Are you a social keeper or a social explorer?
The dynamics of human social behavior in communication networks

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Motivation

How do we manage our social connections in time?

vimeo.com/52390053

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Dynamical processes on real networks

Nodes
appear/disappear

Ties
form/decay
Tie activity is bursty
Groups of conversation
Communities form/change/decay

Network
form/change/decay

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Motivation

Which is the strategy behind tie formation/decay?

- **Node creation/decay**, growth of networks: Preferential attachment (coupled to node appearance) (Leskovec, Backstrom, Kumar & Tomkins ’08)
- **Tie formation** (Rivera, Soderstrom, Uzzi ’10)
  - Homophily
  - Reciprocity
  - Triadic closure
  - Proximity and Social Foci
  - ...
- **Tie decay** (Burt ’00, ’02)
  - Tie persistence: 40% of ties decay in one month (Hidalgo, Rodríguez-Sickert ’08)
Tie formation/decay

- How many people you don’t talk to anymore is in your contacts app?
Attention economy
Limits to sociability

- Cognitive
  - Dunbar’s number

  - There is a cognitive limit to the number of people with whom one can maintain stable social relationships. (Dunbar 1992)


- The magical number Seven Plus Minus Two

  - The number of objects an average human can hold in working memory is 7 ± 2 (Miller ’56)
Limits to sociability

- Monetary and time costs
Questions

How do we **manage** our sociability dynamically?

Is there a **universal behavior** in human social strategies?

Do different strategies give any social **advantage**?
What are our dynamical social strategies?
Data

- CDR (Call Detail Record)
  - 19 months of data
  - 23M people
  - 9000M calls
  - 700M ties

- Only reciprocal ties
- Only users who are present throughout the 19 months
Detecting tie presence - formation/decay

- The problem of detecting formation/decay of ties is coupled to the burstiness of interactions

Average interevent time: 14 days
20% of interevent times larger than 2 months
Disentangling bursty interaction from tie dynamics
(Egocentric) dynamical sociability

- Aggregated (revealed) connectivity
  $$\kappa_i(t)$$

- Social capacity
  $$\kappa_i(t)$$

- Cumulative number of added/removed ties
  $$n_{\alpha,i}(t) \uparrow\uparrow\uparrow\uparrow$$
  $$n_{\omega,i}(t) \downarrow\downarrow\downarrow\downarrow$$

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**Figure:**

- **A:** Graph showing the number of ties over time with different markers indicating additions and removals.

- **B:** Close-up graph focusing on the number of ties with specific markers.

- **C:** Highlighting the cumulative number of ties with annotations for $$\kappa_i(t)$$ and $$n_{\alpha,i}(t) + \kappa_i(0)$$.
Dynamical social strategy

- Very heterogeneous tie evolution
  - Mean $\langle n_{\alpha,i} \rangle \simeq \langle n_{\omega,i} \rangle \simeq 8$  $\langle k_i \rangle \simeq 16$
  - But $n_{\alpha,i} > 15$ for 20% of nodes
  - Aggregated connectivity typically overestimates sociability by 100%
Dynamical social strategy

- Linear tie formation/decay evolution

\[ n_{\alpha,i}(t) + \kappa_i(0) \]

- For 80% of users we find

\[ n_{\alpha,i}(t) \approx \alpha_i t \quad n_{\omega,i}(t) \approx \omega_i t \quad \alpha_i \approx \omega_i \]

- Thus

\[ \kappa_i(t) \approx \kappa_i(0) \]

Social capacity is conserved (!)
Dynamical social strategy

- Linear tie formation/decay evolution
Dynamical social strategy

\[ k_i \simeq \bar{k}_i + n_{\alpha,i} \]

Connectivity = Capacity + Activity
Dynamical social strategy
Characterizing dynamical social strategies

- Social capacity and activity are not independent
  \[ n_{\alpha,i} \propto \bar{K}_i \]
- For a given \( k_i \) we have
  - Social explorers (A) \( n_{\alpha,i} \gg \bar{K}_i \)
  - Balanced (-) \( n_{\alpha,i} \approx \bar{K}_i \)
  - Social keepers (B) \( n_{\alpha,i} \ll \bar{K}_i \)

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Characterizing dynamical social strategies

$n_{\alpha,i} = 23, \bar{k}_i = 4$

Social explorer

$n_{\alpha,i} = 3, \bar{k}_i = 24$

Social keeper
Comparison to other social networks

- Characterization of dynamical social strategies for 6 months of time

<table>
<thead>
<tr>
<th>SocNet</th>
<th>$N$</th>
<th>$\langle k_i \rangle$</th>
<th>$\langle \bar{k}_i \rangle$</th>
<th>$\langle n_{\alpha,i} \rangle$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phone calls</td>
<td>20M</td>
<td>16</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Facebook wall</td>
<td>10k</td>
<td>8</td>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>

Properties of dynamical social strategies
Social strategies are assortative

Social explorer
https://vimeo.com/65257905

Social keeper
https://vimeo.com/63664086
Social strategies demographics

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### Social strategies and economical status

<table>
<thead>
<tr>
<th>Urban / Wealthy Areas</th>
<th>More social explorers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural / Poor Areas</td>
<td>More social keepers</td>
</tr>
</tbody>
</table>
Does social strategies give any advantage to receive information earlier?

Social keepers received information before

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Outlook

Early adopters / alpha users?

Which one is more influential?

Change of behavior?

What is their social / structural role?

$\alpha_{i} = 23, \overline{k}_i = 24$

Social explorer

Social keeper

$n_{\alpha_{i}} = 3, \overline{k}_i = 24$

Temporal/static bridges
Summary

• **There is no such a thing as static social connectivity**
  Observed connectivity is a result of
  • Social Capacity
  • Social activity
  • An thus depends on: time window, data, definition of links, etc.

• Users have different dynamical social strategies
  • **Social explorers** (activity >> capacity)
  • Social balanced (activity = capacity)
  • **Social keepers** (activity << capacity)

• Dynamical social strategies are assortative and change with age
• Best strategy to get aware of information is to be a social keeper
check your strategy at...

Soctrategy

soctrategy.org
Soctrategy.org is a beta online application to check your social strategy on Facebook.

Are you a **social explorer**? This means you are always looking for new people, new sources of information, new people to talk...

Or are you a **social keeper**? You have a closed circle around you, not only in your real life but also in Facebook.

Your **social strategy** is a mood: sometimes you need to explore the limits of your social network to get new friends, new contacts, new conversations. But our social capacity is limited [1] and we maintain a nearly constant number of conversations. Soctrategy shows the evolution of your strategy and tells you when you are a **keeper** or an **explorer**.
“Attention is the rarest and purest form of generosity.”

Simone Weil
- How two people communicate
  - Detect link decay

- How people allocate their time across their social relationships
  - Find your “best” friends

- How people manage their sociability? Social strategies?
  - Detect social behaviors