COMPUTING TIE STRENGTH

Eric Gilbert, Georgia Tech
http://comp.social.gatech.edu & @eegilbert
I study and build social media.
What's on your mind?

Amanda Jo Layton Creep commented on Diana Colbert's photo.
4 hours ago

Matthew Yapchaian Enjoying Karrie's talk, still time to join! http://cyber.law.harvard.edu/interactive/webcast @eegilbert
4 hours ago · Comment · Like

Nancy Baym Thanks so many of you for that flood of birthday greetings!
9 hours ago via Facebook for iPhone · Comment · Like

Laura Smith AAAUGH! Knew I was forgetting something yesterday... Happy (belated) Birthday, Nancy! Hope it was fabulous. xxoo
4 hours ago

Steve Lawson I'd have bought you a massive present, but now that I'm only earning 5 mil a year, I'm just too poor to consider it... ;)
4 hours ago

Write a comment...

Natalie Ljubicic Faster Kill Pussycat
8 hours ago via Facebook for BlackBerry · Comment · Like

View all 4 comments

Jordan Kane Lol. You gotta pet the kitty. Not stroke the kitty.
6 hours ago

Jordan Kane Nice kitty. Nice kitty. Lmao
6 hours ago

Write a comment...
Computationally, we don’t understand the **RELATIONSHIPS** expressed in social media.
BACKGROUND: TIE STRENGTH

*concept*

**STRONG TIES** are the people you really trust.

**WEAK TIES**, conversely, are merely acquaintances.
TIE STRENGTH
concept & impact

7,000+ papers cite TSOWT
firms with right mix of ties get better deals
strong ties can affect mental health
This talk shows how to **RECONSTRUCT** tie strength from digital traces, and how we can **UNDERSTAND** using it.
HEURISTICS

a sample of substitutes

communication reciprocity  Friedkin 1980; Romero & Huberman 2009

one mutual friend  Shi, Adamic & Strauss 2007

communication recency  Lin, Dayton & Greenwald 1978

interaction frequency  Gilbert, Karahalios & Sandvig 2008; Fischer 2006
PARTICIPANT INTERFACE

![Facebook Participant Interface](image-url)

**John Doe**

- **How strong is your relationship with this person?**
  - barely know them
  - we are very close

- **How would you feel asking this friend to loan you $100 or more?**
  - would never ask
  - very comfortable

- **How helpful would this person be if you were looking for a job?**
  - no help at all
  - very helpful

- **How upset would you be if this person unfriended you?**
  - not upset at all
  - very upset

- **If you left Facebook for another social site, how important would it be to bring this friend along?**
  - would not matter
  - must bring them!
PREDICTIVE VARIABLES

intimacy

participant’s friends  729
friend’s friends  2,050
days since last comm.  1,115
wall intimacy words  148
inbox intimacy words  137
together in photo  73
miles between hometowns  8,182 mi
PREDICTIVE VARIABLES

structural

mutual friends

12

groups in common

tf-idf of interests & about

73

emotional support

positive emotion words

197

negative emotion words

51
\[ s_i = \alpha + \beta R_i + \gamma D_i + N(i) + \epsilon_i \]

\[ N(i) = \lambda_0 \mu_M + \lambda_1 med_M + \sum_{k=2}^{4} \sum_{s \in M} \lambda_k (s - \mu_M)^k \]

\[ + \lambda_5 min_M + \lambda_6 max_M \]

\[ M = \{s_j : j \text{ and } i \text{ are mutual friends}\} \]
## MOST PREDICTIVE

*by $|\beta|$*

<table>
<thead>
<tr>
<th>Feature</th>
<th>$\beta$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days since last communication</td>
<td>-0.762</td>
</tr>
<tr>
<td>Days since first communication</td>
<td>0.755</td>
</tr>
<tr>
<td>Intimacy $\times$ Structural</td>
<td>0.4</td>
</tr>
<tr>
<td>Wall words exchanged</td>
<td>0.299</td>
</tr>
<tr>
<td>Mean strength of mutual friends</td>
<td>0.257</td>
</tr>
<tr>
<td>Educational difference</td>
<td>-0.223</td>
</tr>
<tr>
<td>Structural $\times$ Structural</td>
<td>0.195</td>
</tr>
<tr>
<td>Reciprocal Serv. $\times$ Reciprocal Serv.</td>
<td>-0.19</td>
</tr>
<tr>
<td>Participant-initiated wall posts</td>
<td>0.146</td>
</tr>
<tr>
<td>Inbox thread depth</td>
<td>-0.137</td>
</tr>
<tr>
<td>Participant’s number of friends</td>
<td>-0.136</td>
</tr>
<tr>
<td>Inbox positive emotion words</td>
<td>0.135</td>
</tr>
<tr>
<td>Social Distance $\times$ Structural</td>
<td>0.13</td>
</tr>
<tr>
<td>Participant’s number of apps</td>
<td>-0.122</td>
</tr>
<tr>
<td>Wall intimacy words</td>
<td>0.111</td>
</tr>
</tbody>
</table>
### MOST PREDICTIVE

*by |beta|

<table>
<thead>
<tr>
<th>Feature</th>
<th>Beta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days since last communication</td>
<td>-0.762</td>
</tr>
<tr>
<td>Days since first communication</td>
<td>0.755</td>
</tr>
<tr>
<td>Intimacy × Structural</td>
<td>0.4</td>
</tr>
<tr>
<td>Wall words exchanged</td>
<td>0.299</td>
</tr>
<tr>
<td>Mean strength of mutual friends</td>
<td>0.257</td>
</tr>
<tr>
<td>Educational difference</td>
<td>-0.223</td>
</tr>
<tr>
<td>Structural × Structural</td>
<td>0.195</td>
</tr>
<tr>
<td>Reciprocal Serv. × Reciprocal Serv.</td>
<td>-0.19</td>
</tr>
<tr>
<td>Participant-initiated wall posts</td>
<td>0.146</td>
</tr>
<tr>
<td>Inbox thread depth</td>
<td>-0.137</td>
</tr>
<tr>
<td>Participant’s number of friends</td>
<td>-0.136</td>
</tr>
<tr>
<td>Inbox positive emotion words</td>
<td>0.135</td>
</tr>
<tr>
<td>Social Distance × Structural</td>
<td>0.13</td>
</tr>
<tr>
<td>Participant’s number of apps</td>
<td>-0.122</td>
</tr>
<tr>
<td>Wall intimacy words</td>
<td>0.111</td>
</tr>
</tbody>
</table>
MOST PREDICTIVE by $|\beta|$

- Days since last communication $-0.762$
- Days since first communication $0.755$
- Intimacy $\times$ Structural $0.4$
- Wall words exchanged $0.299$
- Mean strength of mutual friends $0.257$
- Educational difference $-0.223$
- Structural $\times$ Structural $0.195$
- Reciprocal Serv. $\times$ Reciprocal Serv. $-0.19$
- Participant-initiated wall posts $0.146$
- Inbox thread depth $-0.137$
- Participant’s number of friends $-0.136$
- Inbox positive emotion words $0.135$
- Social Distance $\times$ Structural $0.13$
- Participant’s number of apps $-0.122$
- Wall intimacy words $0.111$
### MOST PREDICTIVE

by $|\beta|$

| Feature                                           | $|\beta|$ |
|----------------------------------------------------|---------|
| Days since last communication                      | -0.762  |
| Days since first communication                     | 0.755   |
| Intimacy $\times$ Structural                       | 0.4     |
| Wall words exchanged                               | 0.299   |
| Mean strength of mutual friends                   | 0.257   |
| Educational difference                            | -0.223  |
| Structural $\times$ Structural                     | 0.195   |
| Reciprocal Serv. $\times$ Reciprocal Serv.        | -0.19   |
| Participant-initiated wall posts                  | 0.146   |
| Inbox thread depth                                 | -0.137  |
| Participant’s number of friends                   | -0.136  |
| Inbox positive emotion words                      | 0.135   |
| Social Distance $\times$ Structural               | 0.13    |
| Participant’s number of apps                      | -0.122  |
| Wall intimacy words                               | 0.111   |
**MOST PREDICTIVE**

*by* \( |\beta| \)

| Feature                                              | \( |\beta| \)  |
|------------------------------------------------------|----------------|
| Days since last communication                       | -0.762         |
| Days since first communication                       | 0.755          |
| Intimacy × Structural                                | 0.4            |
| Wall words exchanged                                 | 0.299          |
| Mean strength of mutual friends                     | 0.257          |
| Educational difference                              | -0.223         |
| Structural × Structural                              | 0.195          |
| Reciprocal Serv. × Reciprocal Serv.                 | -0.19          |
| Participant-initiated wall posts                    | 0.146          |
| Inbox thread depth                                  | -0.137         |
| Participant’s number of friends                     | -0.136         |
| Inbox positive emotion words                        | 0.135          |
| Social Distance × Structural                         | 0.13           |
| Participant’s number of apps                        | -0.122         |
| Wall intimacy words                                 | 0.111          |
weak as strong

strong as strong

weak as weak

strong as weak

participant’s response

model's prediction

weak as strong

strong as strong

weak as weak

strong as weak
HEURISTICS
the difference

THIS MODEL  89%  Adj. $R^2 = 0.53$

MSGS $\rightarrow$ FRIEND  61%  Adj. $R^2 = 0.09$

BASELINE  52%
Ah yes. This friend is an old ex. We haven't really spoken to each other in about 6 years, but we ended up friending each other on Facebook when I first joined. But he's still important to me. We were best friends for seven years before we dated. So I rated it where I did (I was actually even thinking of rating it higher) because I am optimistically hoping we’ll recover some of our “best friend”-ness after a while. Hasn't happened yet, though.

error:
~0.5
This friend is very special. He and I attended the same high school, we interacted a lot over 3 years and we are very very close. We trust each other. My friend are I are still interacting in ways other than Facebook such as IM, emails, phones. Unfortunately, that friend and I rarely interact through Facebook so I guess your predictor doesn't have enough information to be accurate.

error:
~0.5
... building this into a Twitter tool.
I am trying out @wemeddle
11:34 AM Mar 2nd via Tweetie

mariagrineva
Maria Grineva
i didn't like wemeddle
11:40 AM Mar 2nd via web

mariagrineva
Maria Grineva
wemeddle.com is a very cool idea for making twitter lists. It was good enough to re-create the lists I made myself! Worth checking out.
listening to this talk @berkmancenter on & tie strength http://wemeddle.com -surprisingly accurate brkdwon 4me

11:05 AM Mar 2nd via web

amarashar
Amar Ashar
這是從 http://wemeddle.com/client/ 發的tweet. wemeddle真不錯, 自動把我的推友分群, 這樣就不怕重要朋友的偶爾一推的淹沒在一片汪洋裡...

about 14 hours ago via We Meddle
Retweeted by 1 person

vgod
Tsung-Hsiang Chang
this is a tweet from this link...
http://wemeddle.com/client/
wemeddle is pretty good, it automatically divides my friends into groups, so that occasional tweets from my important friends won't be buried in oceans of other tweets.

about 14 hours ago via We Meddle
Retweeted by 1 person

vgod
Tsung-Hsiang Chang
http://wemeddle.com/client/ 这个东西太神奇了，我很想知道工作原理，它甚至把我从未发过推的GF的帐号也算入Inner Circle，而把一些我不是特别关心的算到outer circle里。而且按照它的四种分类准确率我可以认为是100%。太神奇了
http://wemeddle.com/client/
This thing is miraculous, I want to know how it works very much. It even classifies my GF's account into Inner Circle, but I never send tweets to her account, and it also classifies accounts that I don't care about into outer circle. The 4 categories are very accurate, almost 100%. It is miraculous.
INFLUENCE THROUGH WEIGHTED NETWORKS
from Onnela, et al.
TIE STRENGTH AFFECTS INFLUENCE
TIE STRENGTH AFFECTS INFLUENCE

reference distribution

retweets with multimedia links

tie strength

0.0 0.2 0.4 0.6 0.8 1.0
\[ P(RT \mid ts \leq t) \]
What’s next?
COMPUTING TIE STRENGTH

Eric Gilbert / Georgia Tech / @eegilbert