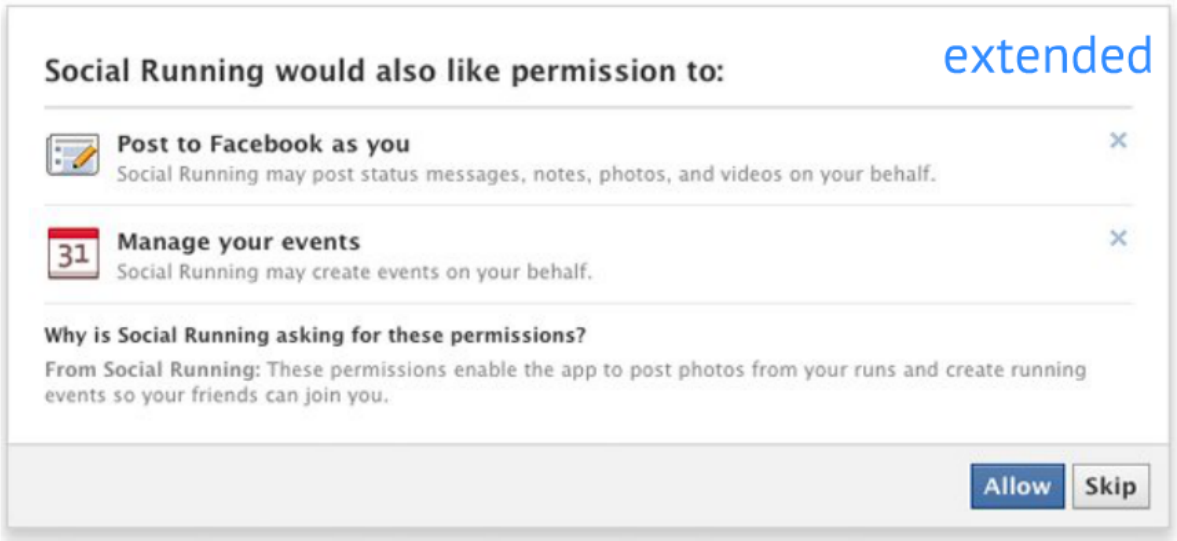

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Measurement results

Dimension	Dependency (Affecting)	# app	% app
Personal	Self	18204 [4634]	67.35 [17.15]
	Friends	518	1.92
Relational	Both self and friends	18204 [480]	67.35 [1.78]
Spatial	Self	494	1.83
	Friends	6249	23.12

Table 1: Online privacy dimensions, dependency of privacy control (equivalently, the affected victim), and the number of apps posing the respective risks. Figures in [brackets] exclude apps that request only the single `basic` permission.

Personal privacy

Permission	# app	% app
basic	18204	67.35
email	3766	13.93
user_about_me	284	1.05
user_activities	67	0.25
user_birthday	914	3.38
user_checkins	24	0.09
user_education_history	67	0.25
user_events	27	0.10
user_games_activity	5	0.02
user_groups	35	0.13
user_hometown	204	0.75
user_interests	94	0.35
user_likes	314	1.16
user_location	412	1.52
user_notes	12	0.04
user_online_presence	67	0.25
user_photos	574	2.12
user_questions	-	-
user_relationships	77	0.28
user_relationship_details	21	0.08
user_religion_politics	50	0.18
user_status	131	0.48
user_subscriptions	-	-
user_videos	187	0.69
user_website	12	0.04
user_work_history	107	0.40

Control: user

Permission	# app	% app
friends_about_me	25	0.09
friends_activities	23	0.09
friends_birthday	162	0.60
friends_checkins	15	0.06
friends_education_history	30	0.11
friends_events	7	0.03
friends_games_activity	5	0.02
friends_groups	8	0.03
friends_hometown	44	0.16
friends_interests	33	0.12
friends_likes	51	0.19
friends_location	62	0.23
friends_notes	3	0.01
friends_online_presence	89	0.33
friends_photos	256	0.95
friends_questions	-	-
friends_relationships	19	0.07
friends_relationship_details	8	0.03
friends_religion_politics	20	0.07
friends_status	16	0.06
friends_subscriptions	-	-
friends_videos	75	0.28
friends_website	2	0.01
friends_work_history	29	0.11

Control: friend

Relational privacy

Permission	# app	% app	
basic	18204	67.35	list of friends
read_friendlists	114	0.42	custom lists: close, family, ...
read_mailbox	1	0.00	
read_requests	5	0.02	
read_stream	356	1.32	postings by friends to user's timeline
rsvp_event	12	0.04	
xmpp_login	14	0.05	private chat messages
manage_friendlists	1	0.00	
manage_notifications	7	0.03	

Spatial privacy

Permission	# app	% app	
publish_actions	485	1.79	can post to user's own space
publish_checkins	9	0.03	

Permission	# app	% app	
publish_stream	6249	23.12	can post also to friends' spaces: main culprit for uninvited postings/invites

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list of friends

custom lists: close, family, ...

postings by friends to user's timeline

private chat messages

Spatial privacy

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can post also to friends' spaces: main culprit for uninvited postings/invites

Interdependent Privacy Game

IPG: assumptions, players, strategies

Assumptions
- 2 players, 1 app, non-cooperative, players are friends and symmetrical
- app asks for permissions w/ interdependent privacy issues

Players
2 FB users with an established friend relationship

Strategies
"Install" or "Not install"

Payoffs
- own valuation (+/-): useful/useless, fun/boring
- positive externality (+): network effect improves experience
- negative externality (-): privacy risk imposed by friend

IPG: analysis

	(I)nstall	(N)ot
(I)nstall	$(v+e^{+}+e^{-}, v+e^{+}+e^{-})$	(v, e^{-})
(N)ot	(e^{-}, v)	$(0, 0)$

NE depends on:
- Is the positive externality stronger than the negative? (1/0)
- Can the network effect make the user install if she doesn't like the app itself? (1/0)
- Does the user like the app itself? (1/0)

8 -2 = 6 potential outcomes!
- we are looking for interesting ones

IPG: equilibria

Case	v	$e^{-}+e$	NE	SO	PO	VO	
$\uparrow\uparrow\uparrow$	+	+	(i, i)	Y	Y	Y	
$\uparrow 0\Downarrow$	+	−	(n, n)	Y	Y	N	
$0 0\Downarrow$	−	−	(n, n)	Y	Y	N	
$0\uparrow\uparrow$	+	+	(i, i)	Y/N	Y/N	Y	Prisoner's Dilemma
$\uparrow\uparrow 0$	−	+	(n, n); (i, i); mixed	Y/N	Y/N	Y/N	Coordination Game

III: classical PD if negative externality is strong
- NE is not PO/SO, but VO
- users install b/c of fear of negative externality from the other

III: CG, w/ potentially very inefficient outcome
- (i, i) can have the worst total payoff and be NE
- users can punish each other with installing the app, even if their own valuation and their total payoff is negative

Discussion

Sub-optimal equilibrium
- Users can install risky apps and miss out on potentially good apps
- Who will be incentivized to change the situation?

Incentive misalignment
- Vendor optimality (VO) vs. social optimality (SO): mismatched
- PD case: vendor have no incentive to warn against risky app

Absence of risk signaling
- B/c mismatched incentives: only community ratings remain
  - not factoring in risks and negative externality
  - removed from FB Auth Dialog*
- replaced with list of friends using the app: helps estimate externalities

User awareness & default settings
- users not aware: friend-permissions are not shown separately (non-extended)
- default interdep privacy settings allow almost everything to be shared

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(I)nstall	$(v + e^+ + e^-, v + e^+ + e^-)$	(v, e^-)
(N)ot	(e^-, v)	$(0, 0)$

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111	+	+	(i,i)	Y	Y	Y
100	−	−	(n,n)	Y	Y	N
000	−	−	(n,n)	Y	Y	N
011	+	+	(i,i)	Y/N	Y/N	Y
110 *010*	−	+	(n,n), (i,i), mixed	Y/N	Y/N	Y/N

Prisoner's Dilemma

Coordination Game

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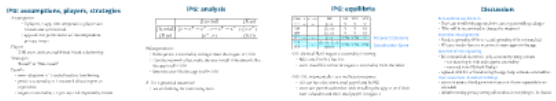

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Post Scriptum

Someone at FB must have read the paper…

- Dec 2012: slightly redesigned app install
- but changes are mixed from our perspective
- does NOT eliminate negative externality

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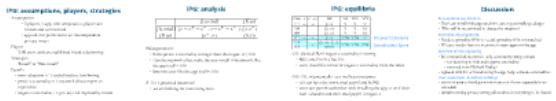

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