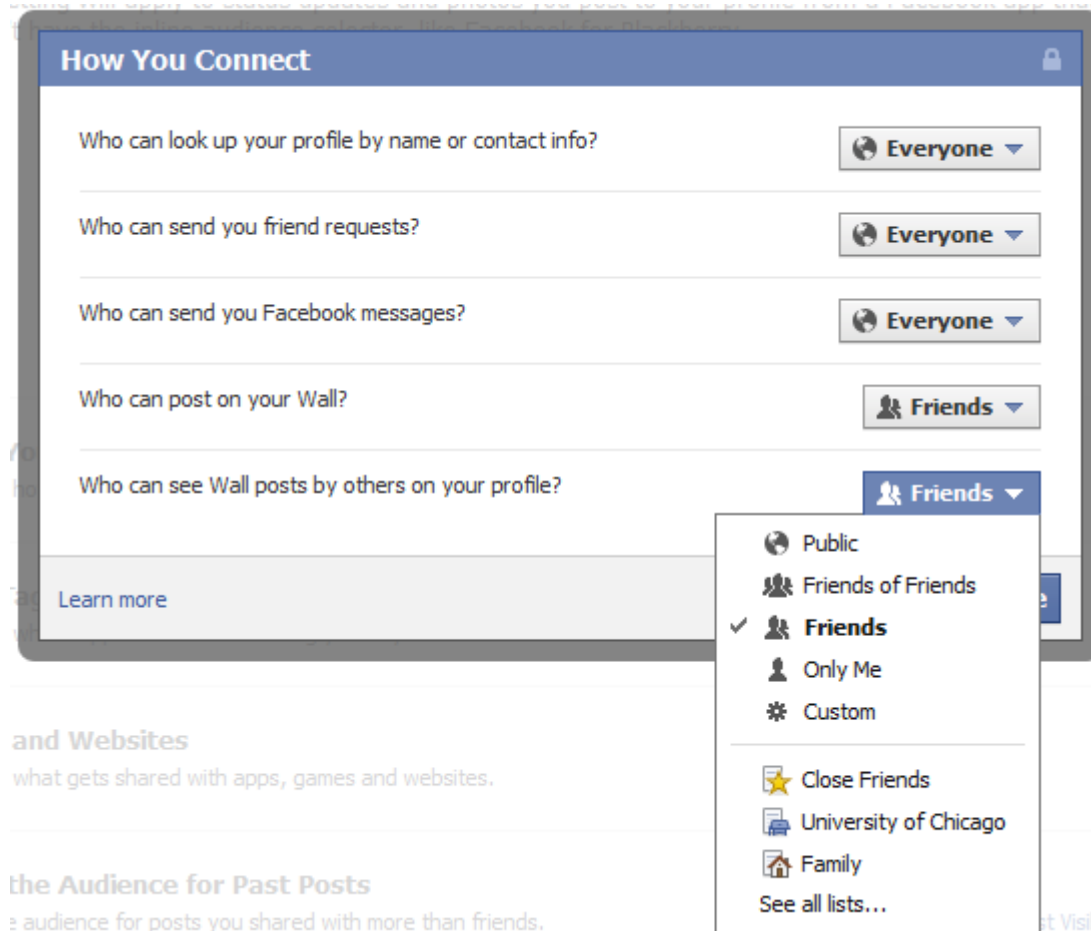**Herd Privacy on Social Networking Sites**

David Masad

George Mason University

Facebook privacy settings

How You Connect 🔒

Who can look up your profile by name or contact info? | 🌐 Everyone ▼

Who can send you friend requests? | 🌐 Everyone ▼

Who can send you Facebook messages? | 🌐 Everyone ▼

Who can post on your Wall? | 👥 Friends ▼

Who can see Wall posts by others on your profile? | 👥 Friends ▼

- 🌐 Public
- 👥 Friends of Friends
- ✓ 👥 **Friends**
- 👤 Only Me
- ✴ Custom

- ⭐ Close Friends
- 🏛 University of Chicago
- 🏠 Family

See all lists...

Learn more

and Websites
what gets shared with apps, games and websites.

the Audience for Past Posts
audience for posts you shared with more than friends.

Twitter Account Settings

Tweet Privacy   ☐ Protect my tweets

Only let people whom I approve follow my tweets.
If this is checked, your future tweets will not be available publicly. Tweets posted
previously may still be publicly visible in some places.

- Users expose information on their friends' pages:
    - Comments
    - Photographs
    - The friendships themselves

- Average ~140 friends[2] – up to 19,600 friends-of-friends.

- "Share with friends of friends"

Users' privacy depends in part on their friends' privacy.

This is already intuitively understood – sometimes…

Katlin [redacted] ▶ Amber F[redacted]: Hey bitch , so im going to london soo and ur fine ass is gunna hang out with me :) ♥ .. Me + you + my bed = ;) aha I love you hun . Chillz Soo000o0on!

about an hour ago · Comment · Like · See Wall-to-Wall

about an hour ago

Wendy F[redacted] I heard about whats going on and we'll be talkign about this when dads not around; this is exactly why your not allowed to hang out with kailtin [redacted] i just got confirmation about what i thought was going on. call me NOW

38 minutes ago

lamebook.com

Source: *http://www.lamebook.com/smokin-dopes/*

Subject: RE: Absence on Thursday 21st 2008

Hi Niresh,

My leave was due to medical reasons, so you cannot deny leave based on a line manager's discretion, with no proof, please process leave as requested.

Thanks

Subject: RE: Absence on Thursday 21st 2008

Hi Kyle,

I believe the proof that you are after is below

Kyle[redacted]
is not going to work. fuck it i'm still trashed. SICKIE WOO!
Updated on Thursday

Networks: Australia
Sex: Male
Interested In: Women
Birthday: [redacted]
Hometown: Sydney, Australia
Political Views: Liberal Party Of Australia
Religious Views: Agnostic

Mini-Feed

failbook.com

Source: *http://failbook.failblog.org/2011/09/21/funny-facebook-fails-classic-medical-reasons/ /*

- Real data difficult to obtain.

- Support intuitive understanding with formal analysis.

- Estimate magnitude of effect.

- (Demonstrate modeling approach to SNS)

- Random network of Users / User Pages, connected by mutual Friendships.

- Users expose personal information on Friend's pages.

- Each user's page is shared with either:
  - Friends only
  - Friends of Friends

- Measure maximum possible information exposed.

- Mutual Friendships.

- Random subset of Friends are 'close friends'
  - Information only exposed on close friends' pages.

- Only 2 privacy options.

- Personal information treated abstractly:
  - [0,1] – *proportion* of personal information exposed.
  - All users expose information uniformly.

SNS represented by an undirected graph:

- Nodes: Users / User Pages
- Edges: Friendships

User Model:

- Exposure vector b: Information on self and others exposed.
- Knowledge vector k: What information on other users can the user access?
- Privacy: 0 (Closed) or 1 (Open).
  - Chosen randomly with fixed probability.

Target User (Closed Profile)

Close Friend (Open Profile)

Close Friend (Closed Profile)
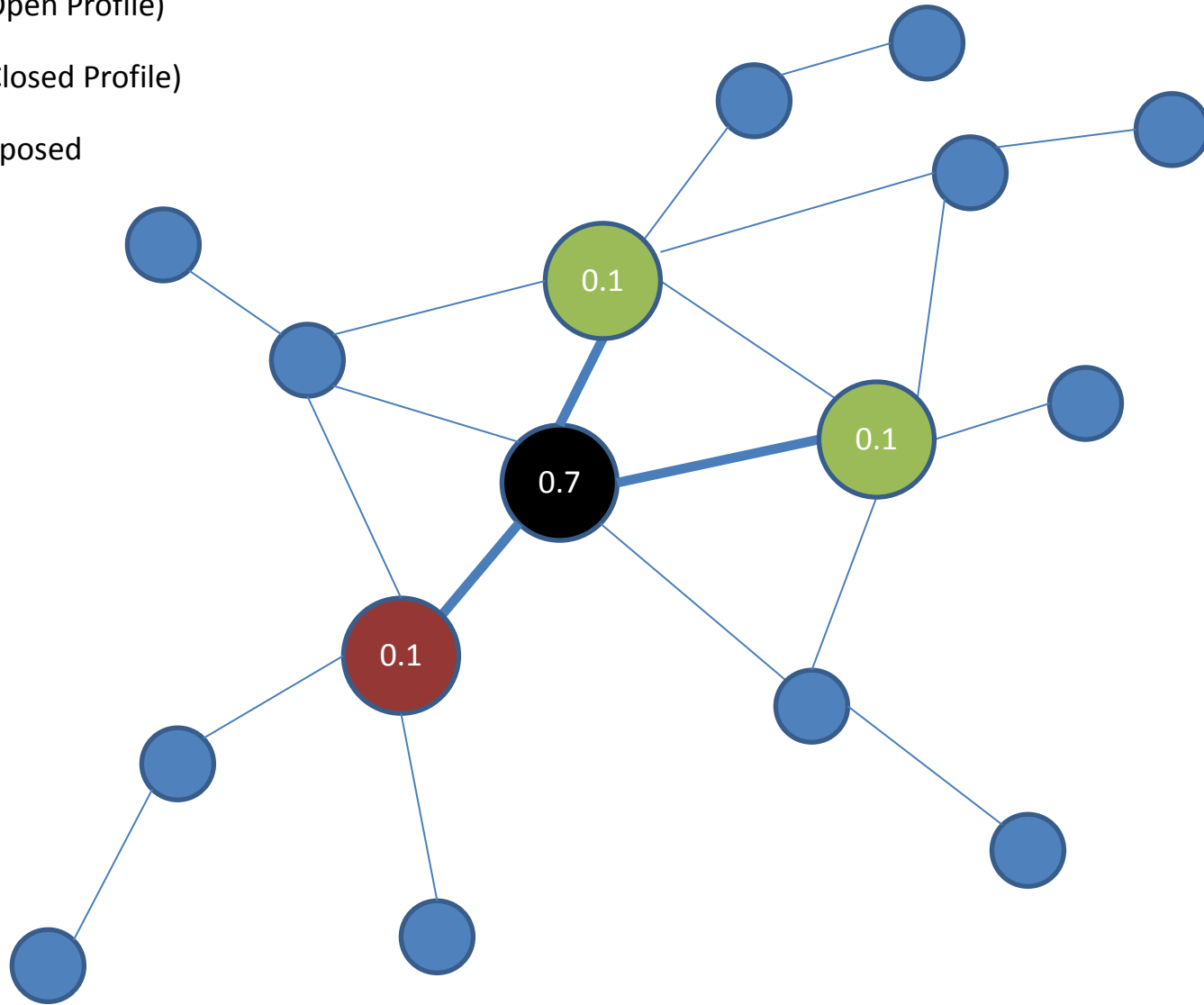
Information Exposed

Target User (Closed Profile)

Close Friend (Open Profile)

Close Friend (Closed Profile)

Information Exposed

Information Visible
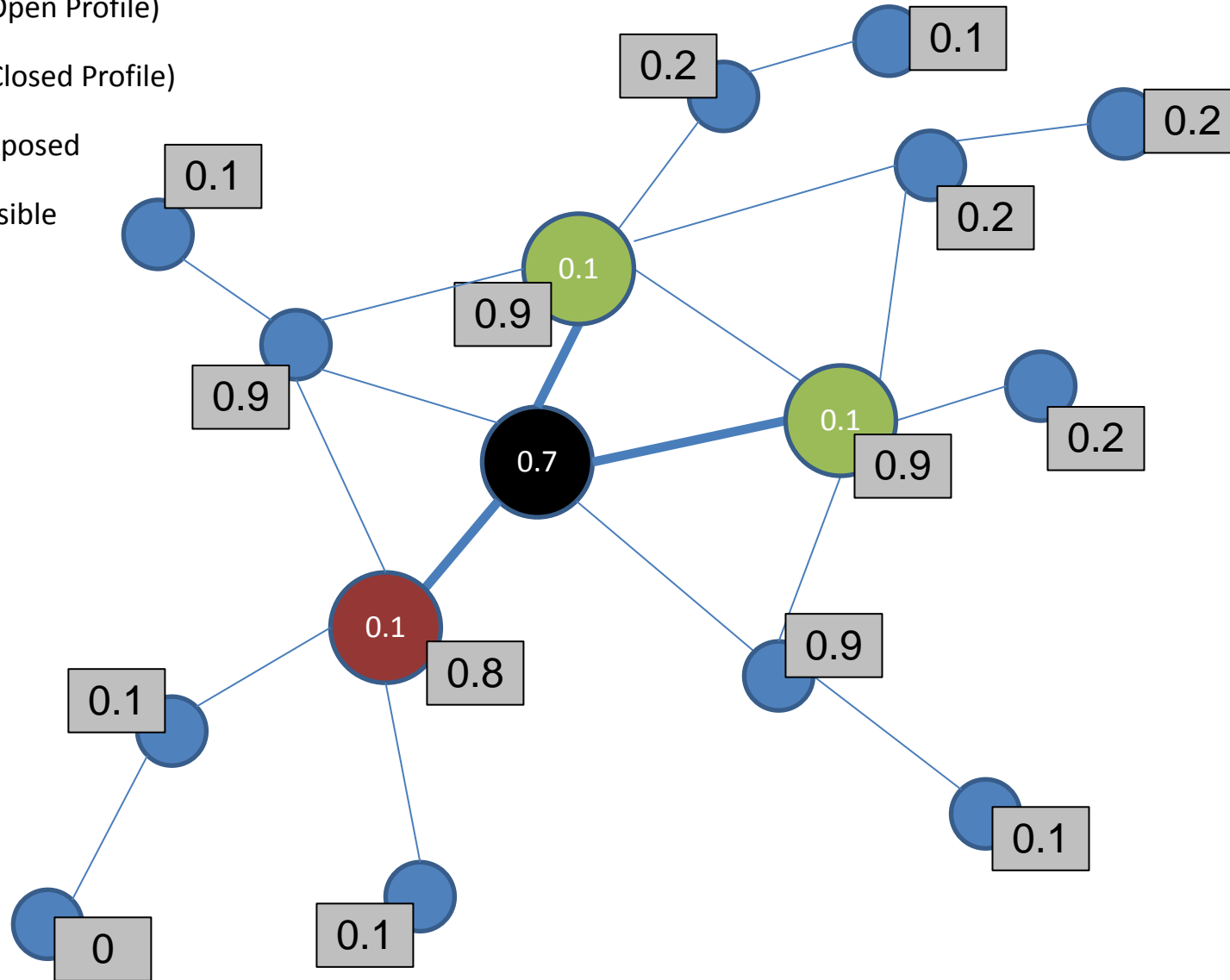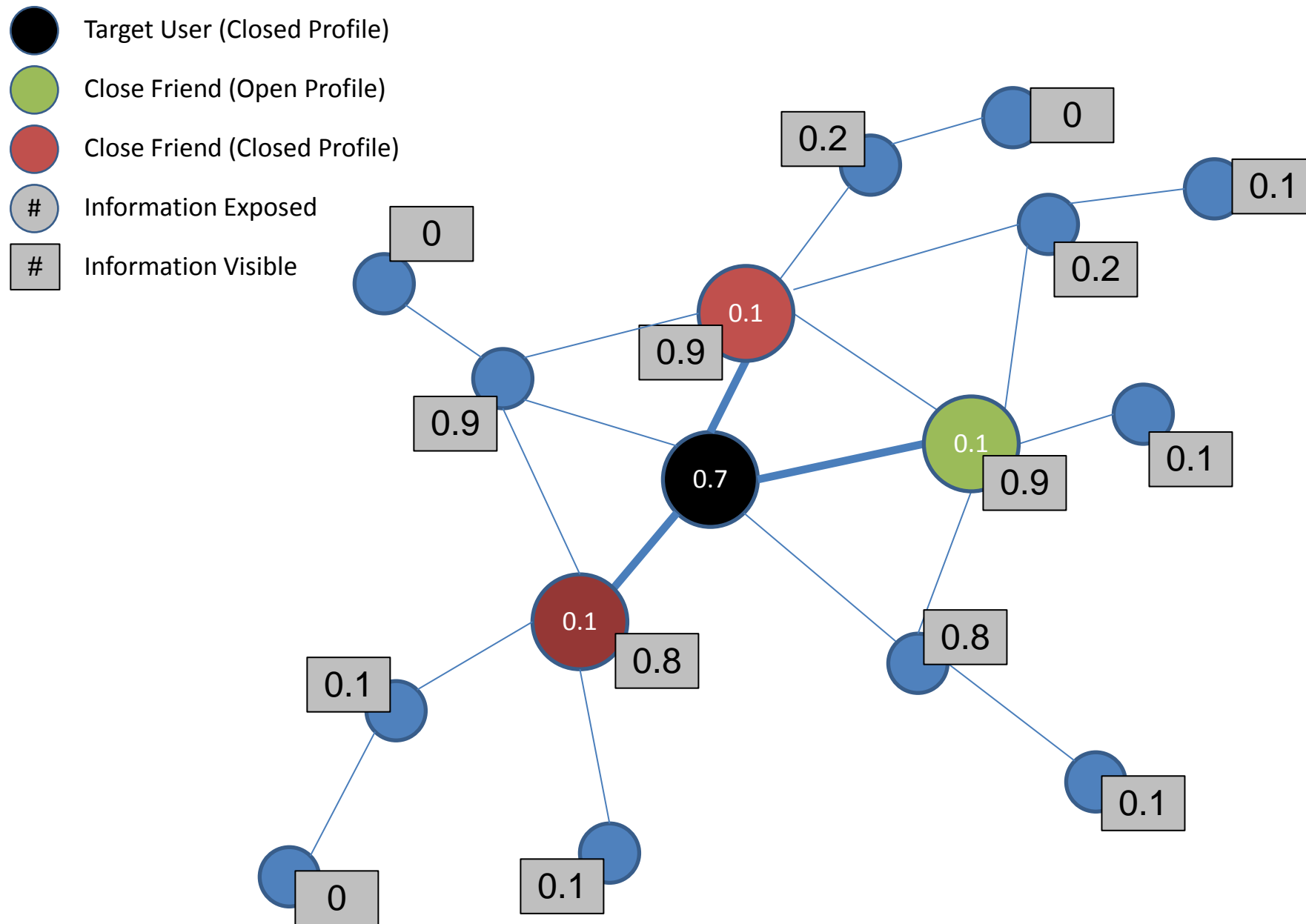
$b_{j,i}$ – The information on user i exposed on user j's page.

$b_{i,i}$ – The information user i exposes on i's page. **Constant for all users.**

When i and j are close friends:

$$b_{j,i} = \frac{1 - b_{i,i}}{number\ of\ i's\ close\ friends}$$

Otherwise: $\quad b_{j,i} = 0$

$k_{j,i}$ – The total of user i's personal information that user *j* has access to.

$$k_{j,i} = \sum_{n=1}^{N} b_{n,i} \cdot v_{j,n}$$
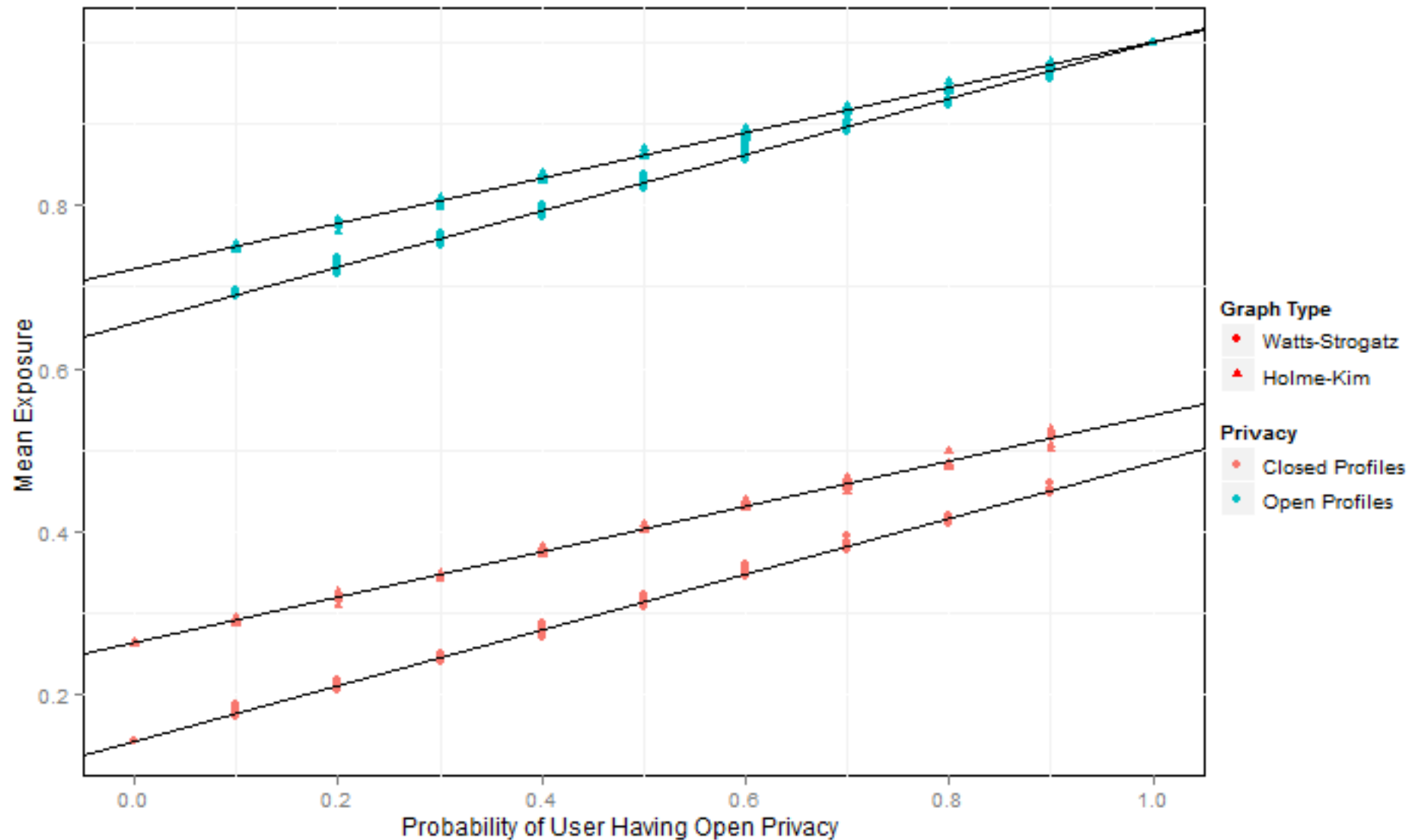
$v_{j,n}$ – visibility

$v_{j,n}$ = 1 if either:

- j and n are friends
- j is a friend-of-a-friend of n AND n's privacy is Open.

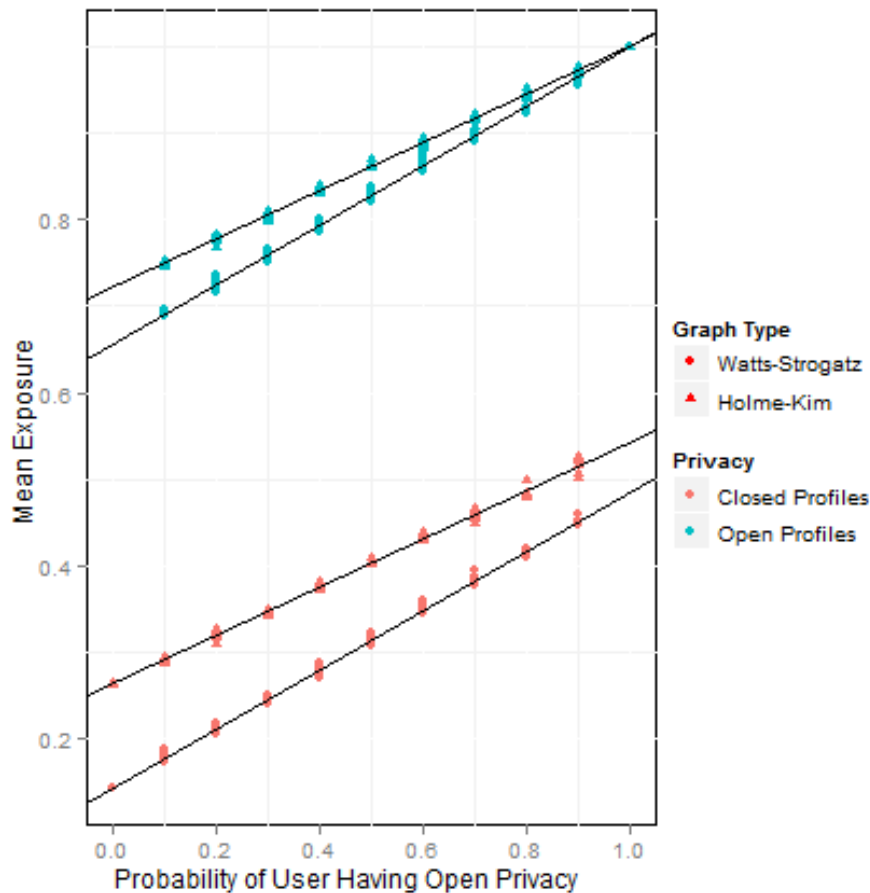User i's Exposure is mean of $k_{j,i}$ across all j.

- # of Nodes: 1,000

- Graph generators
    - Watts-Strogatz (Cluster-heavy)
    - Holme-Kim (Scale-free + clustering)

- Base edge count: 144

- Fraction of close friends: 0.15

- $b_{i,i} = 0.6$
    <u>Parameter sweep over Privacy Mix.</u>

- Users' own privacy settings have a stronger effect than other users' settings.

- As the proportion of users with Open privacy settings increase, the exposure of **all** users increases.

	Graph Type	
	Watts-Strogatz	Holme-Kim
(Intercept)	-0.383**	-0.124**
Pr(Open)	0.002	0.012*
Open Privacy	0.514**	0.458**
Fraction of Friends w/ Open Privacy	0.340**	0.266**
Closeness	0.977**	0.680**
R^2	0.99	0.98

* – significant at 5% level; ** – significant at 0.1% level

	Graph Type	
	Watts-Strogatz	Holme-Kim
(Intercept)	-0.383**	-0.124**
Pr(Open)	0.002	0.012*
Open Privacy	0.514**	0.458**
Friends w/ Open Privacy	0.340**	0.266**
Closeness	0.977**	0.680**
R^2	0.99	0.98

- Exposure is affected strongly by Friends with open privacy settings.

- Overall network Openness is not separately significant.

- Position within the network is important.

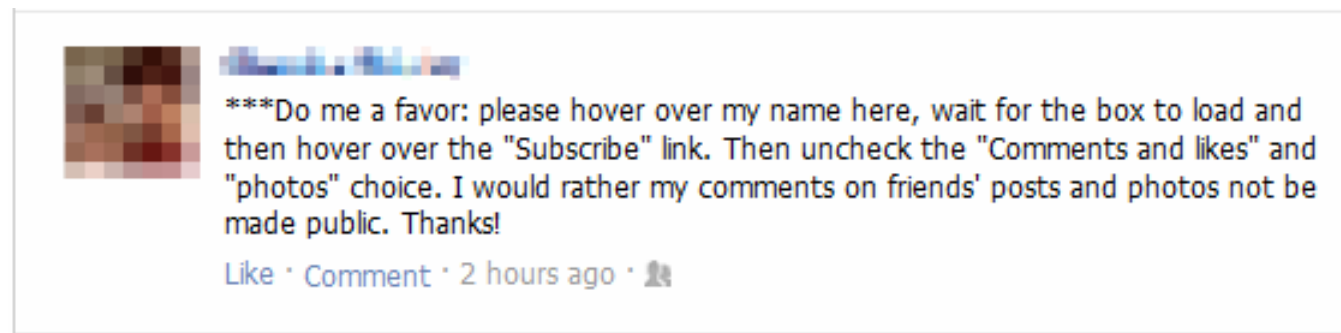Besides their own page settings, user privacy is significantly affected by:

- Friends' privacy settings.

- Position within the network.

<u>Users have little/no ability to assess or control these factors.</u>

Besides their own page settings, user privacy is significantly affected by:

- Friends' privacy settings.

- Position within the network.

<u>Users have little/no ability to assess or control these factors.</u>

***Do me a favor: please hover over my name here, wait for the box to load and then hover over the "Subscribe" link. Then uncheck the "Comments and likes" and "photos" choice. I would rather my comments on friends' posts and photos not be made public. Thanks!

Like · Comment · 2 hours ago ·

Friends' Privacy Settings:

- Generally unknown.

- May change with no notice.

- Friends may add additional friends.

Position within the network:

- Nearly impossible for users to determine.

- Centrality higher among both popular and boundary-spanning users.

Both factors may exacerbate effects of broad changes to SNS policy.

Questions / Comments?