

Virality Prediction and Community Structure in Social Networks

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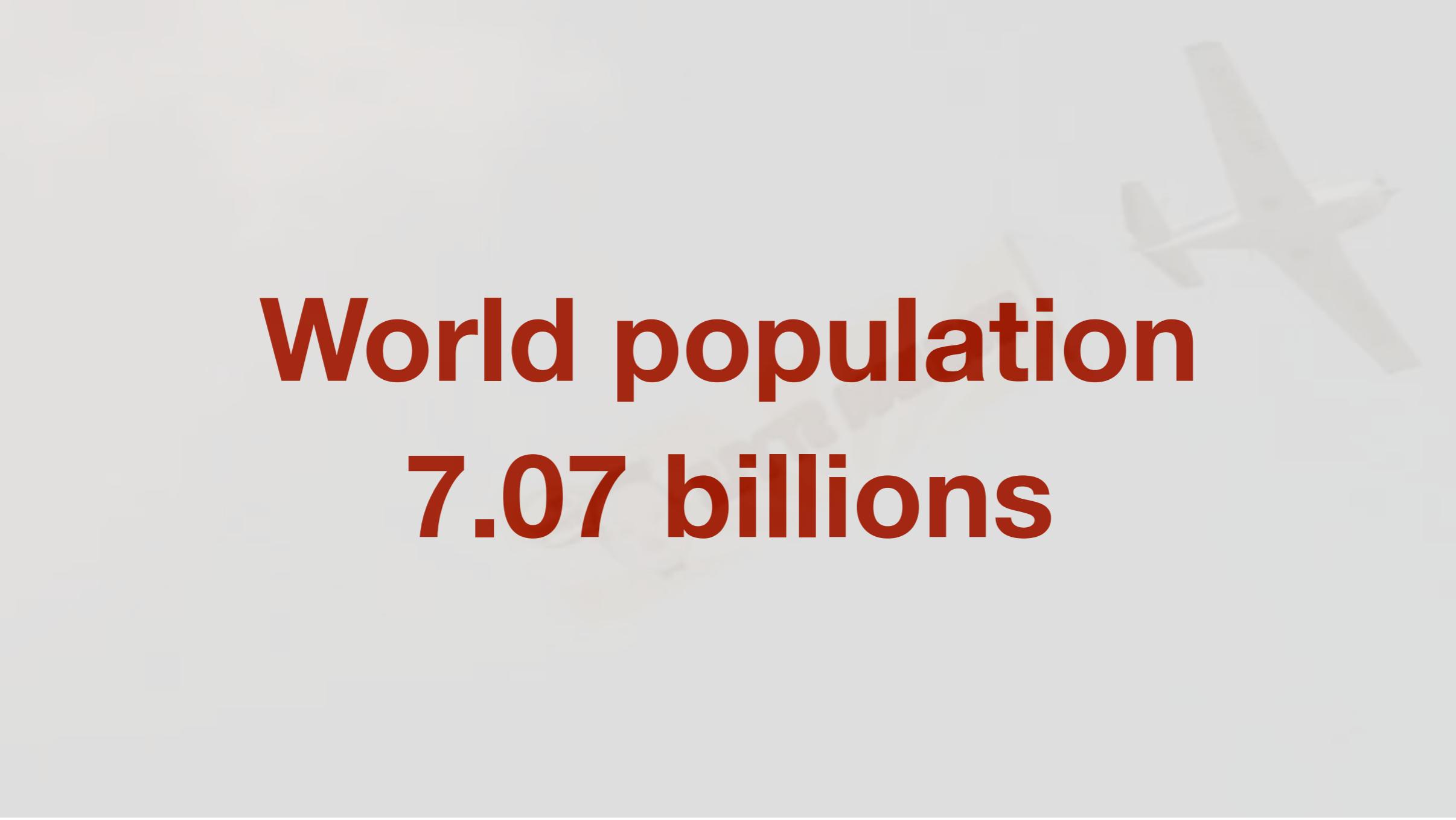
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**World population
7.07 billions**

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4 months
2.4k FB likes
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As a PhD student:



MAKE GIFS AT GIFSOU.P.COM

As a post doc:



As a professor:



**Corporations
Government
Political Campaigns**

THE ATTENTION ECONOMY

Understanding the *New Currency of Business*



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JOHN C. BECK

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THE ATTENTION ECONOMY

Understanding the *New Currency of Business*



Virality  Attention

THOMAS H. DAVENPORT
JOHN C. BECK

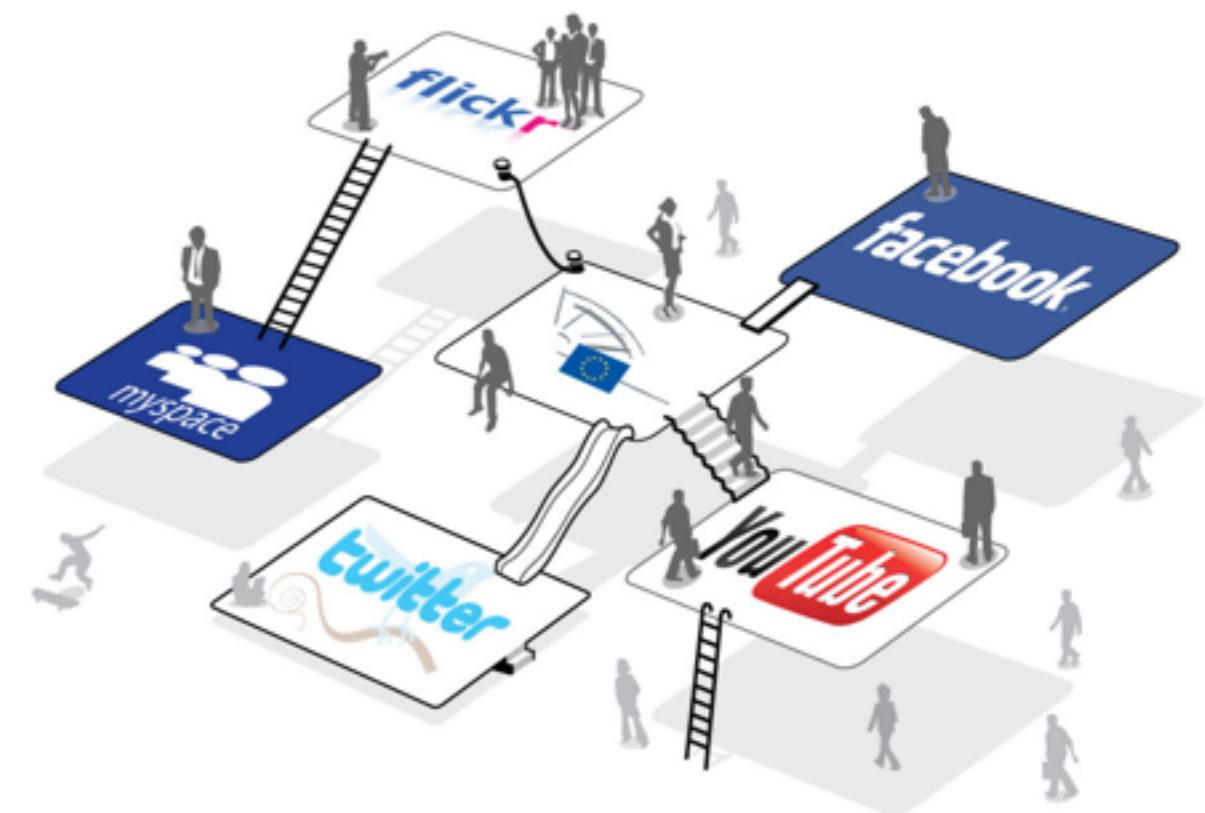
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Viral information
spread through
social networks

Epidemic Spreading: Germs and viruses spread through the “social” network



Ideas and behaviors also spread



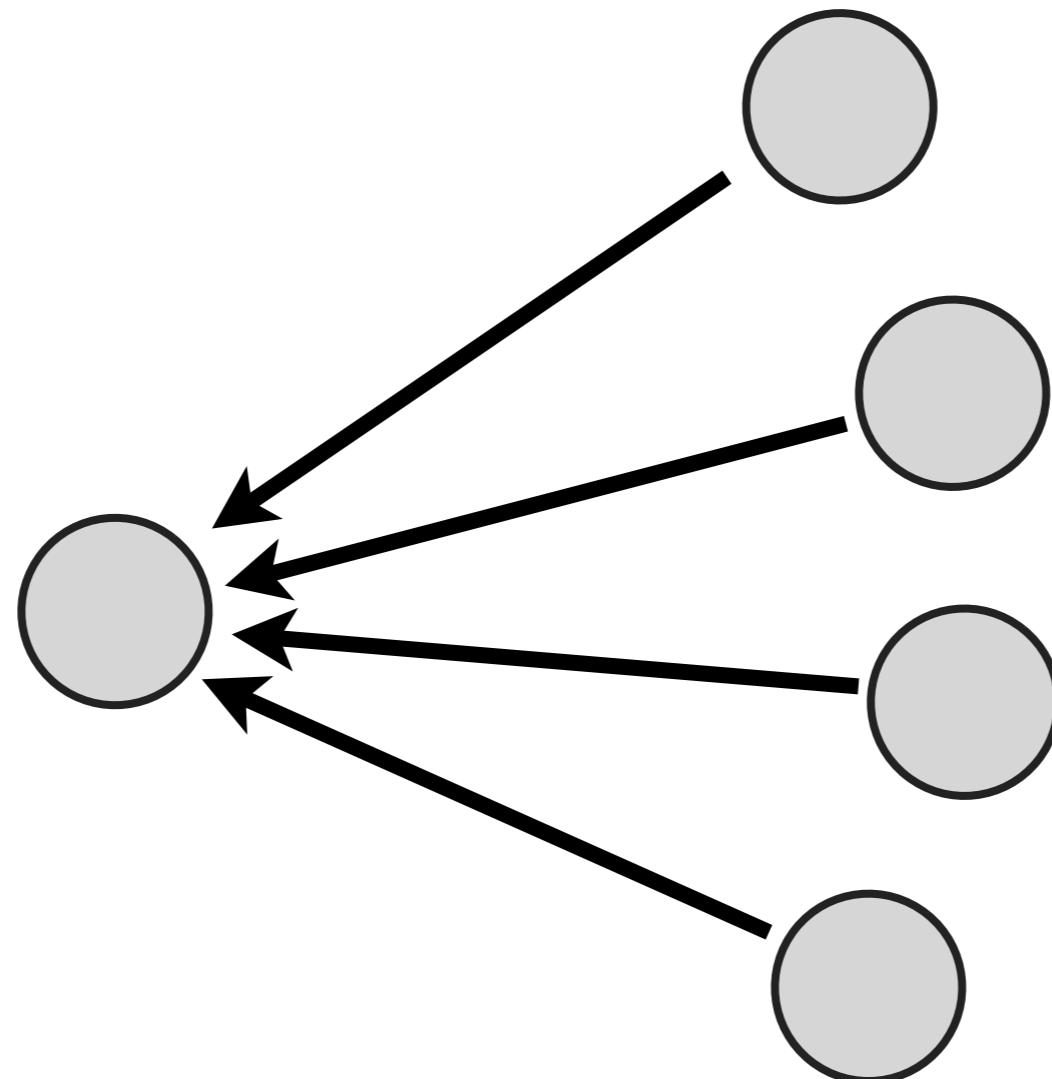
Are they same?

Aha!

They are Different

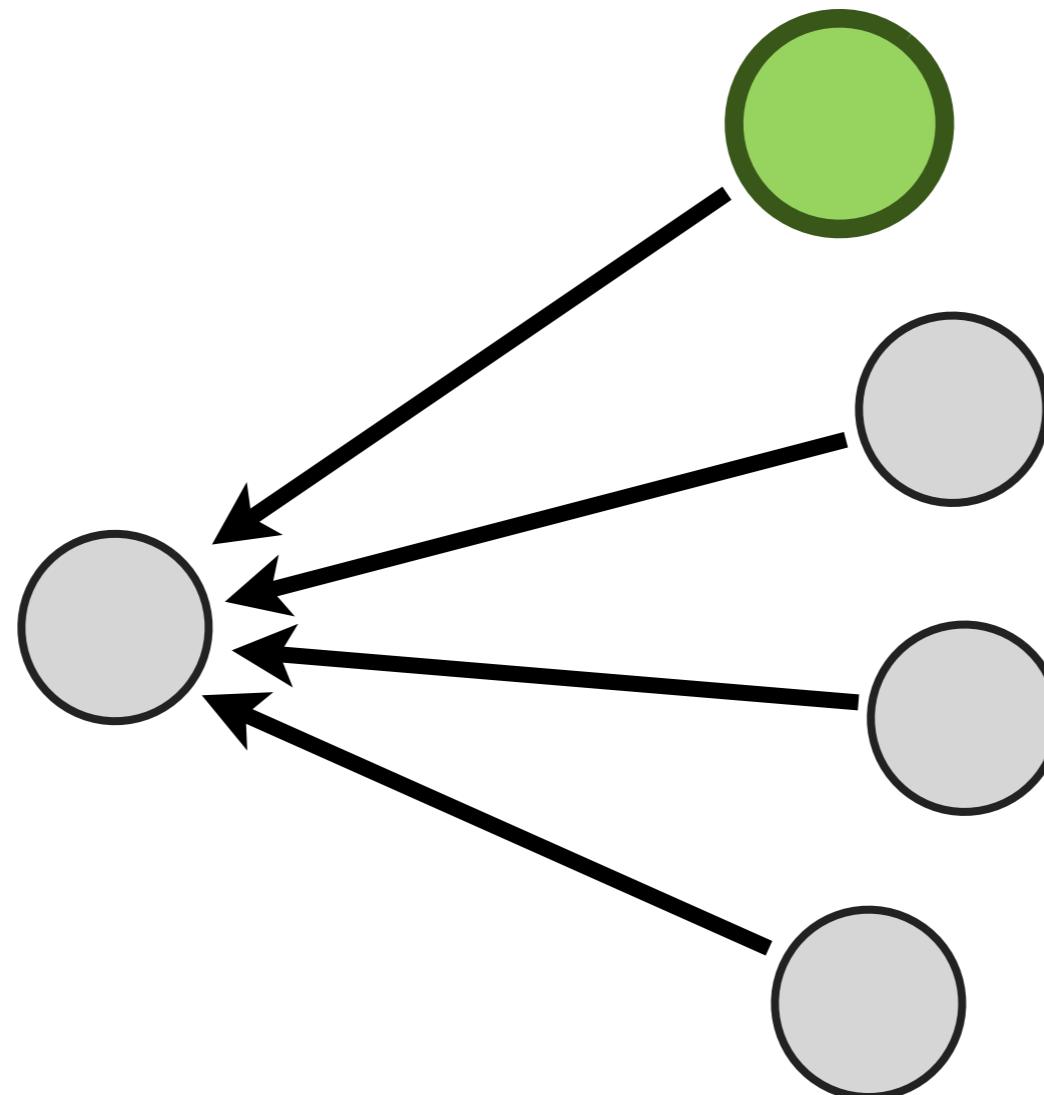
Social Reinforcement

Multiple exposures



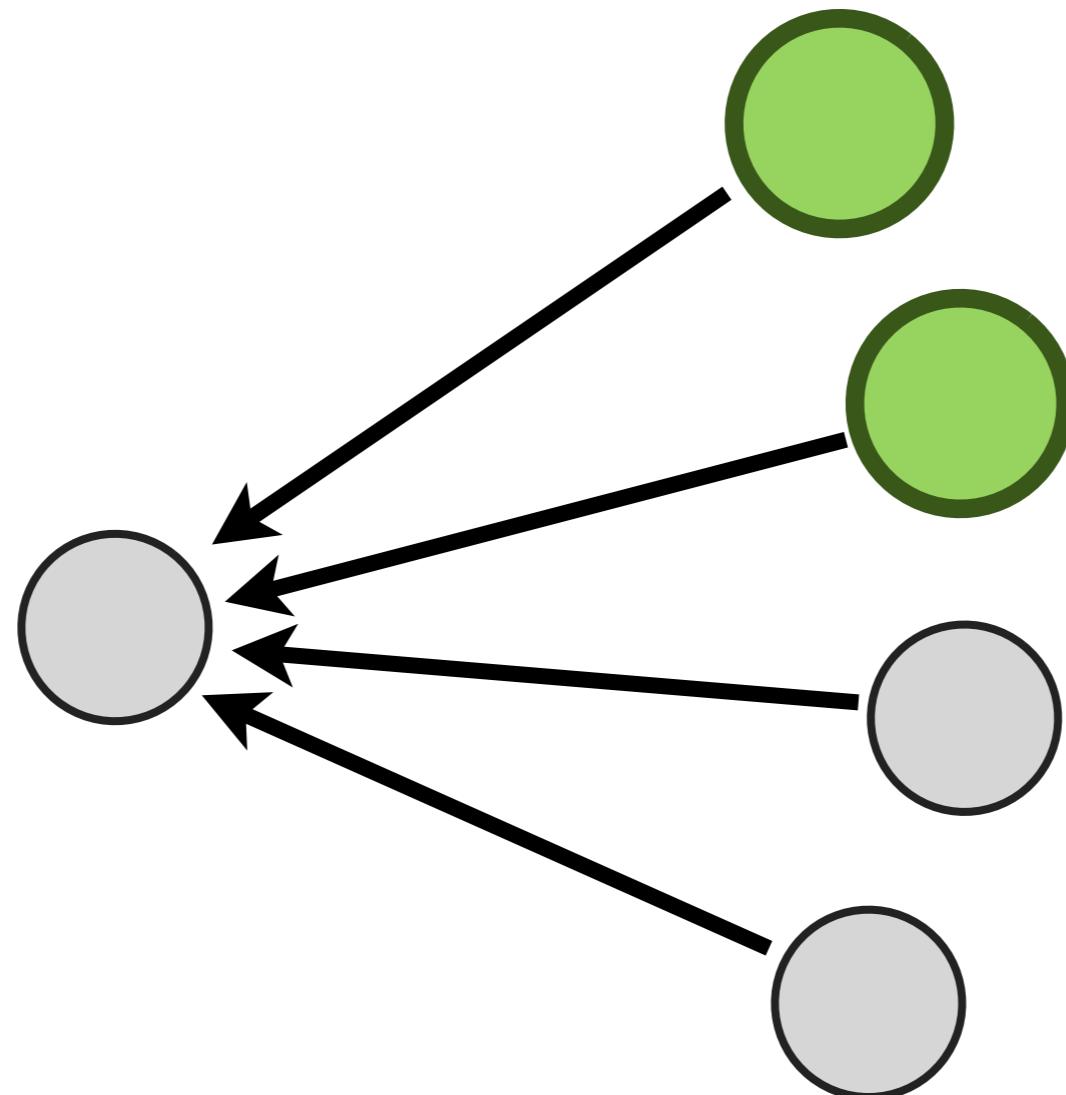
Social Reinforcement

Multiple exposures



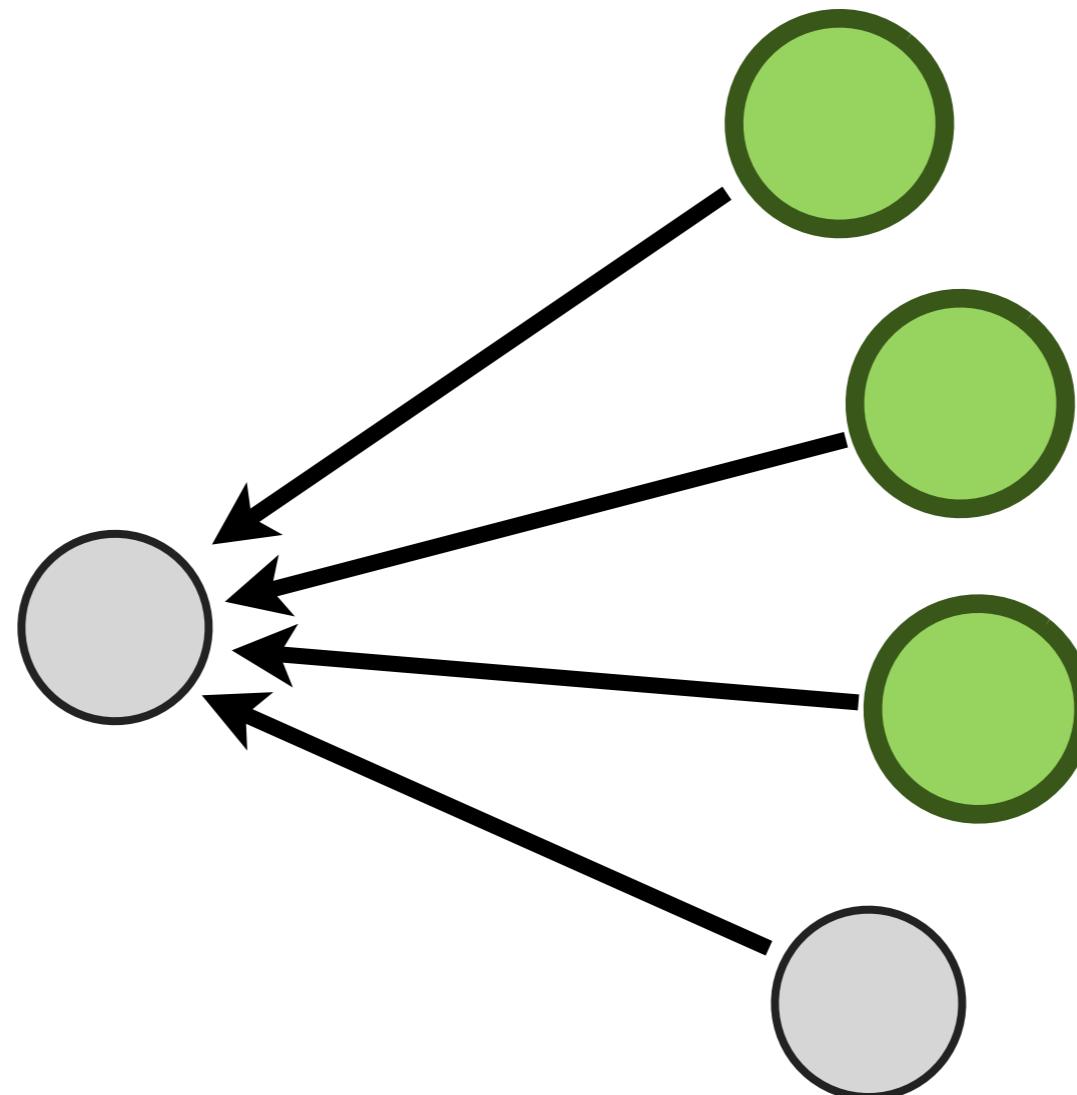
Social Reinforcement

Multiple exposures



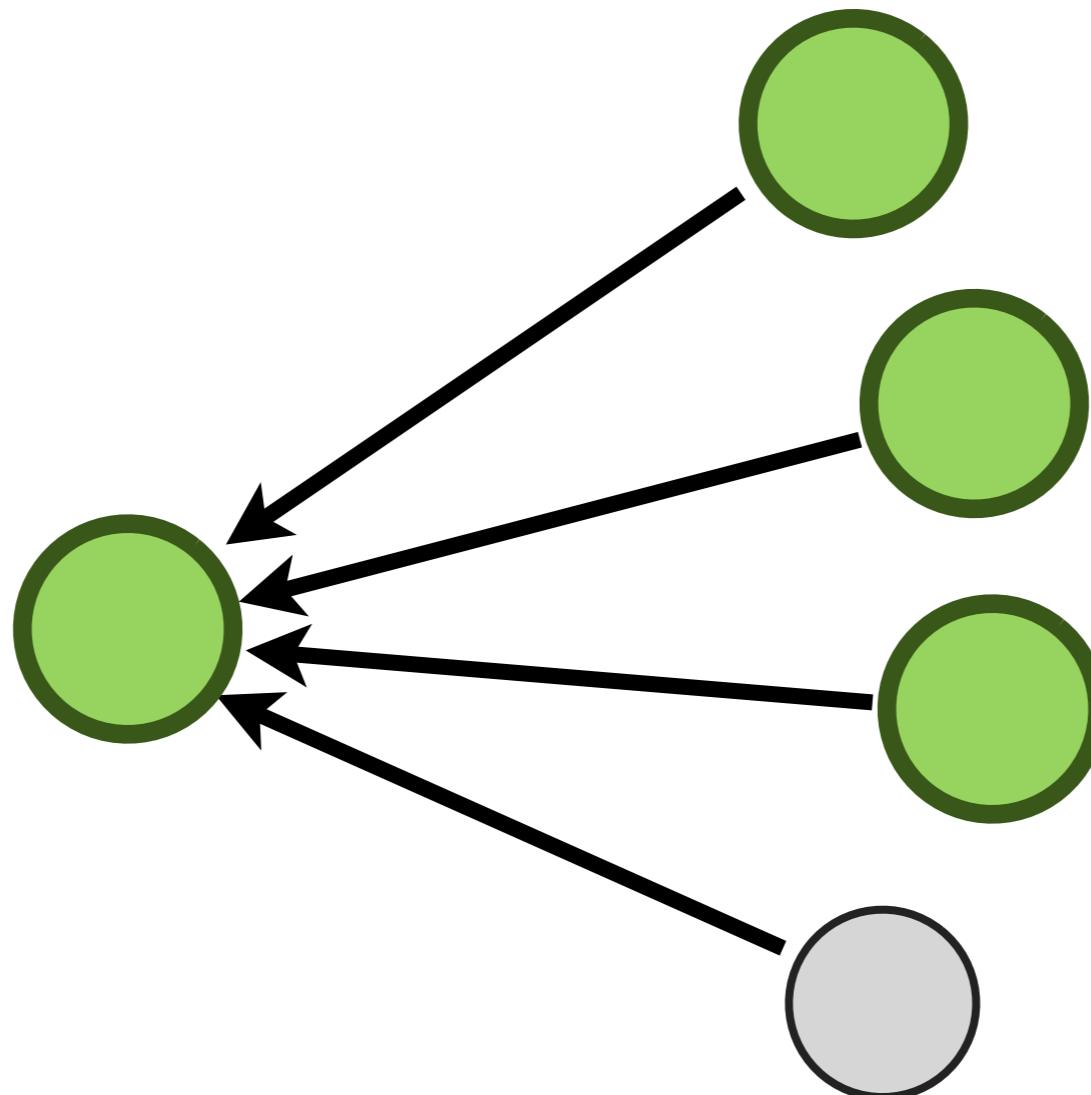
Social Reinforcement

Multiple exposures

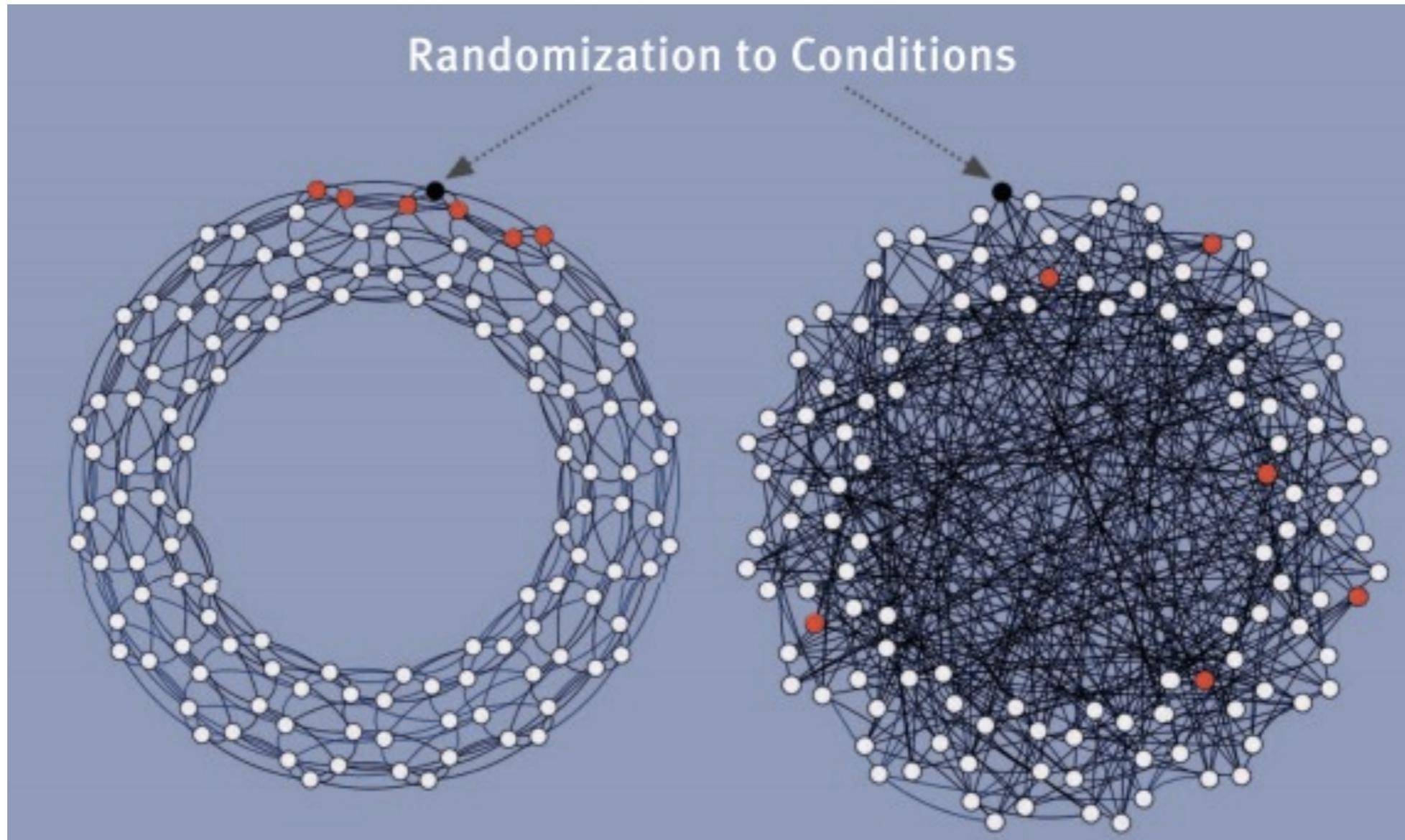


Social Reinforcement

Multiple exposures



Which network is better at spreading information quickly?

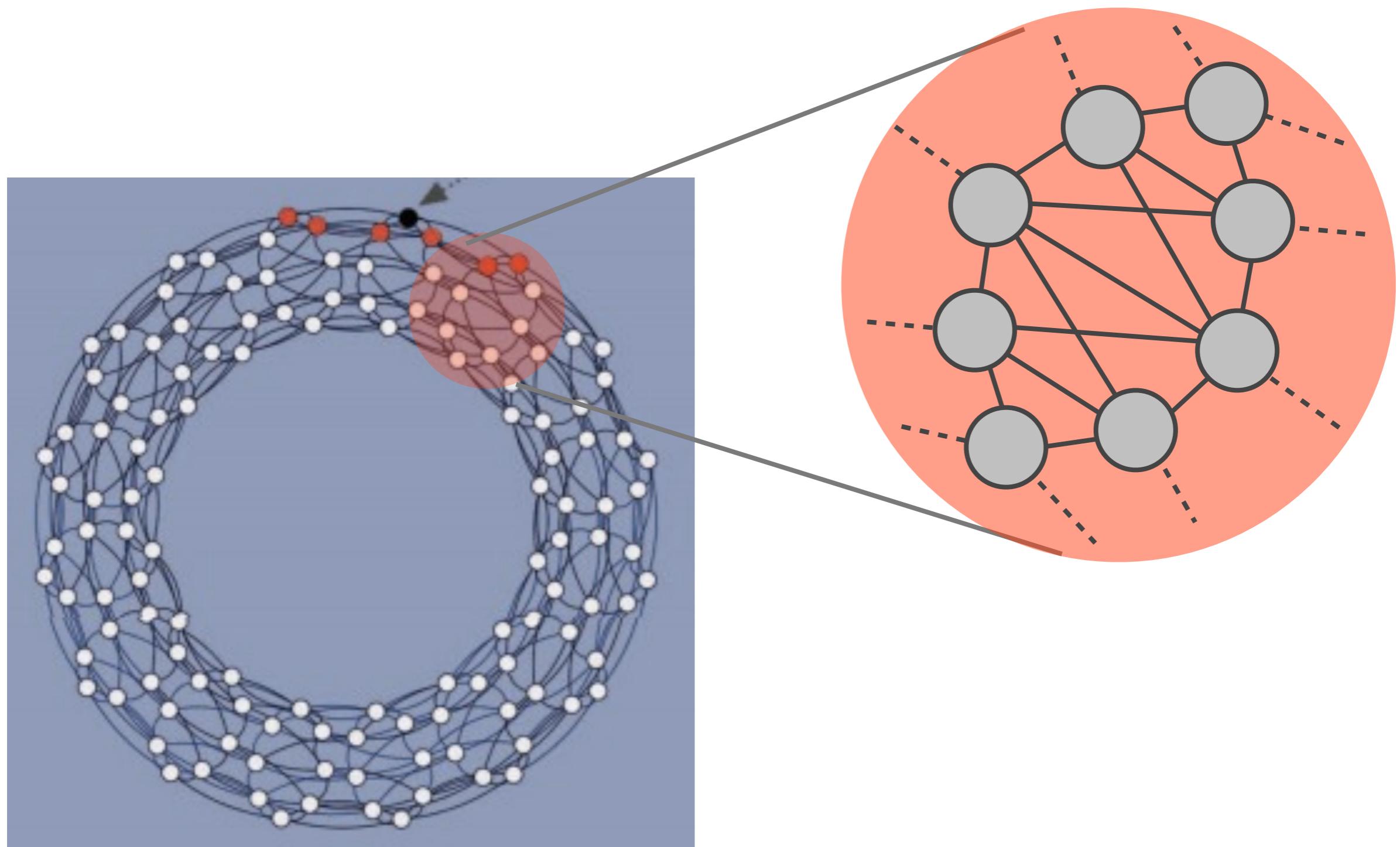


“Large” world

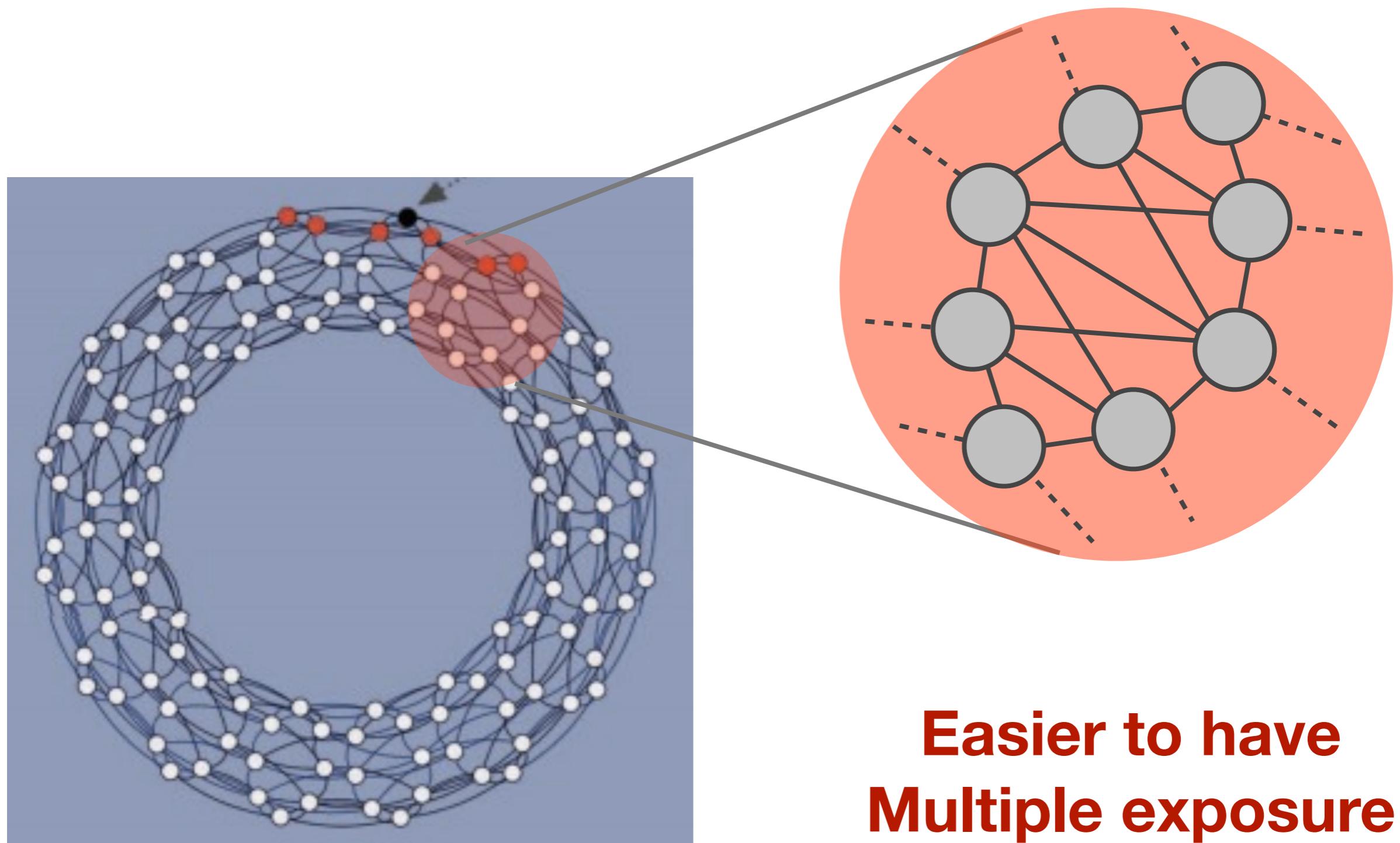
“Small” world

D. Centola, *Science* 2010

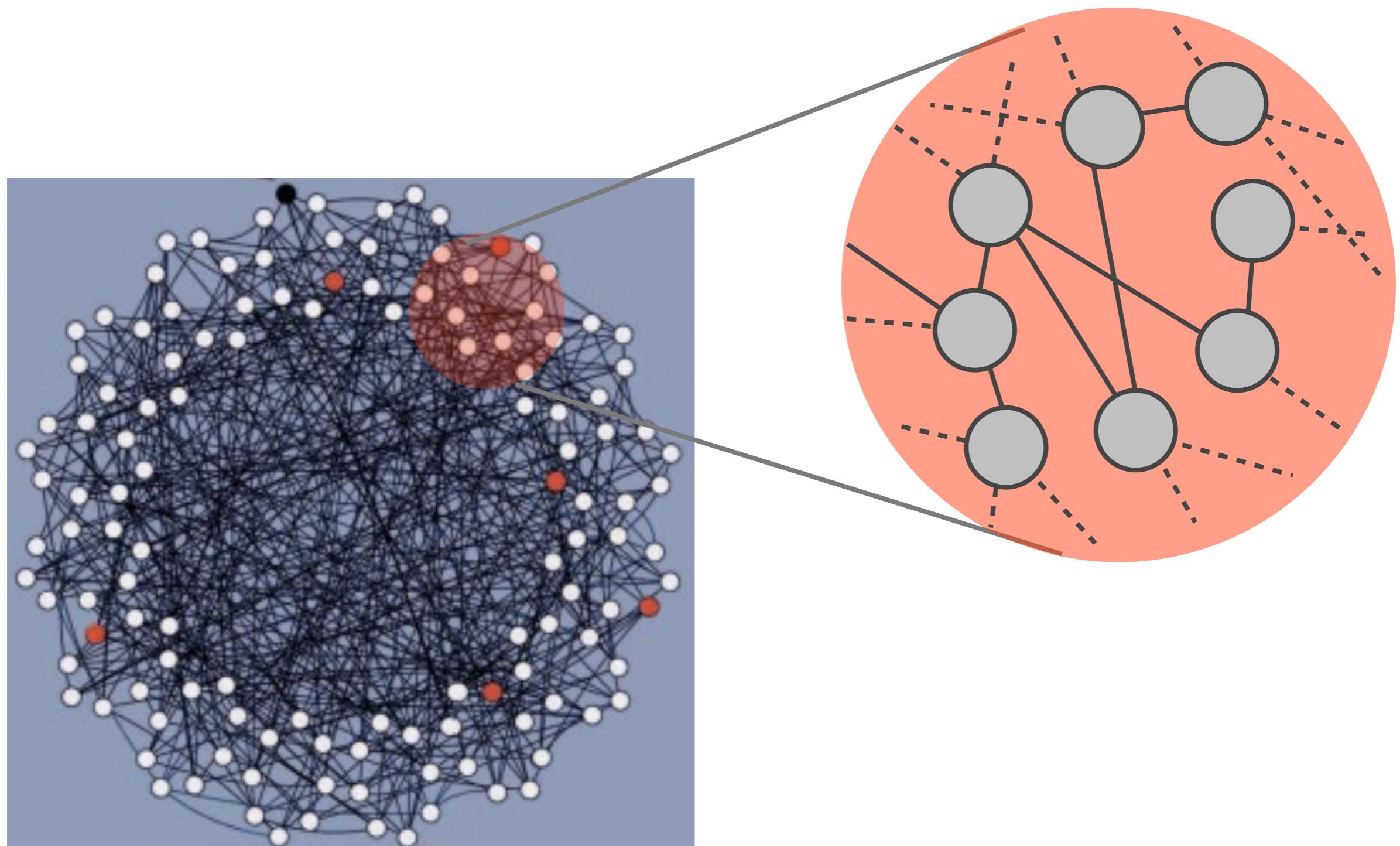
Information spread more quickly on “large” world network



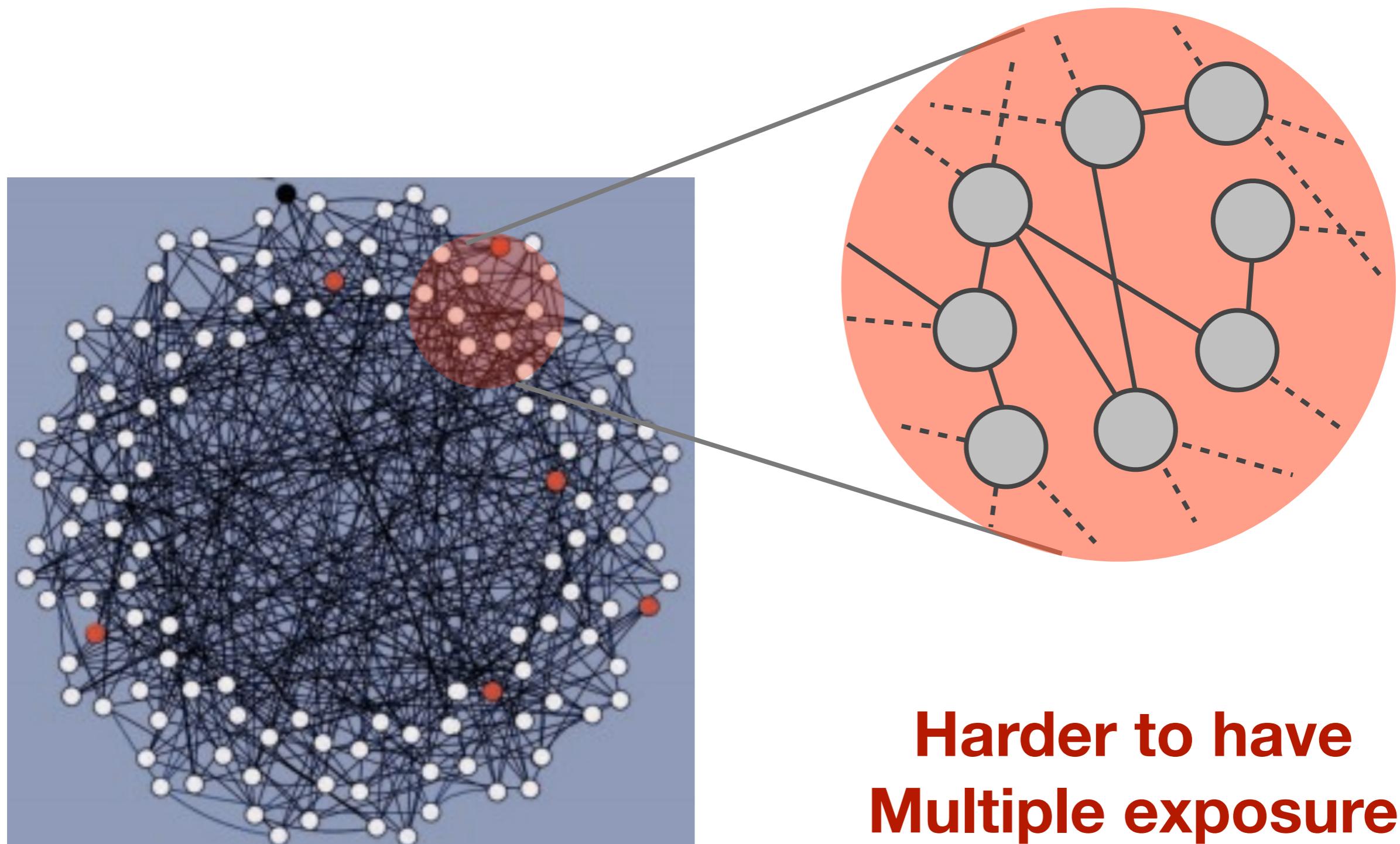
Information spread more quickly on “large” world network



Information spread more quickly on “large” world network



Information spread more quickly on “large” world network



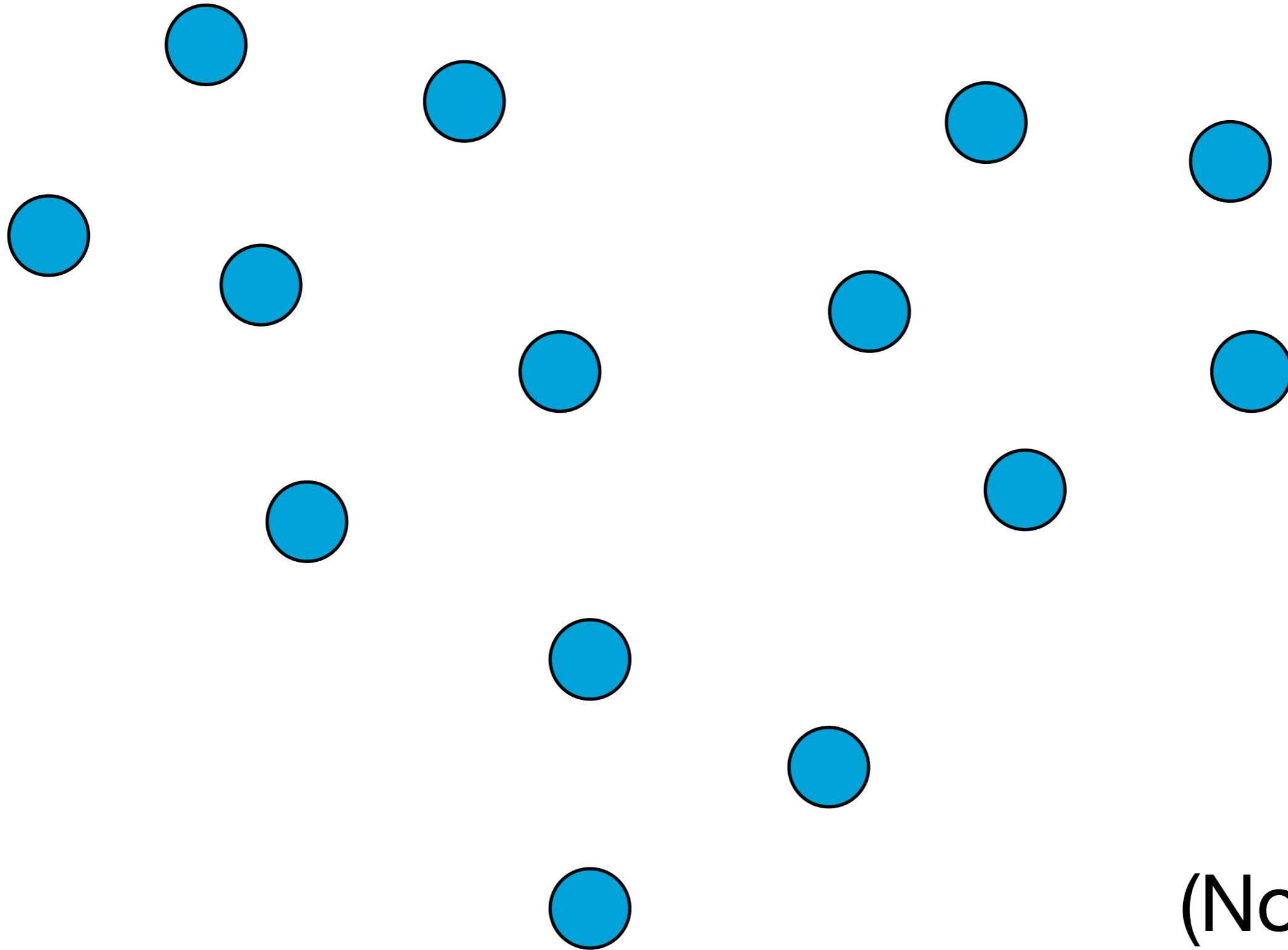
Epidemic Spreading:
Germs spread through the
“social” network

Simple Contagions

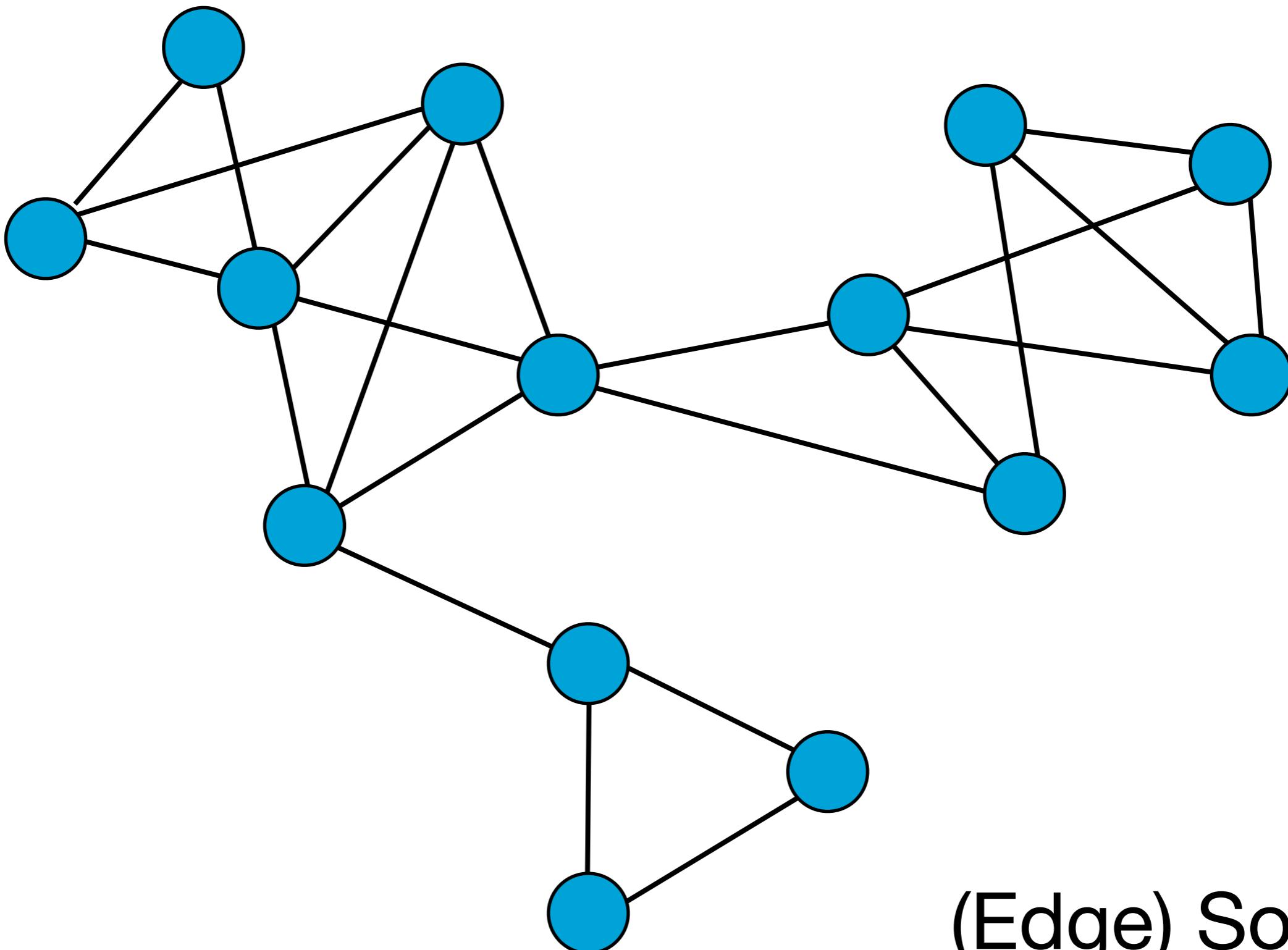
Ideas and behaviors
also spread

Complex Contagions

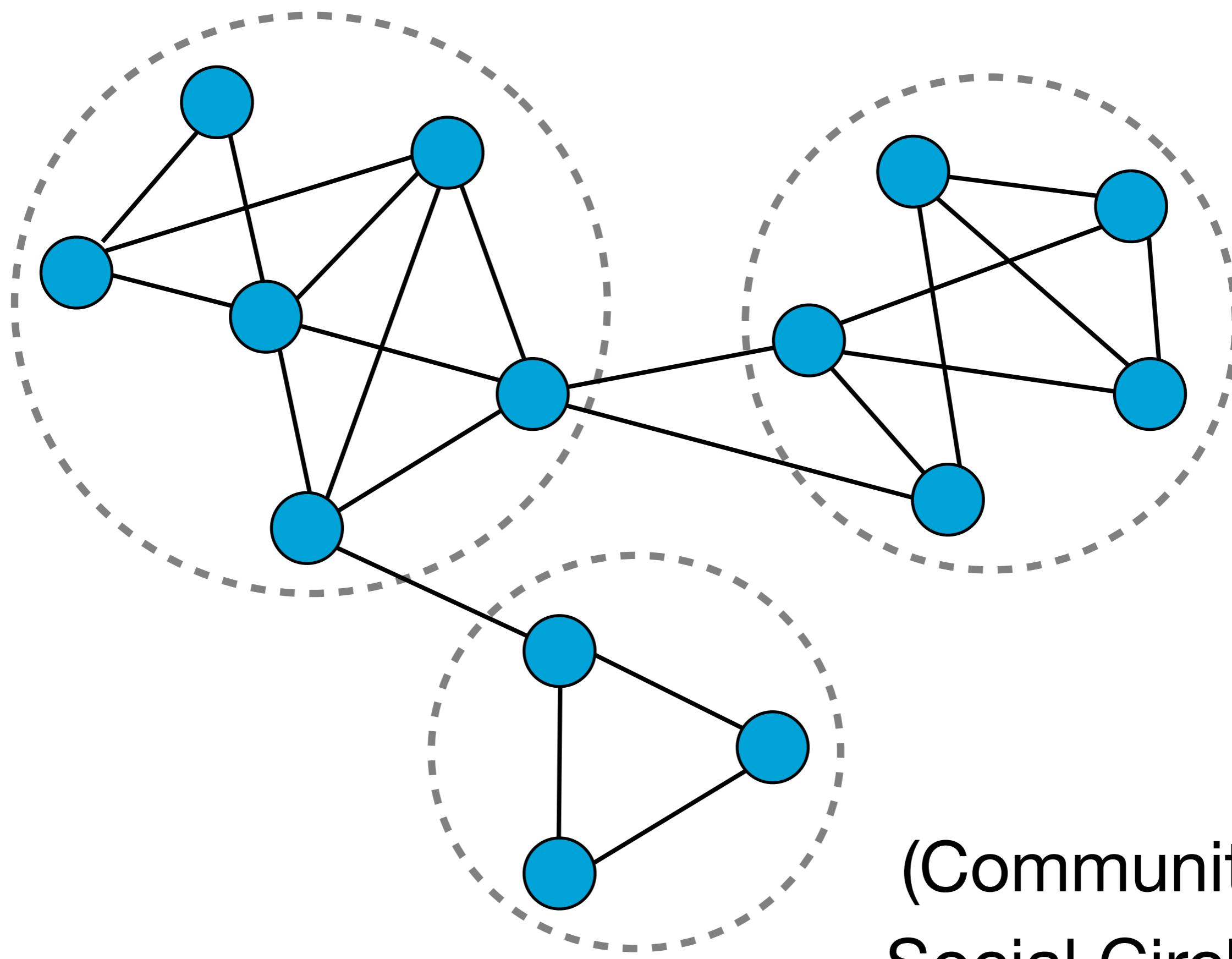
D. Centola and M. Macy. Complex Contagions and the Weakness of Long Ties. AJS, 2007.



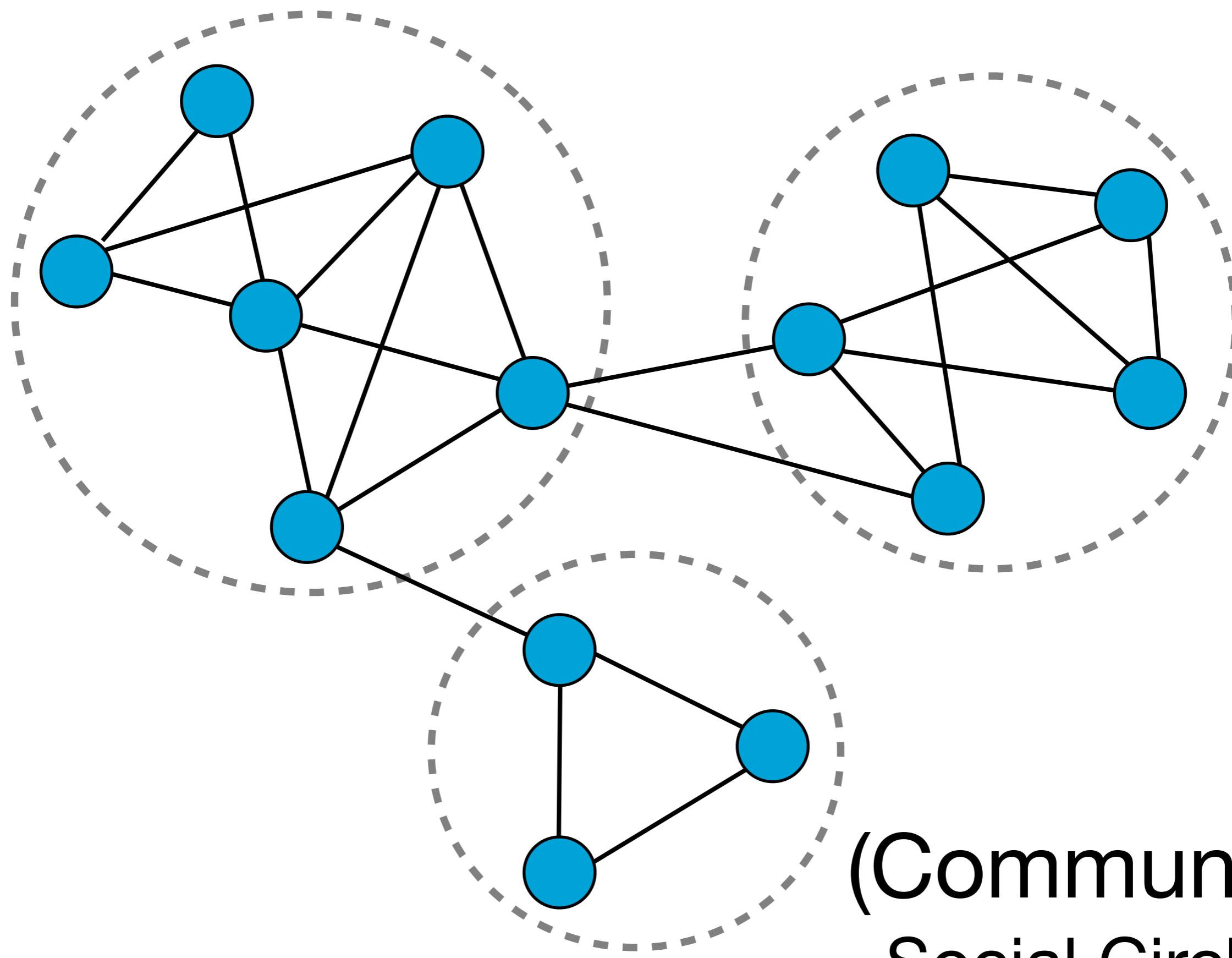
(Node)
Users



(Edge) Social
Relationship

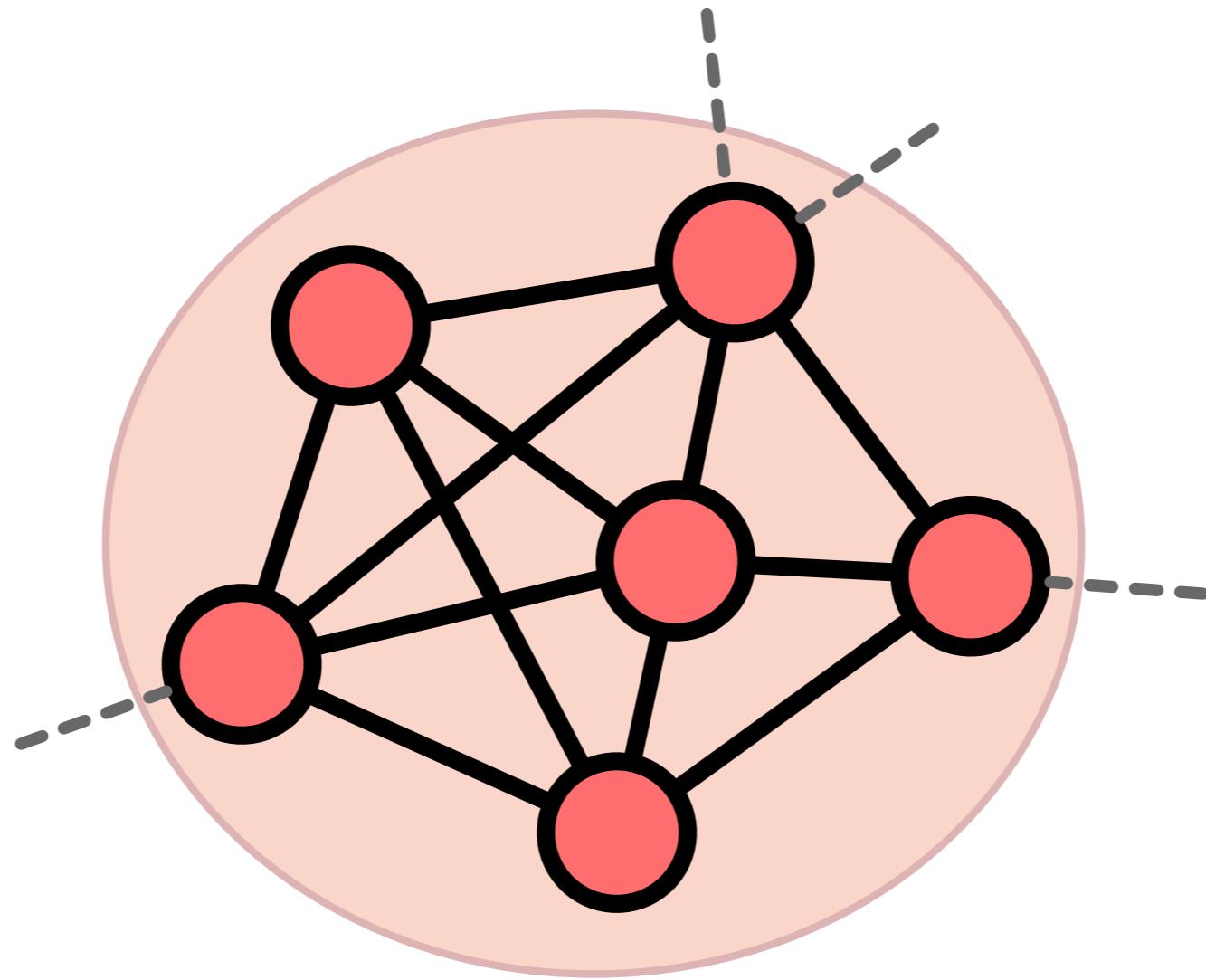


(Community)
Social Circles

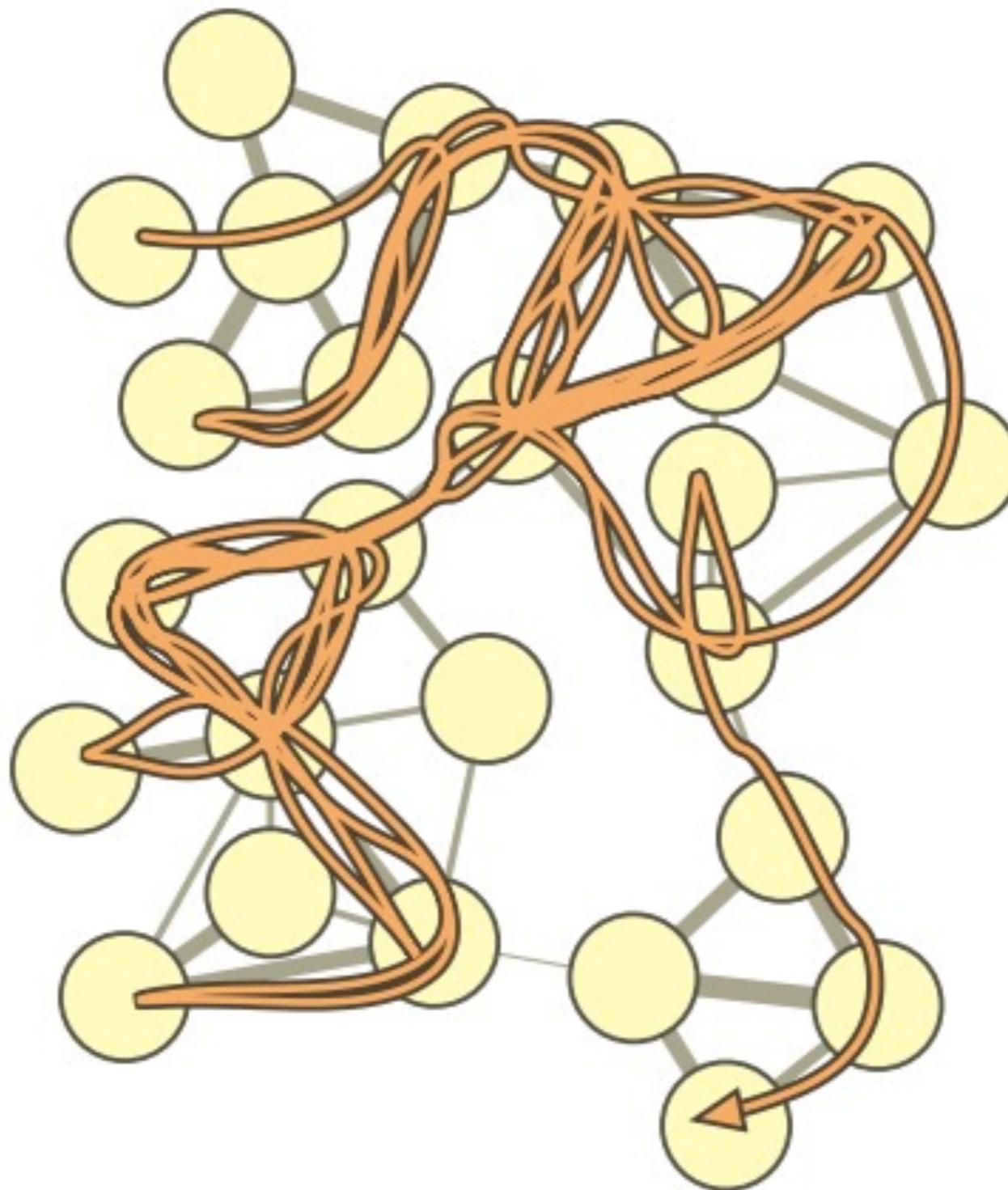


(Community)
Social Circles

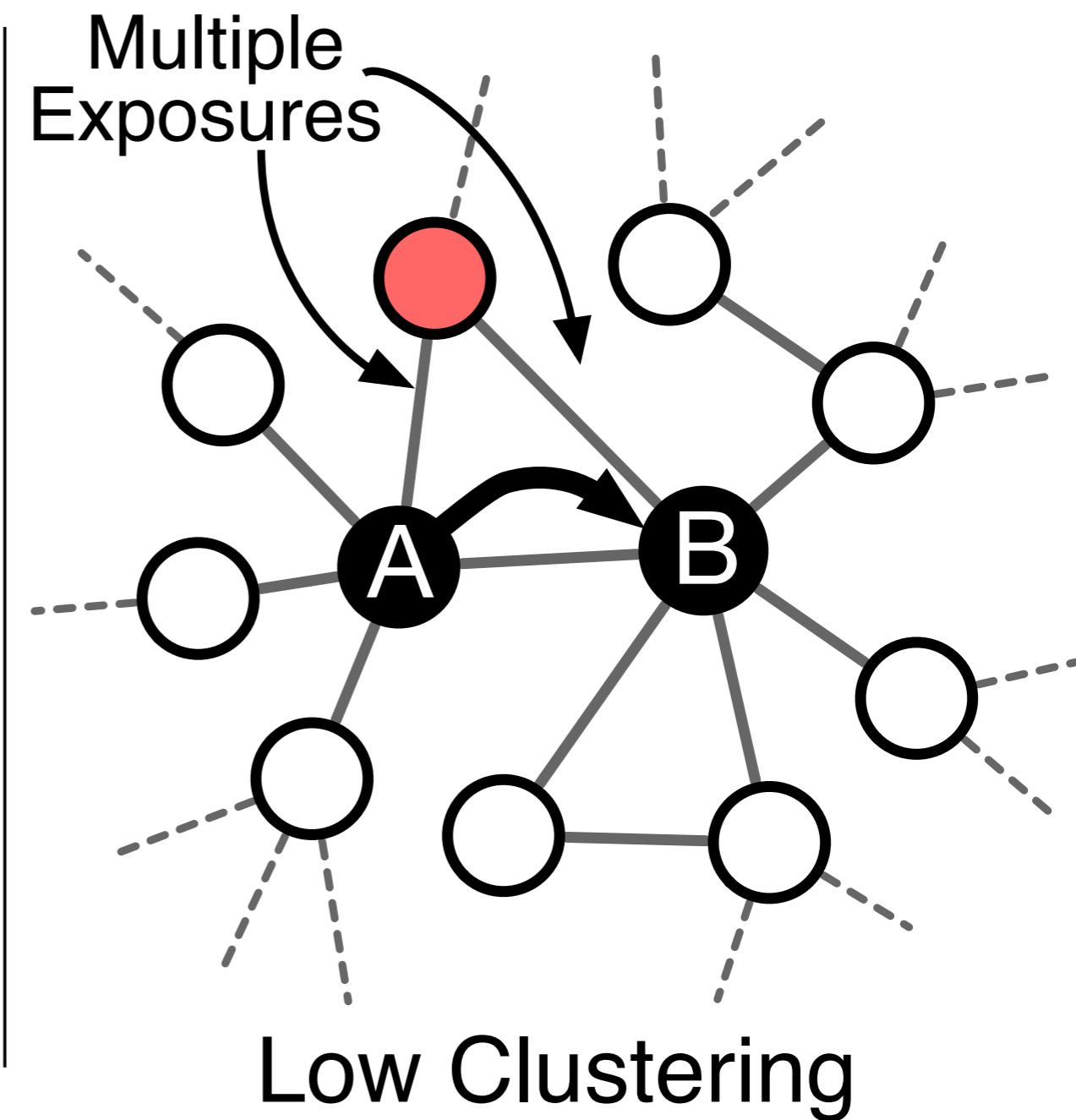
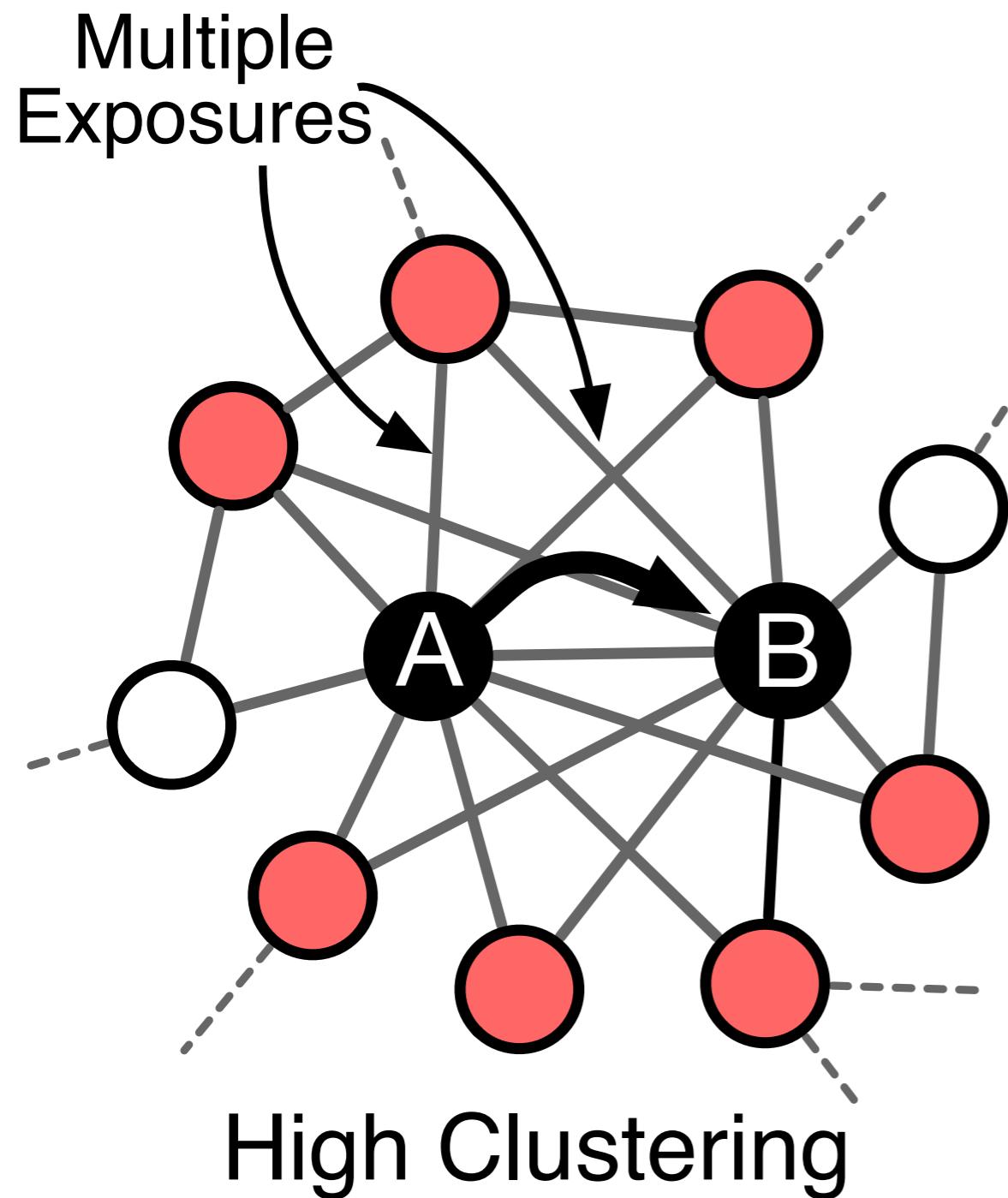
**How do communities
affect information
diffusion?**



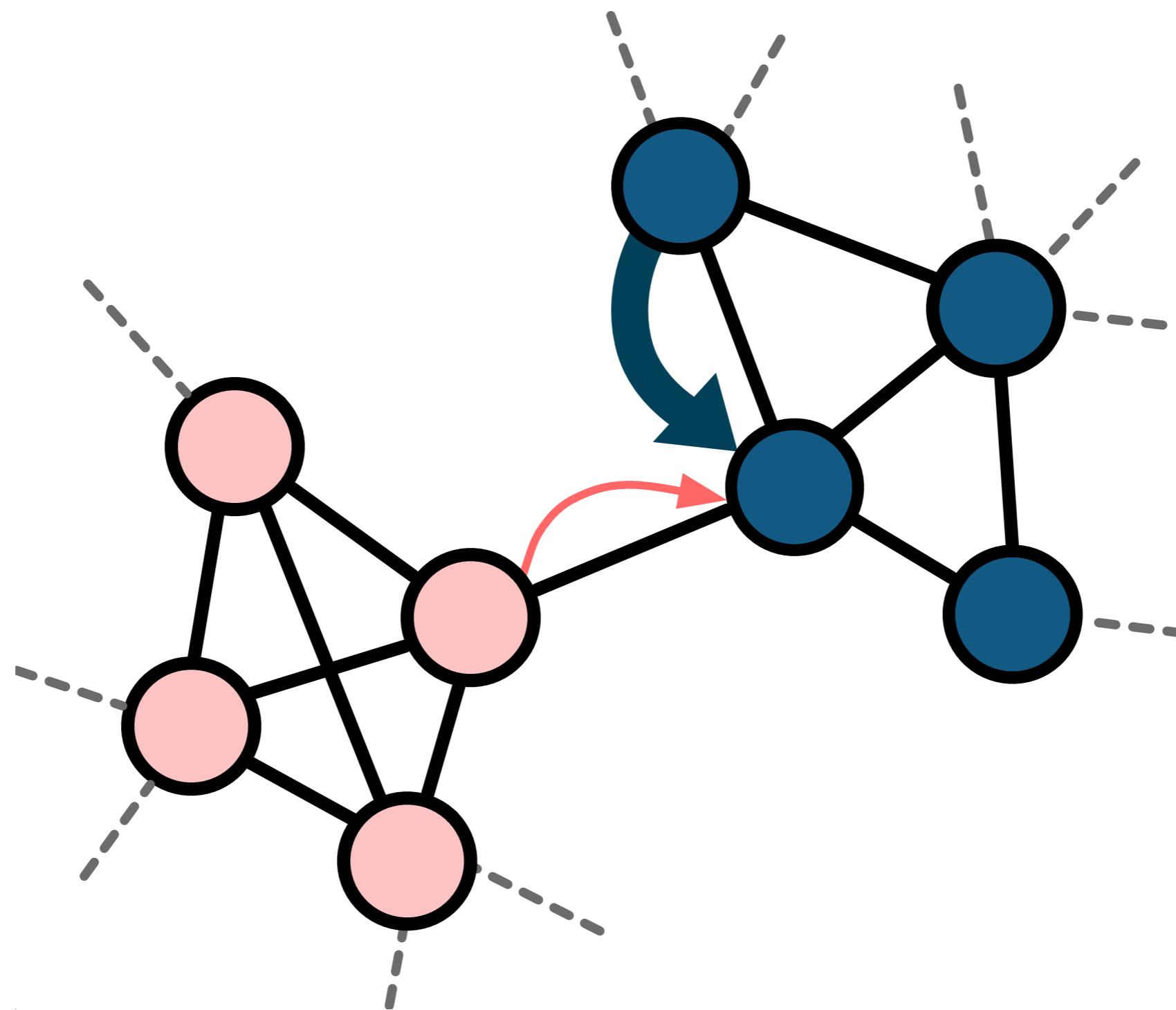
Structural Trapping



Traps for random walkers

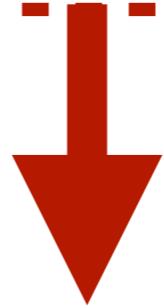


Social Reinforcement



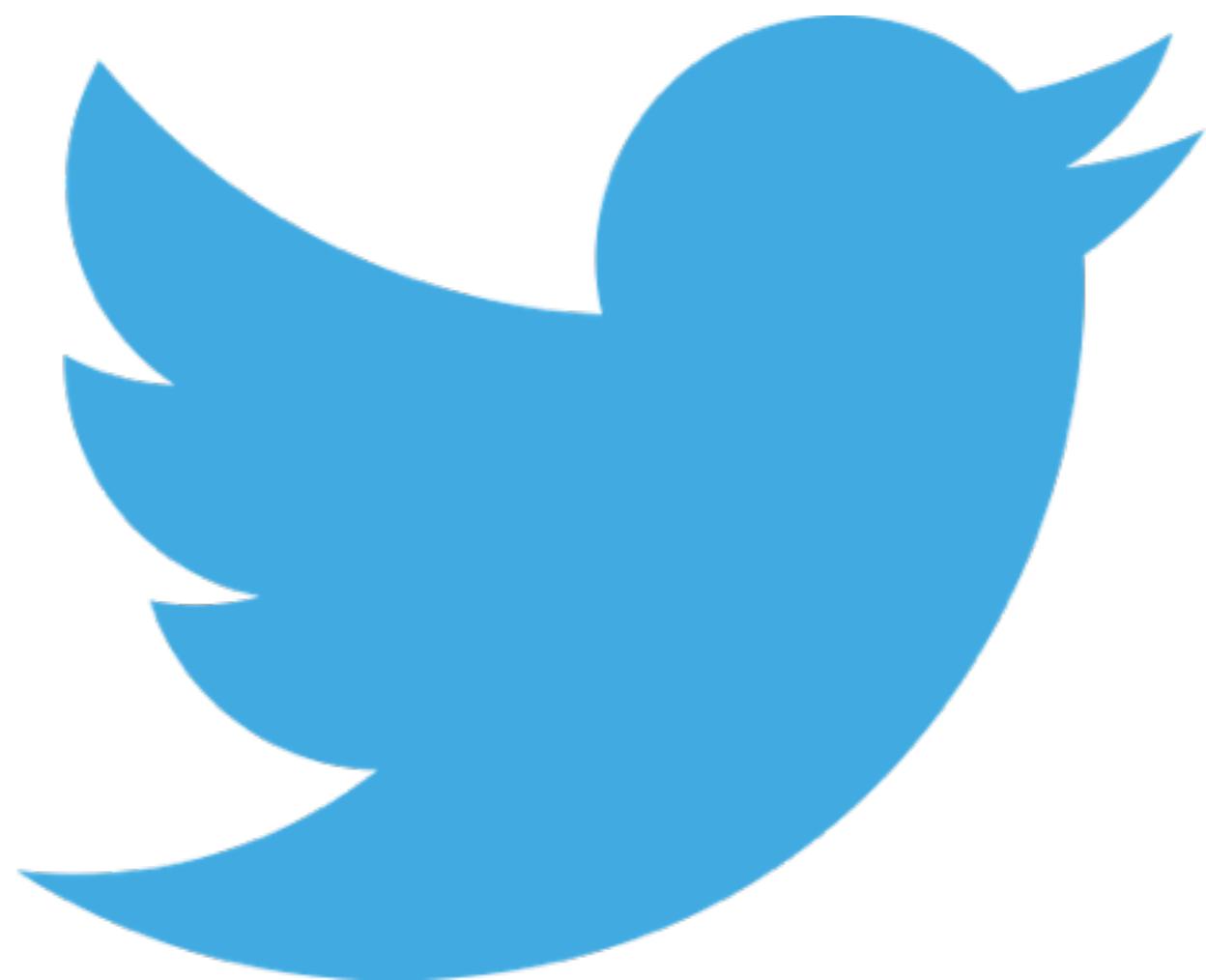
Homophily

- 
- (1) Structural Trapping
 - (2) Social Reinforcement
 - (3) Homophily



More communication **within** than across communities;

Communities **trap** information.



500 million users

340 million tweets per day



Gardenhose (10%)

Tweet
Short messages

Follow
Subscribe users

Retweet
Spread messages

Hashtag
Topic identifier, i.e. #ows

Mention
@users

Hashtag ~ Meme [1]

truthy.indiana.edu Browse Politics Gallery Movies API Info Meme Search

Meme List Popular topics in Twitter's past 90 days

Here you find our collection of Memes (#hashtag, @user, http://url, or "phrase") from the past 90 days of Twitter communication.

For each meme, we calculate statistics and provide interactive interfaces that visualize the networks, allow you to identify interesting users, and download data. We show here a user-generated definition from [tagdef.com](#), a timeline of collected tweets, and the static diffusion network.

FILTER AND SORT MEMES

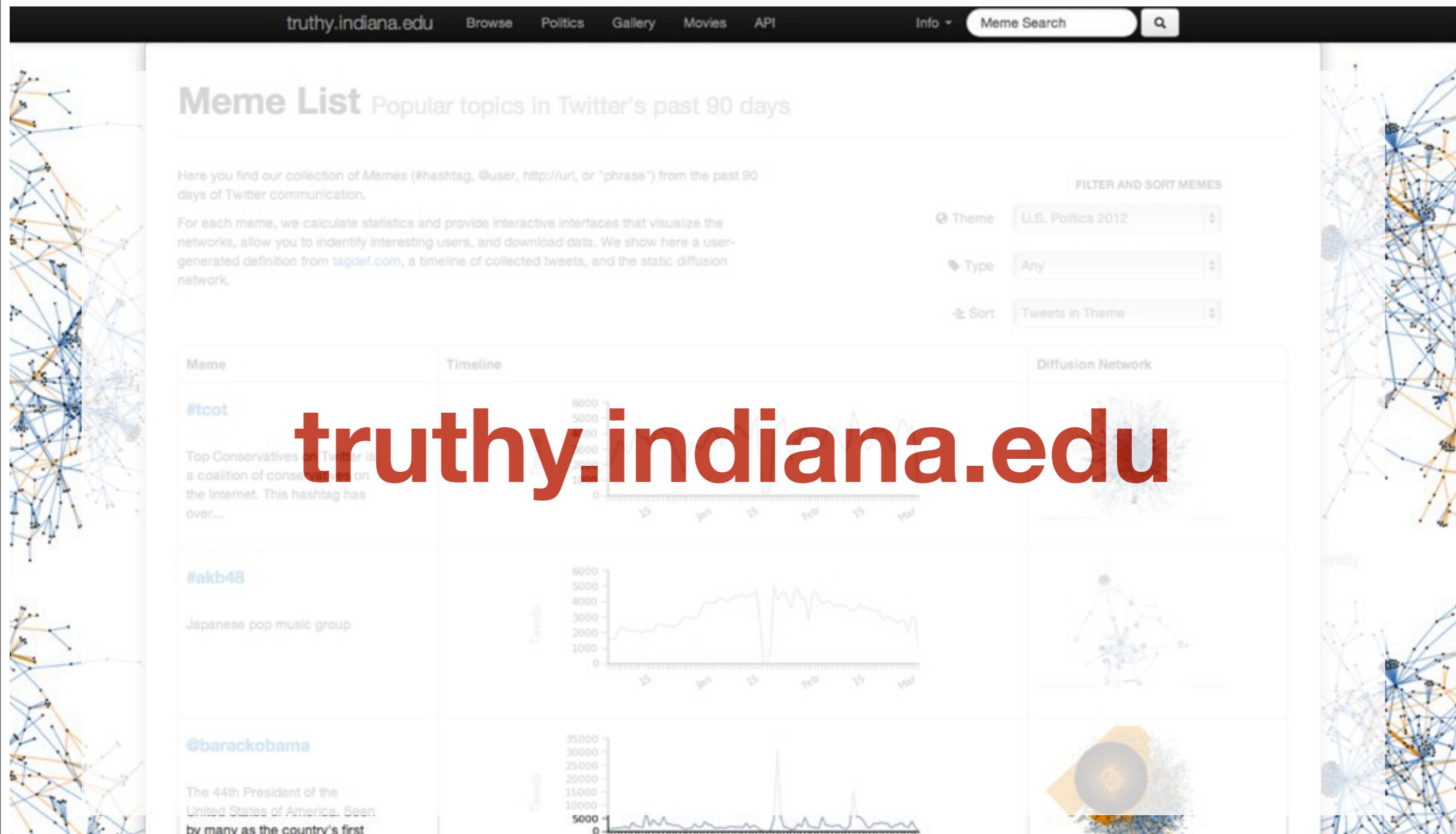
Theme: U.S. Politics 2012

Type: Any

Sort: Tweets in Theme

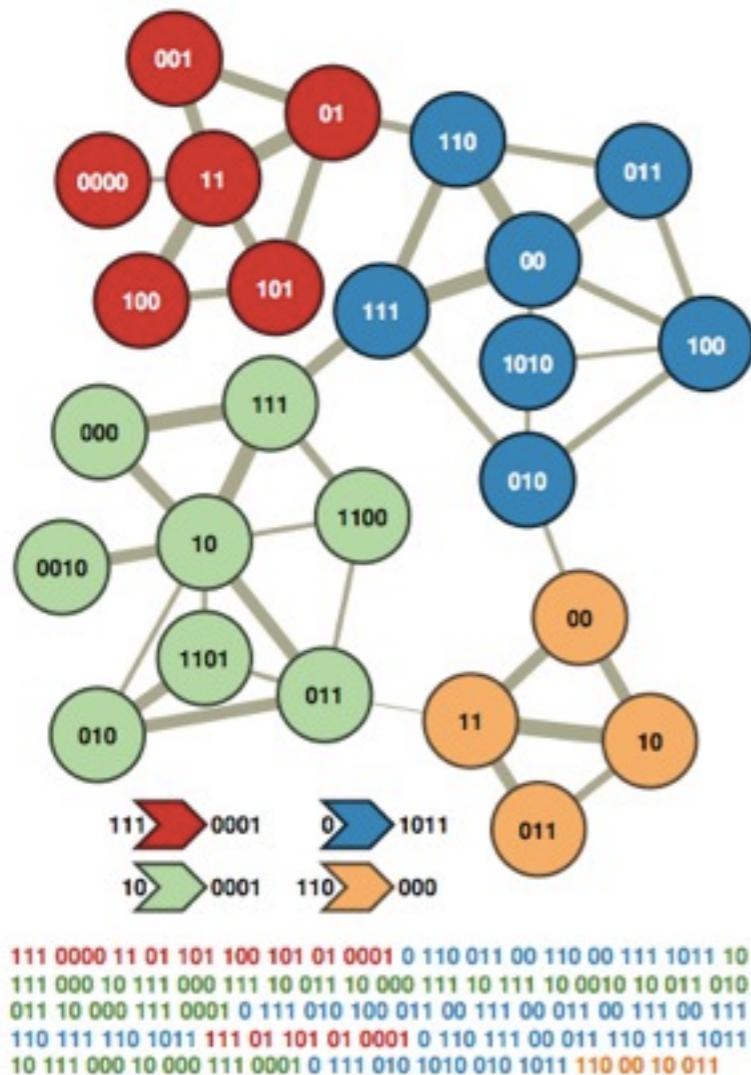
Meme	Timeline	Diffusion Network
#tcot		
#akb48		
@barackobama		

Hashtag ~ Meme [1]

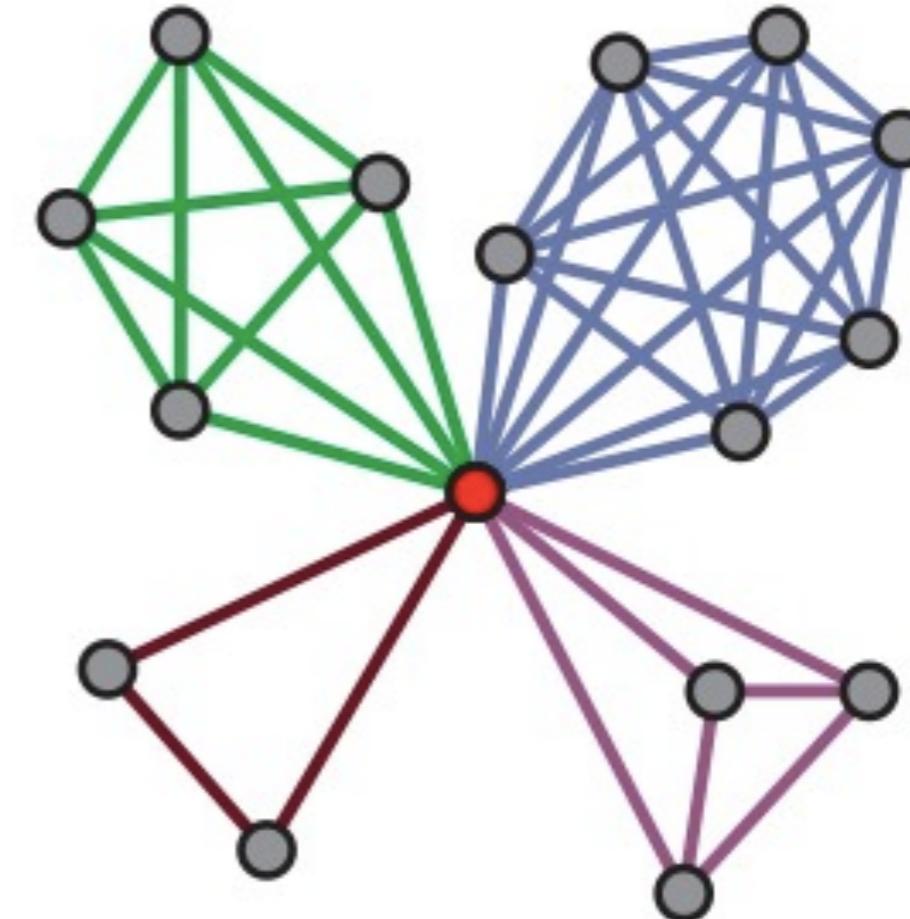


[1] Richard Dawkins. *The Selfish Gene*. 1989.

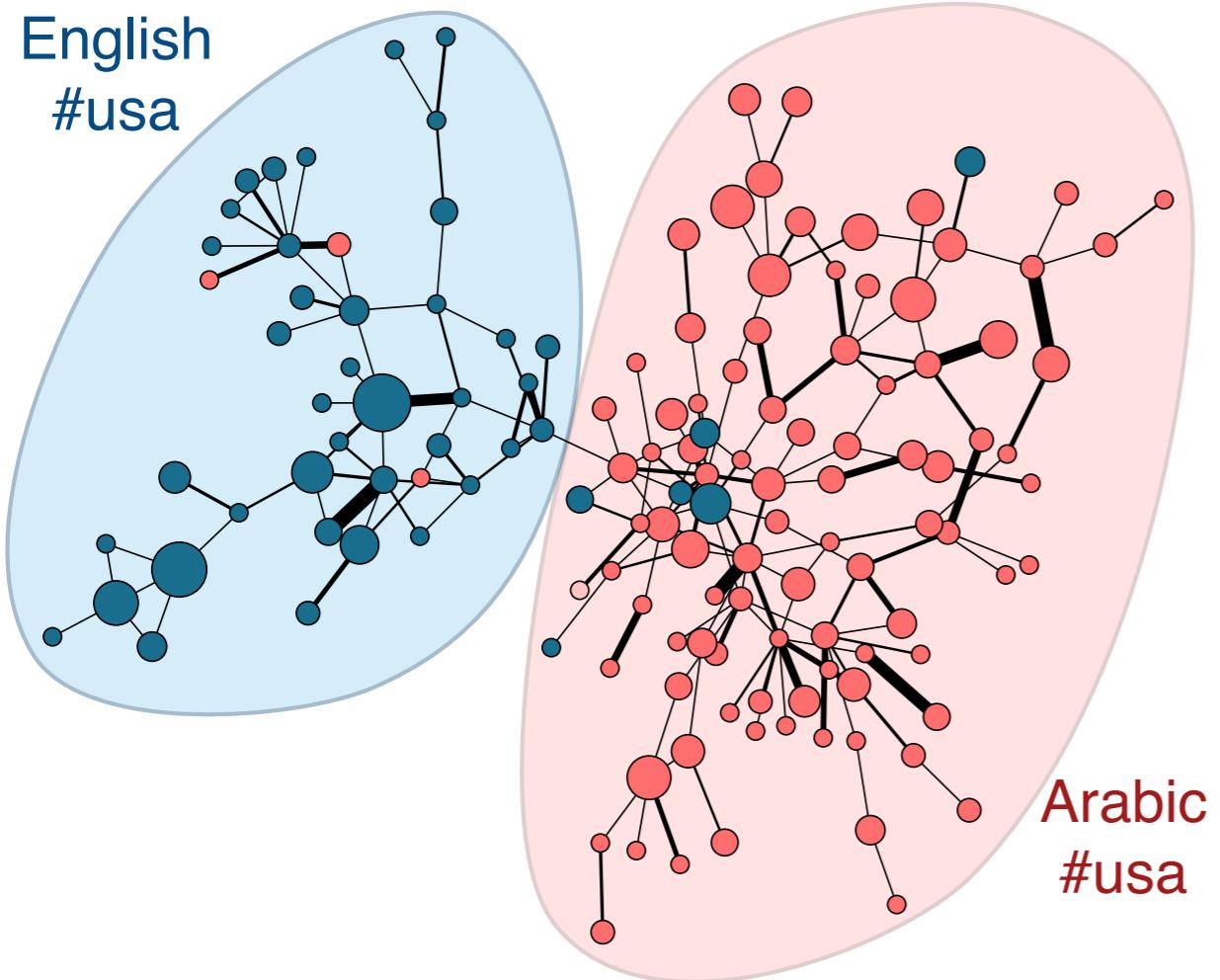
Two community detection methods



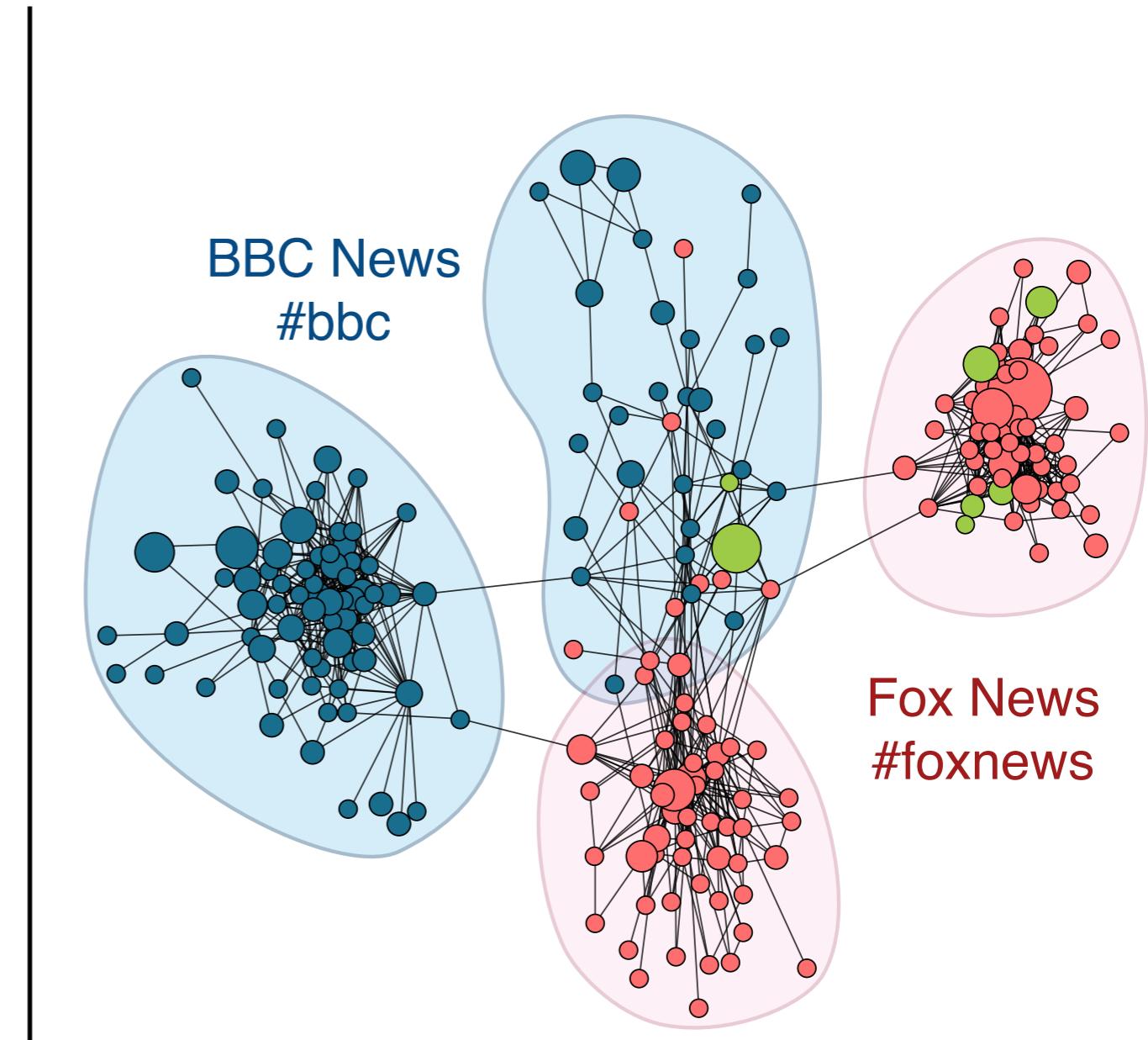
Disjoint
Communities
Infomap (Rosvall &
Bergstrom, 2008)



Overlapping
Communities
Link clustering (Ahn,
Bagrow, Lehmann, 2010)



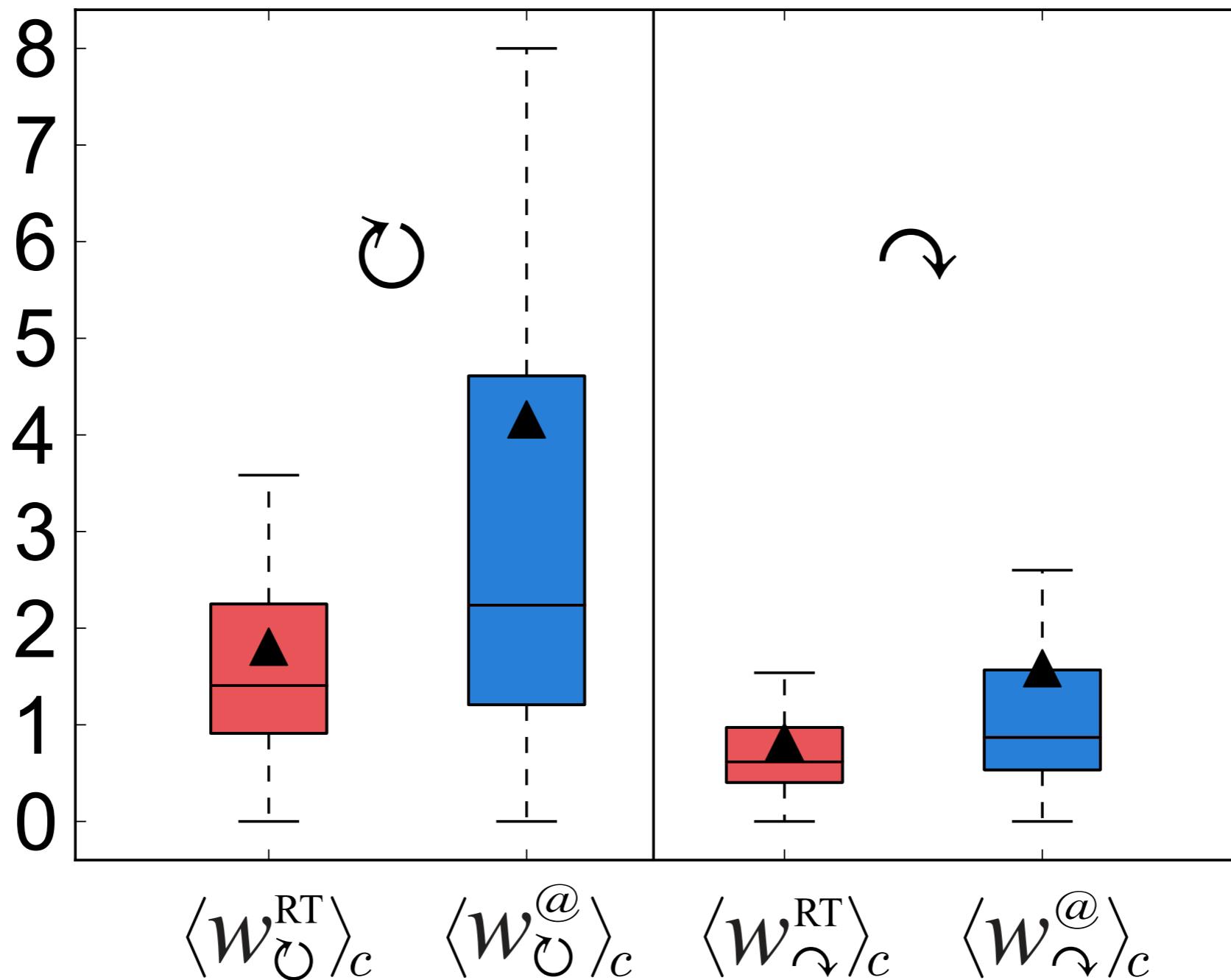
Retweet Network



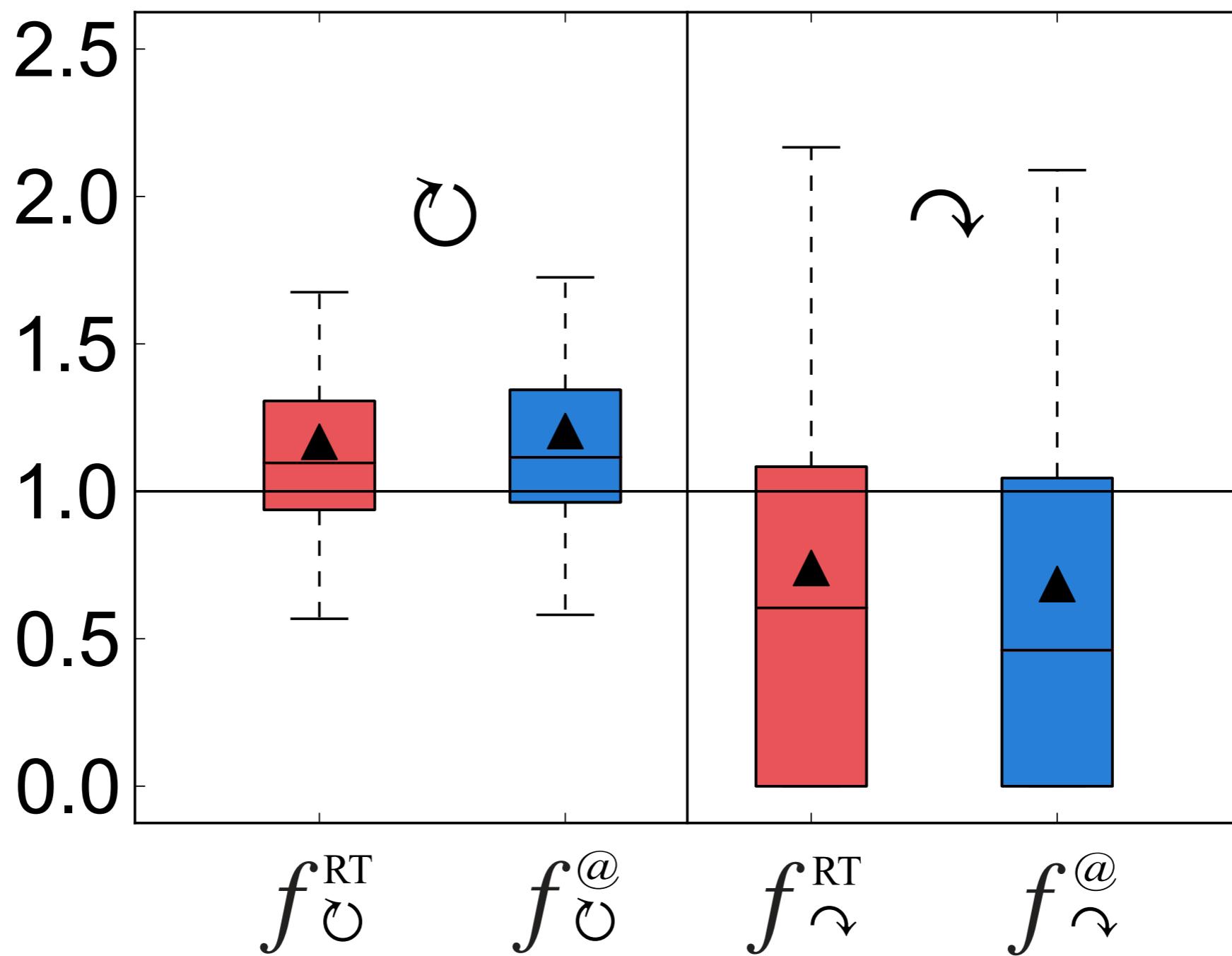
Follower Network

**Do the edges inside
communities transmit
more information?**

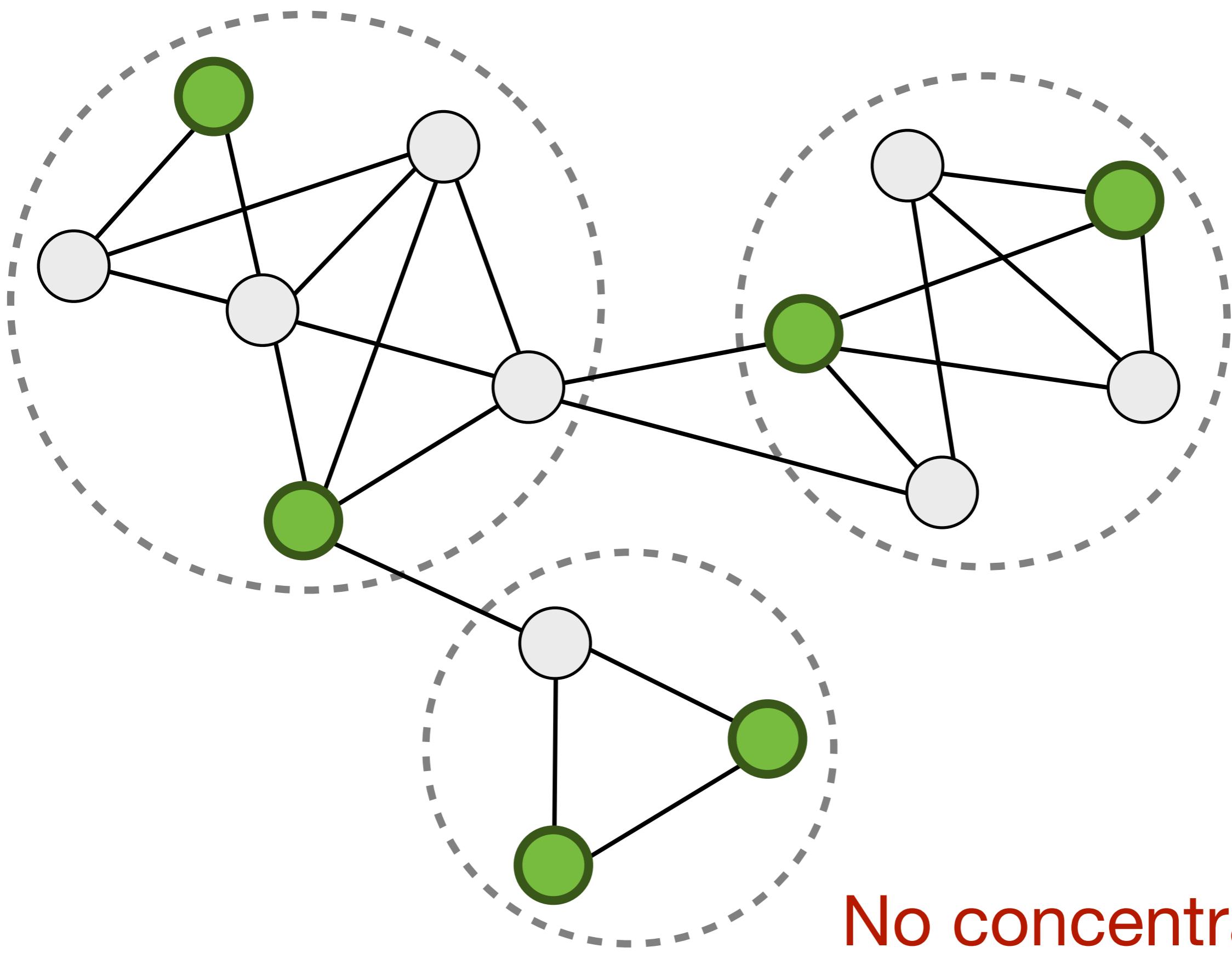
For each community, we measure the average edge weights of intra- and inter-community links.



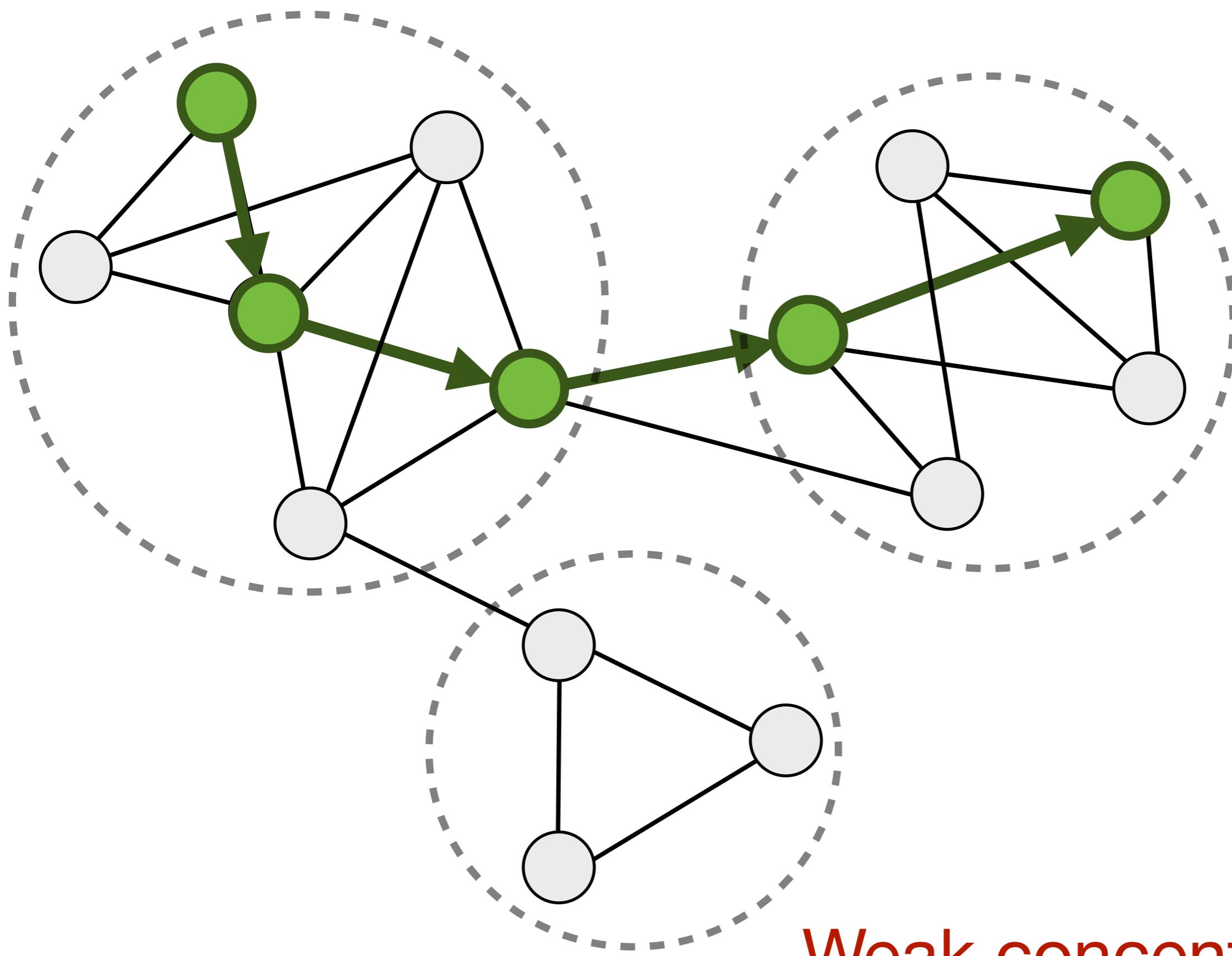
For each user, we measure fraction of activity that is directed to each neighbor in the same or different community.



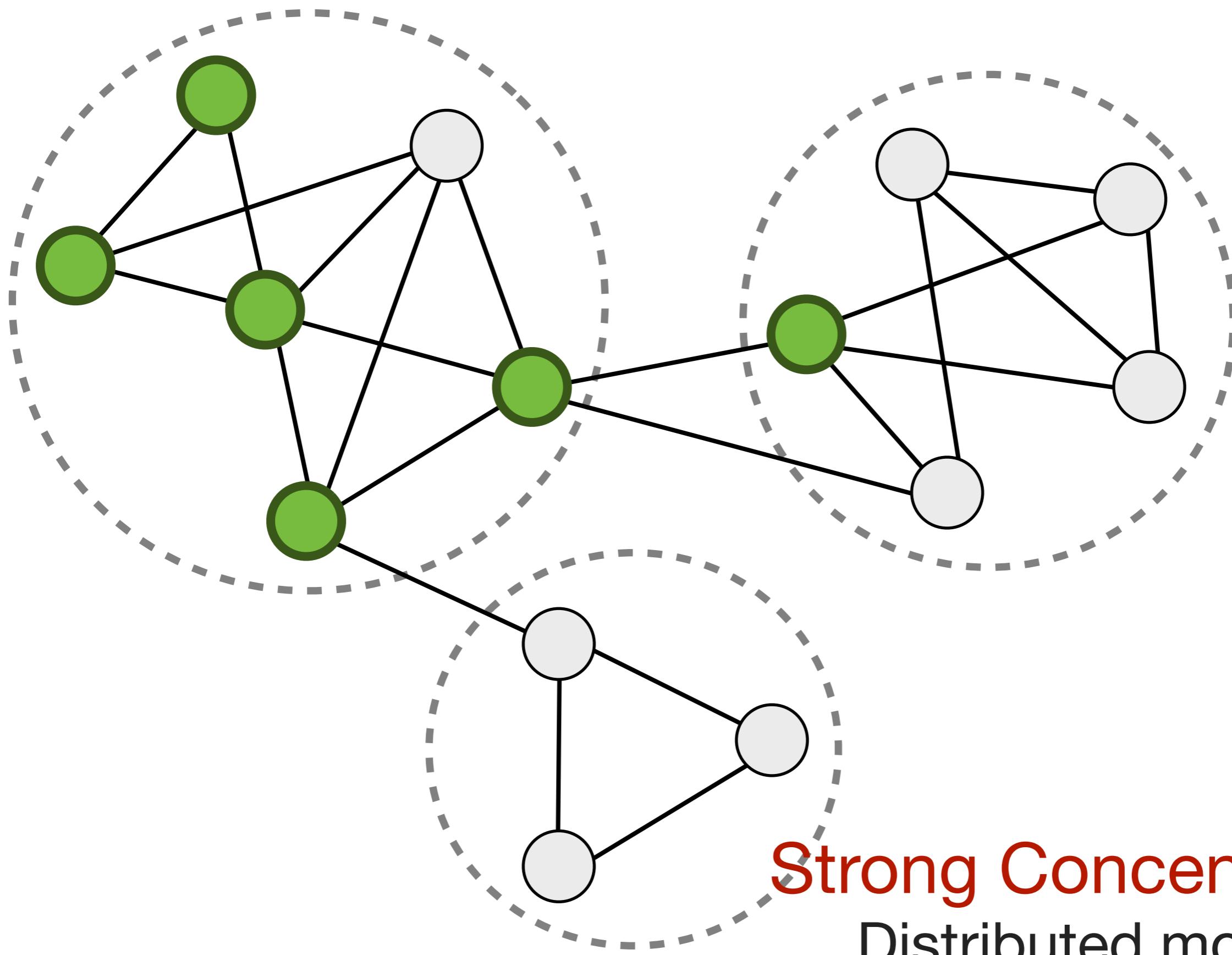
**Is the communication
concentrated inside
communities?**



No concentration
Randomly distributed



Weak concentration
Randomly diffusion



Strong Concentration

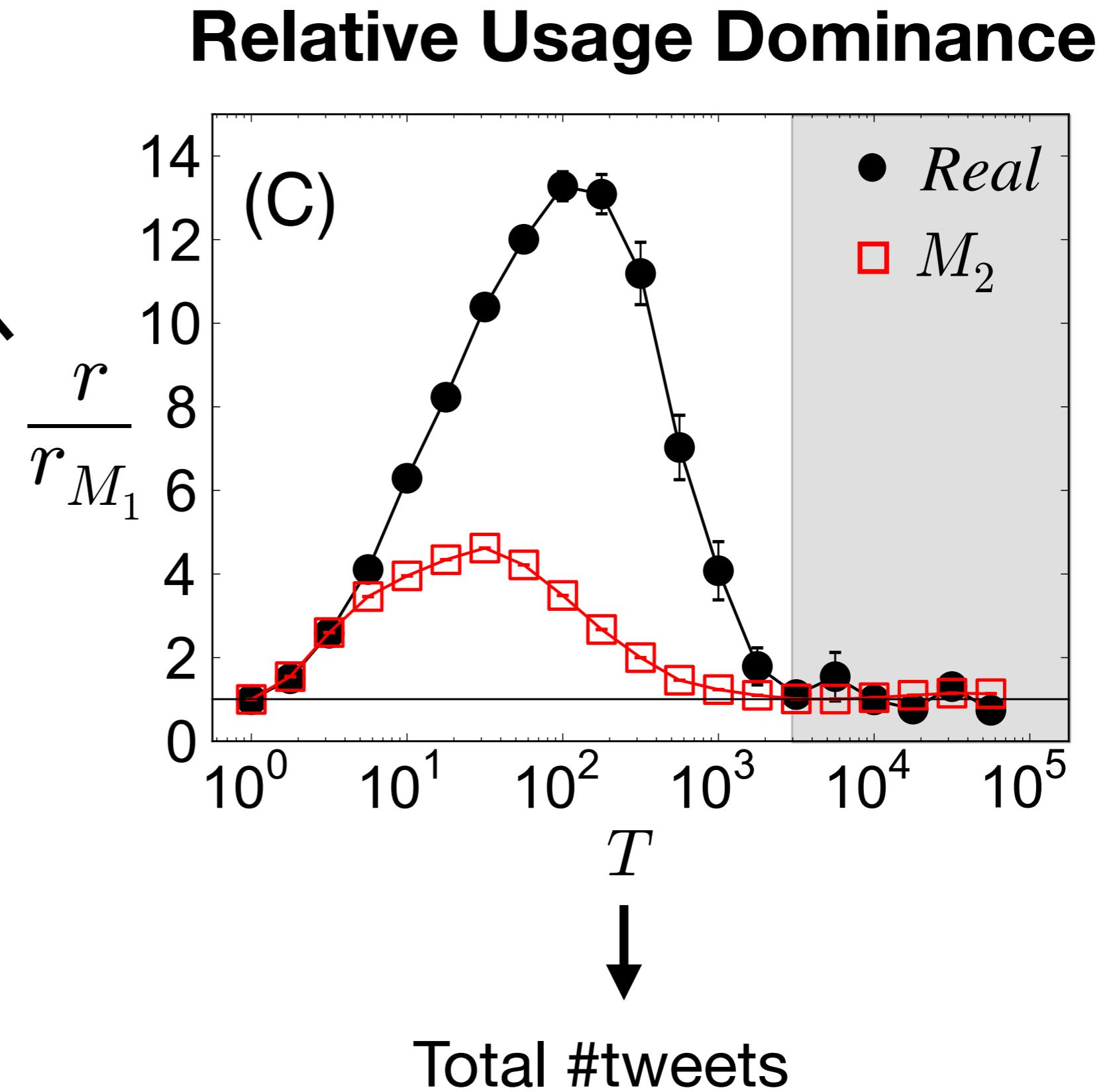
Distributed more in
a few communities

Null models

M_1 Random selection

M_2 Random diffusion
(structural trapping)

Proportion of
#tweets in
dominant
community

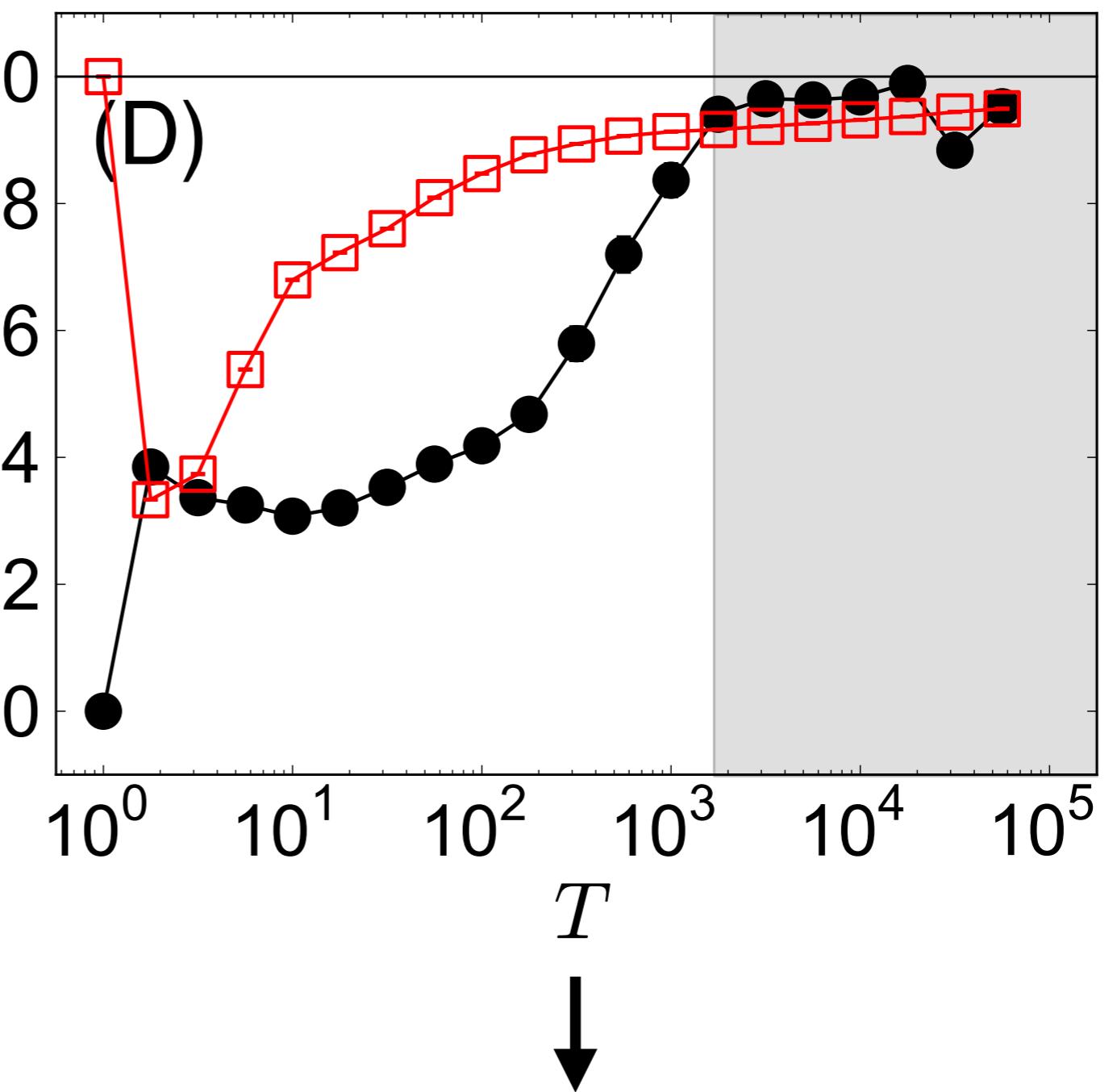


Entropy of #tweets
distributed in
different communities

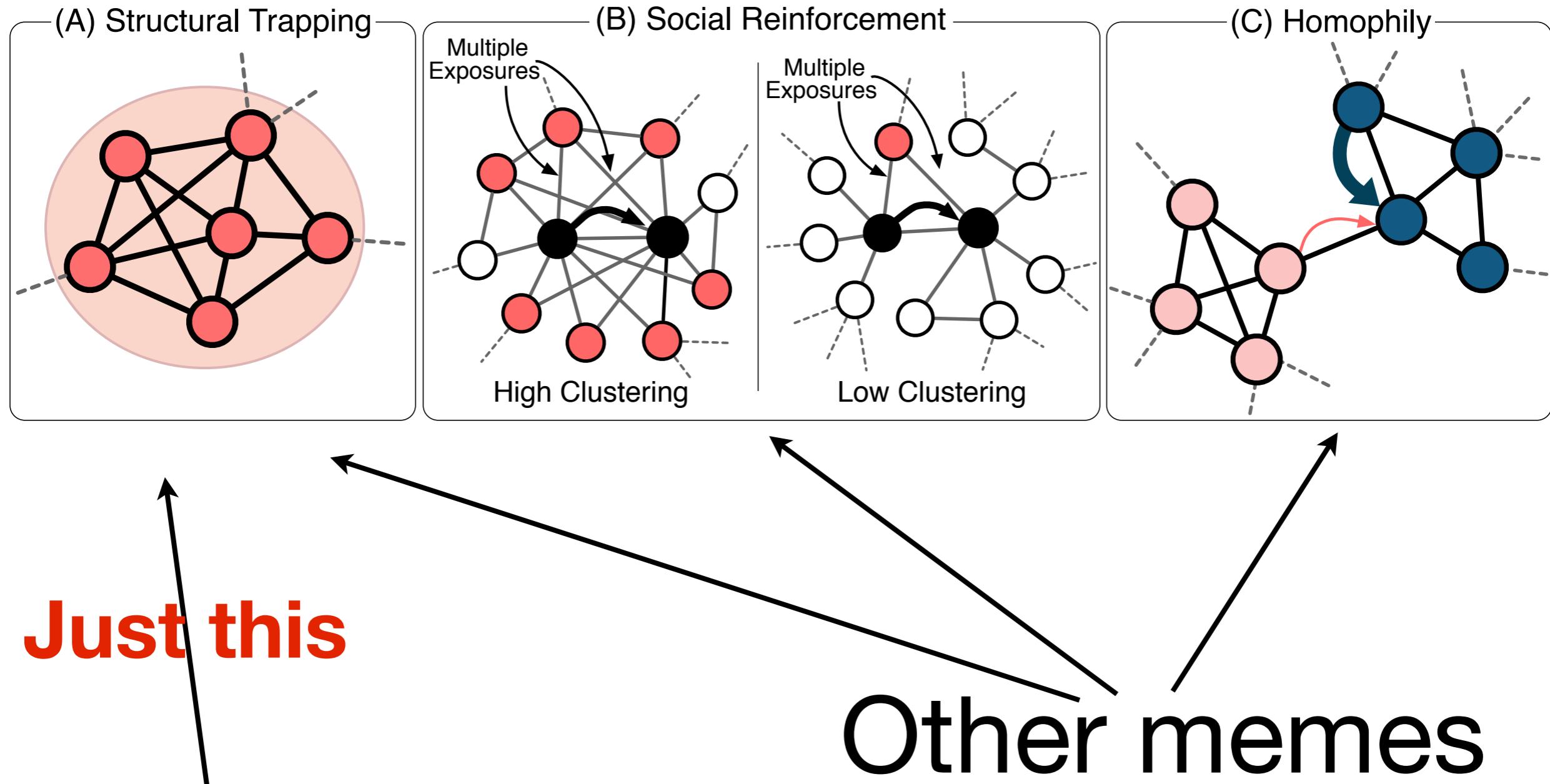


$$\frac{H^t}{\overline{H}_{M_1}^t}$$

Relative Usage Entropy



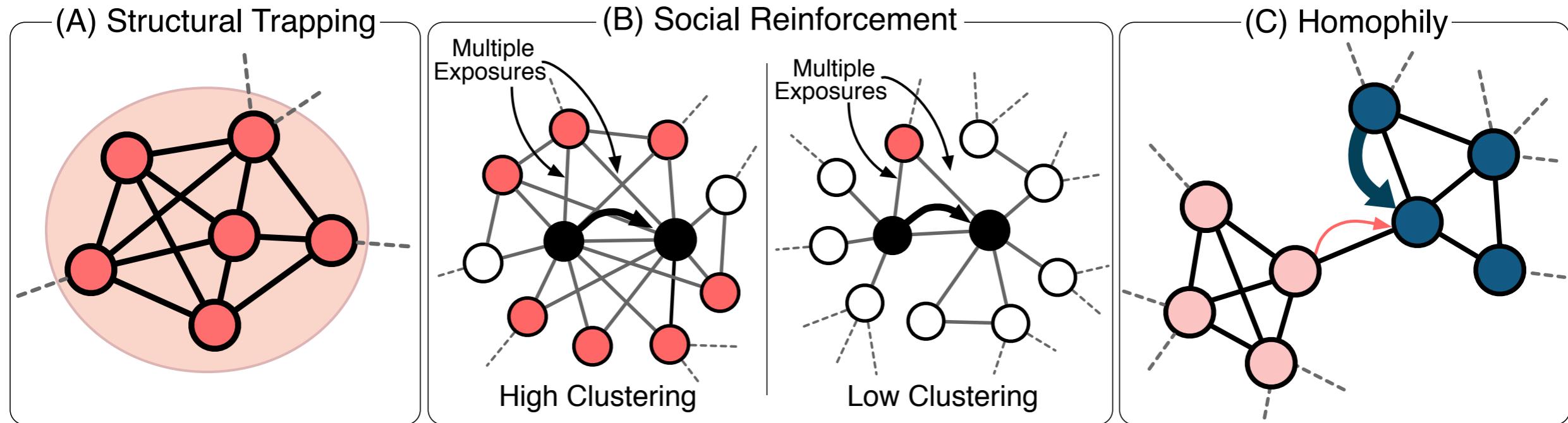
Viral memes are less trapped by communities, spreading like diseases.



Just this

Viral memes

Other memes

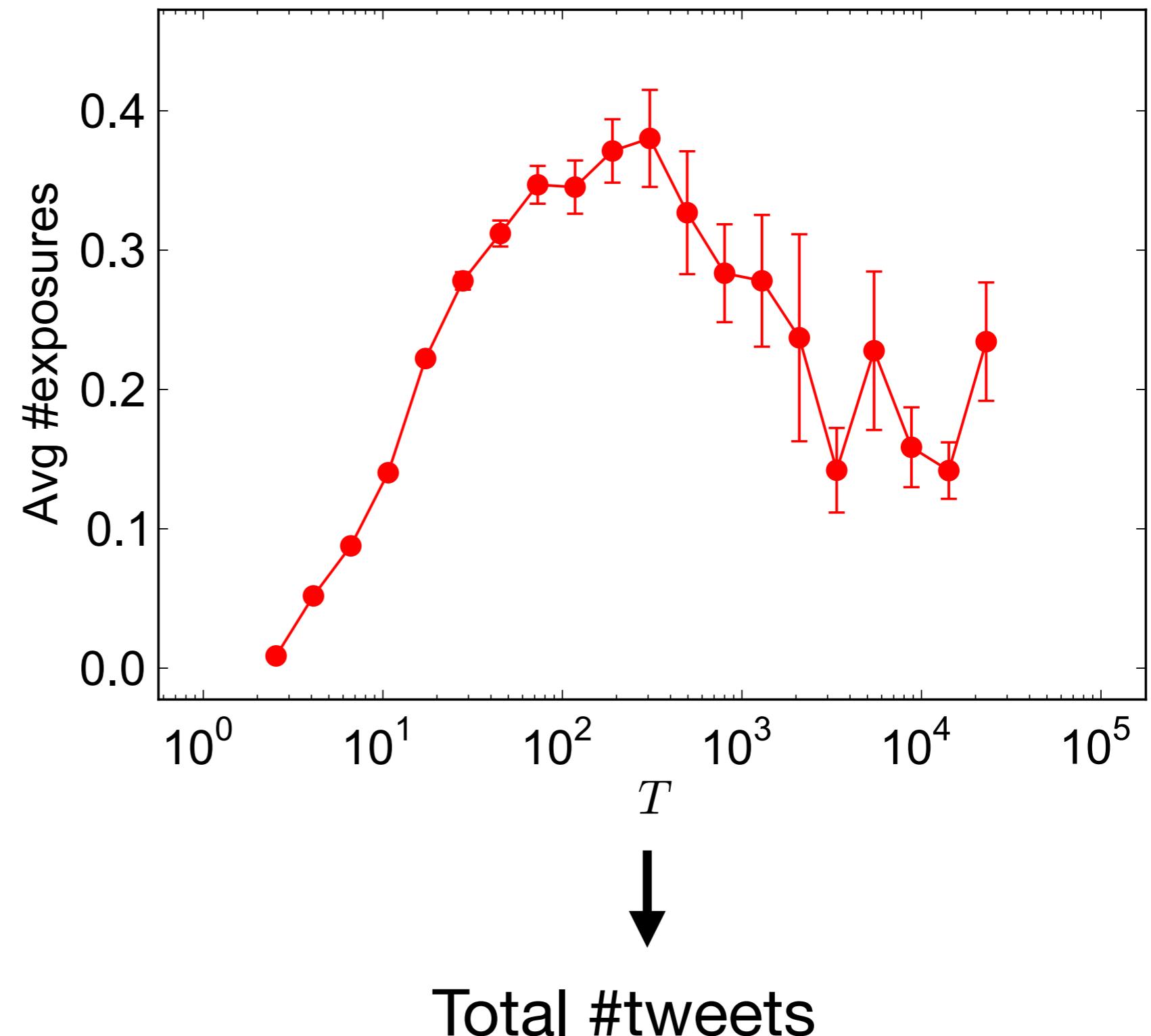


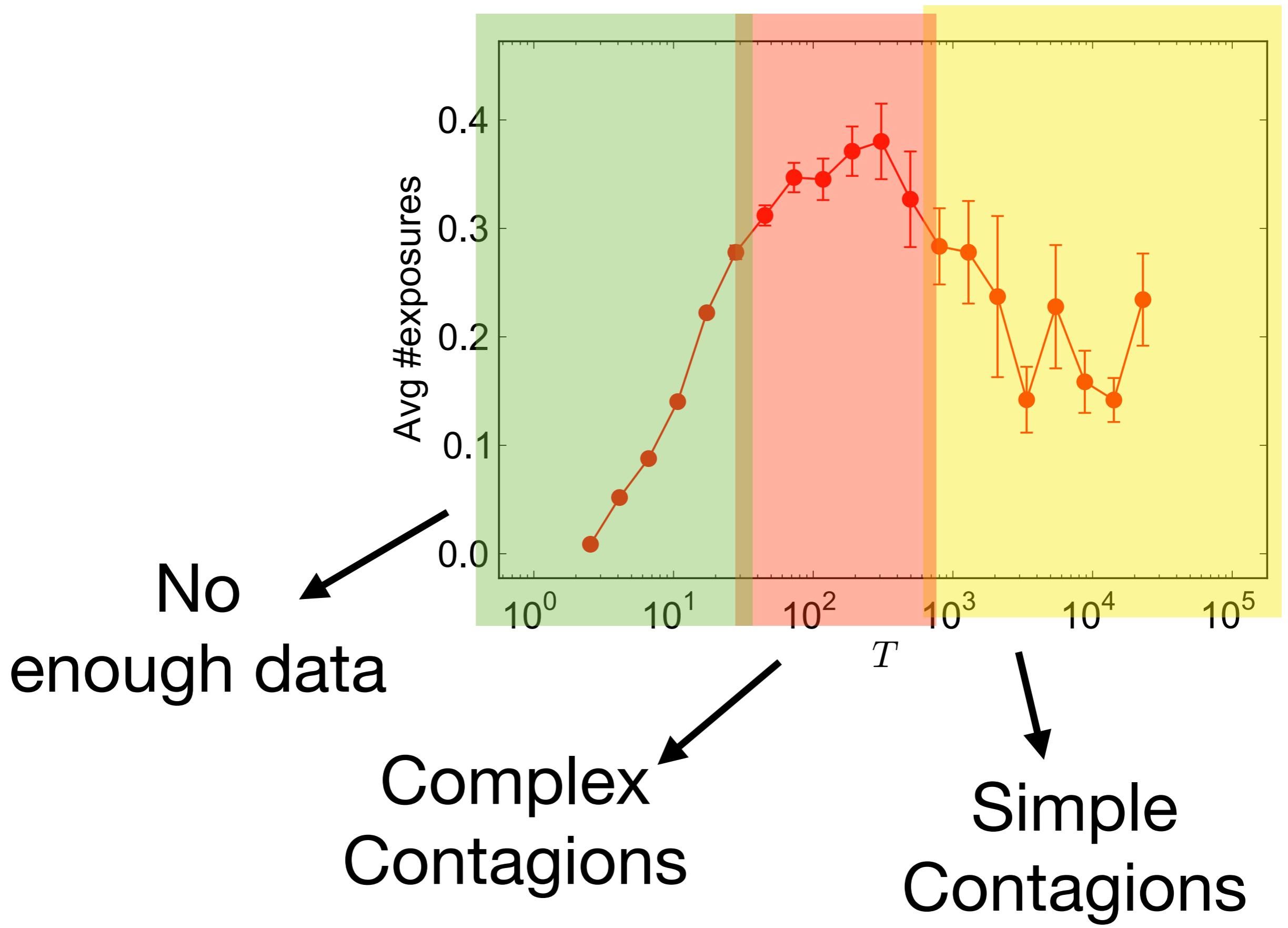
Just this

Viral memes
Simple Contagions

Other memes
Complex Contagions

Avg. #exposures
required for each
adopters





**Maybe....We can do
virality prediction by
qualifying concentration?**

Old



New

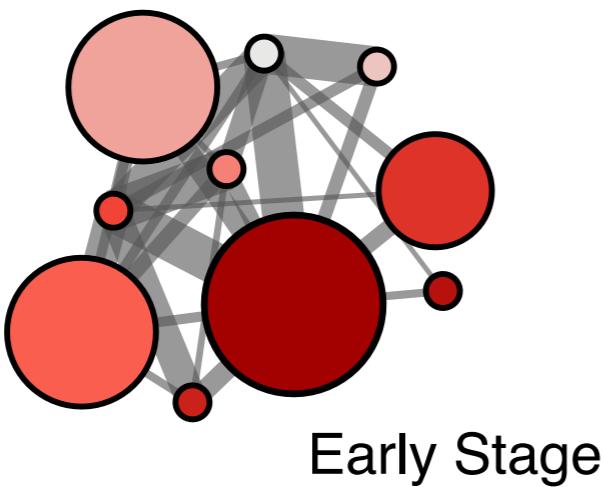
Less dominant



More dominant

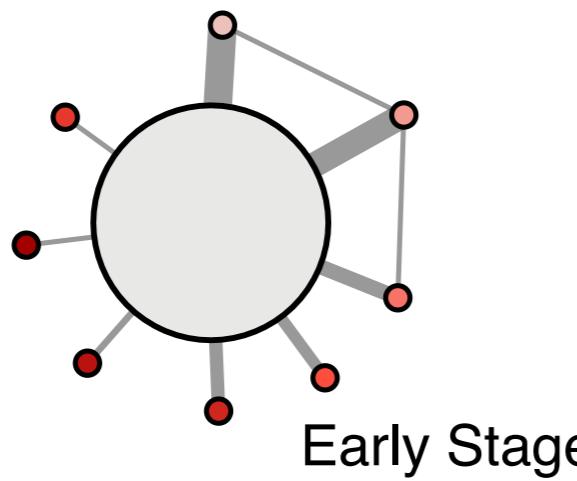
(A) #ThoughtsDuringSchool

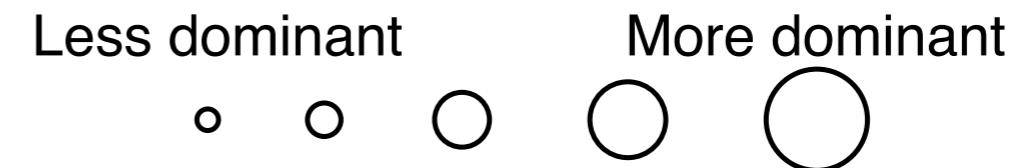
30 tweets



(B) #ProperBand

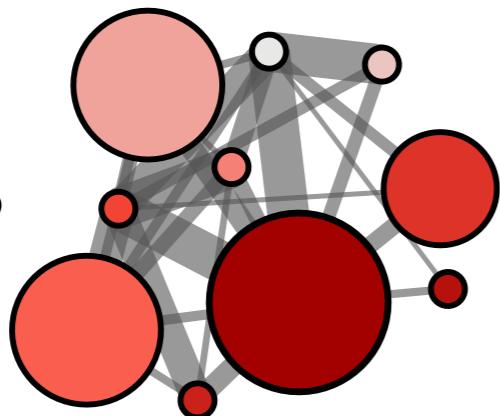
30 tweets





(A) #ThoughtsDuringSchool

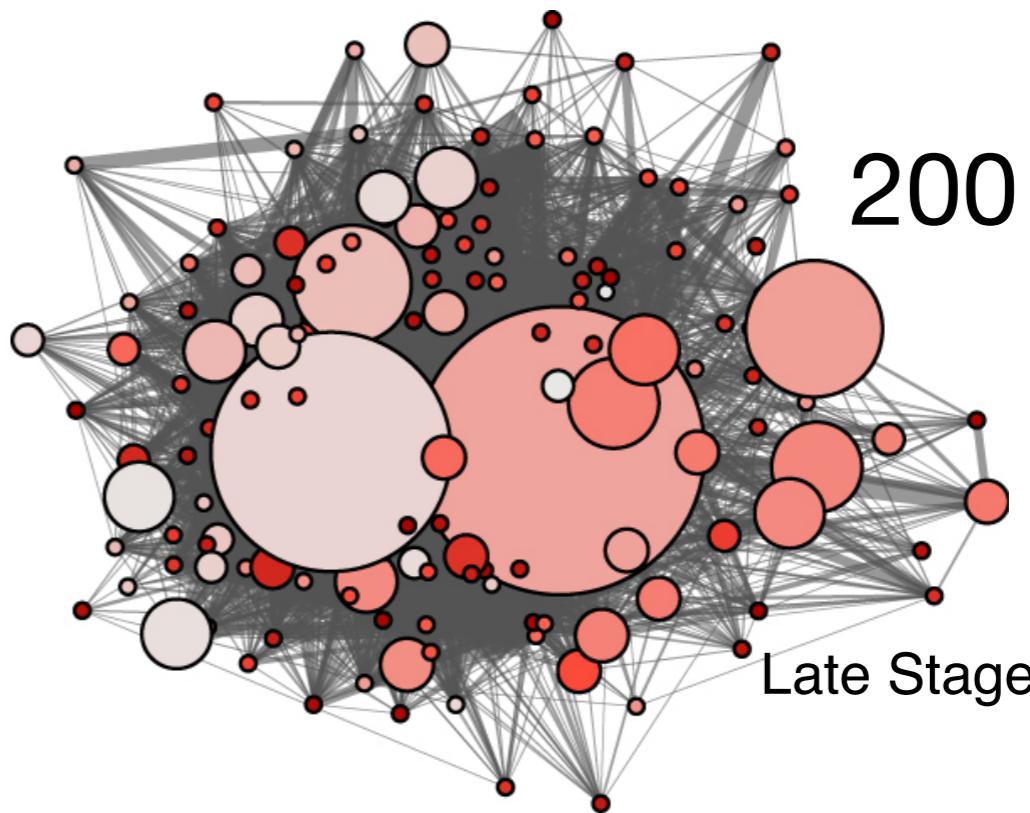
30 tweets



Early Stage



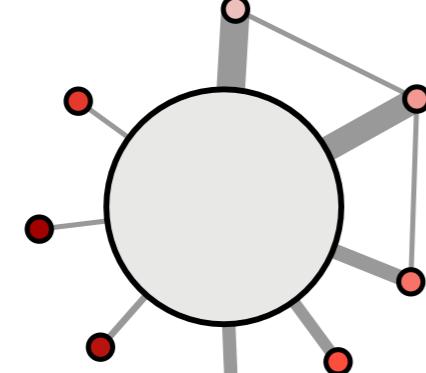
200 tweets



Late Stage

(B) #ProperBand

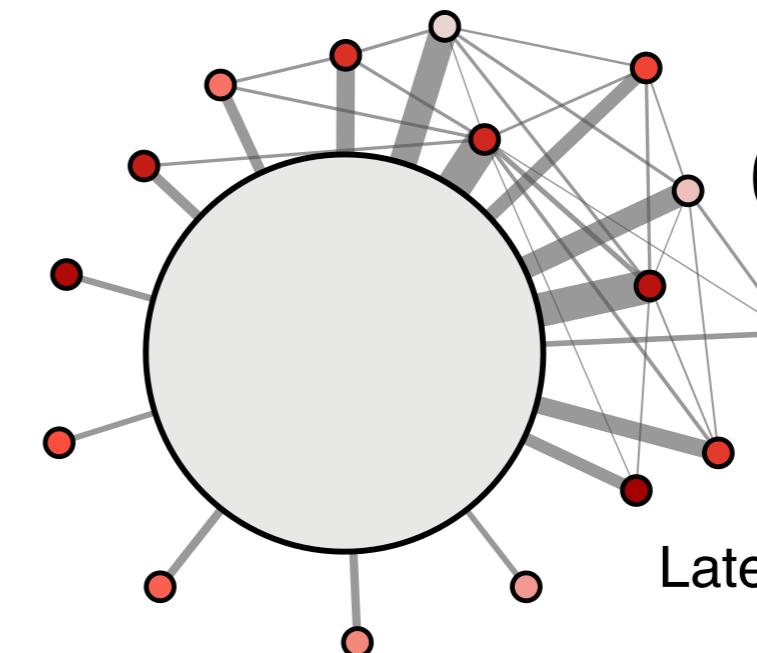
30 tweets



Early Stage

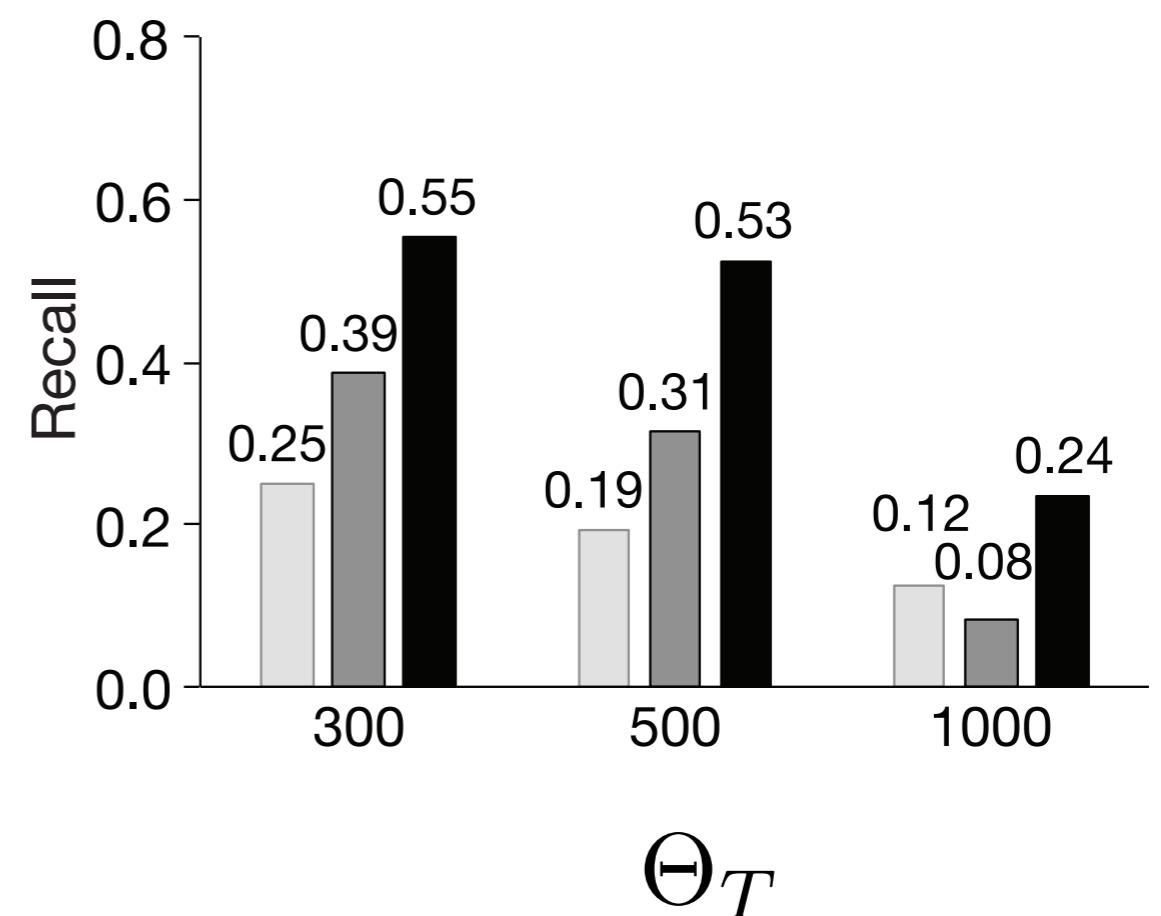
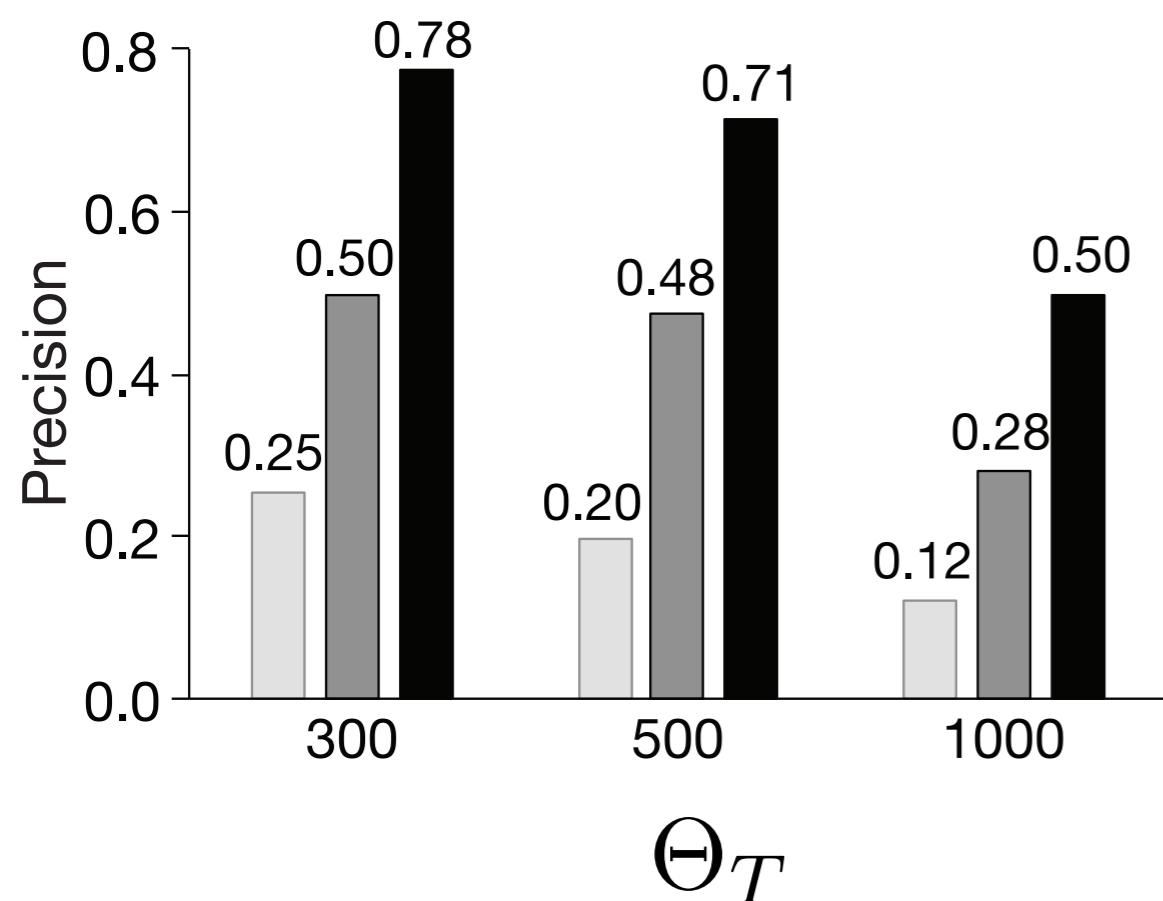


65 tweets



Late Stage

■ Random guess ■ Community-blind prediction ■ Community-based prediction



Viral memes $\geq \Theta_T$ tweets.

Summary

- Communities give us invaluable information about spreading patterns of memes.
- We can predict viral memes by looking at communities
- Non-viral memes seems to act like complex contagions, strongly affected by social reinforcement and homophily, while viral memes are not.
- **Viral memes spread like (literally) epidemics.**

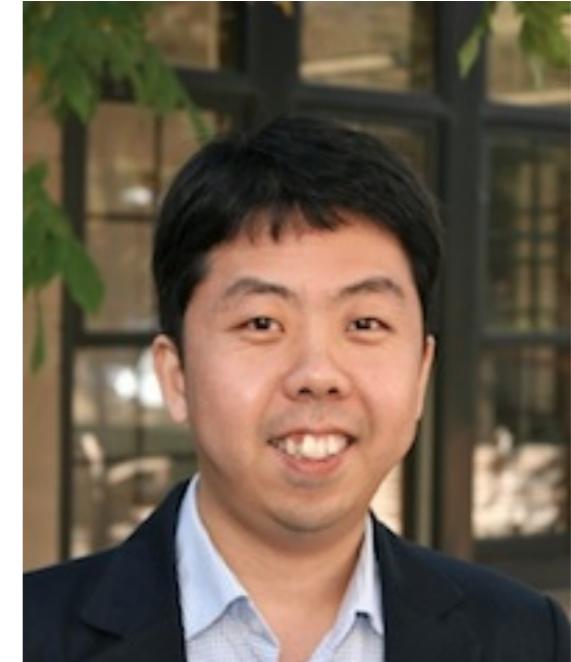
Thanks! Questions?



Lilian Weng



Fil Menczer



YY Ahn

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