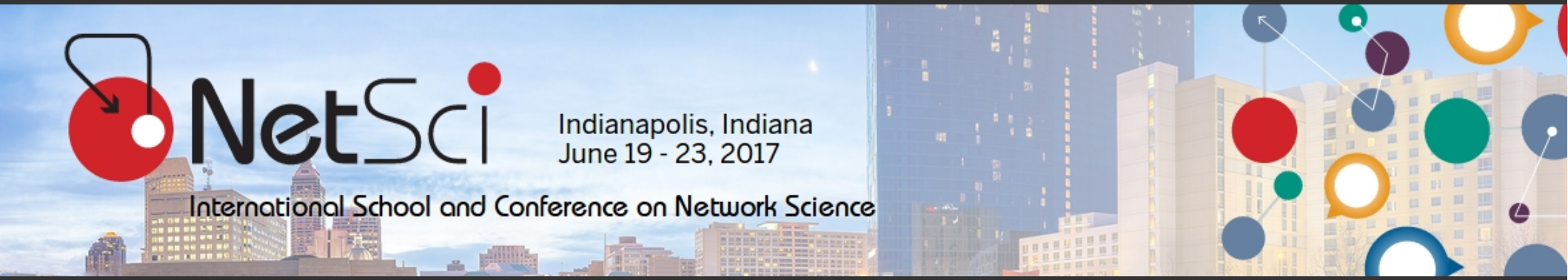
NAXYS

Communities-based Networks as a Consequence of homophily effects

Floriana Gargiulo
Yérali Gandica



In Collaboration with Floriana Gargiulo

GEMASS, CNRS, Université de Paris-Sorbonne, France

Scheme

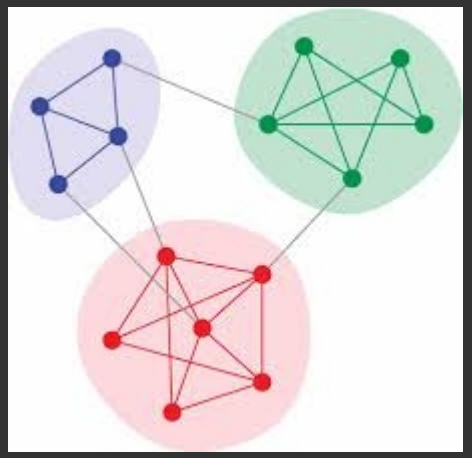
- Motivation
- Definition
- Topological Characterization
- Opinion dynamics
- The role of mass media
- Work in progress

JASSS The role of homophily in the emergence of opinion controversies

Floriana Gargiulo and Yerali Gandica. To appears in The Journal for Artificial Societies and Social Simulation 2017.

How does dominant opinions emerge in societies?
(old question)

Role of communities



Why if mass media tends to dominate most of the opinions, several different points of view always remain?

Opinion dynamics models:

Agent interaction models to study the opinion scenario evolution.

- Agents interact only with their social peers
- The basic rules are inspired by social psychology

Festinger L., A Theory of Cognitive Dissonance (Stanford University Press, Stanford, Cal.) 1957, p. 291.

Opinions Evolve in time

Two principles:

- Reduce cognitive dissonance
- Confirmation bias

Bounded confidence model (Deffuant et al. (2000))

Homophily model:

Definition

Bounded confidence model:

Opinions in the ABM

For each agent: $\theta_I \in [-1, 1]$

At each time step:

1) A new Agent N enters in a pre-existing network

2) The new agent establishes M new links with the pre-existing nodes, choosing the new links according to a preference function

$$P_{N \to I}$$

Homophily model: Definition

Preferential attachment:
New nodes will preferentially connect to highly connected nodes

$$P_{N \to I} \sim k_I$$

Networks with heterogeneous degrees (scale free degree distribution)

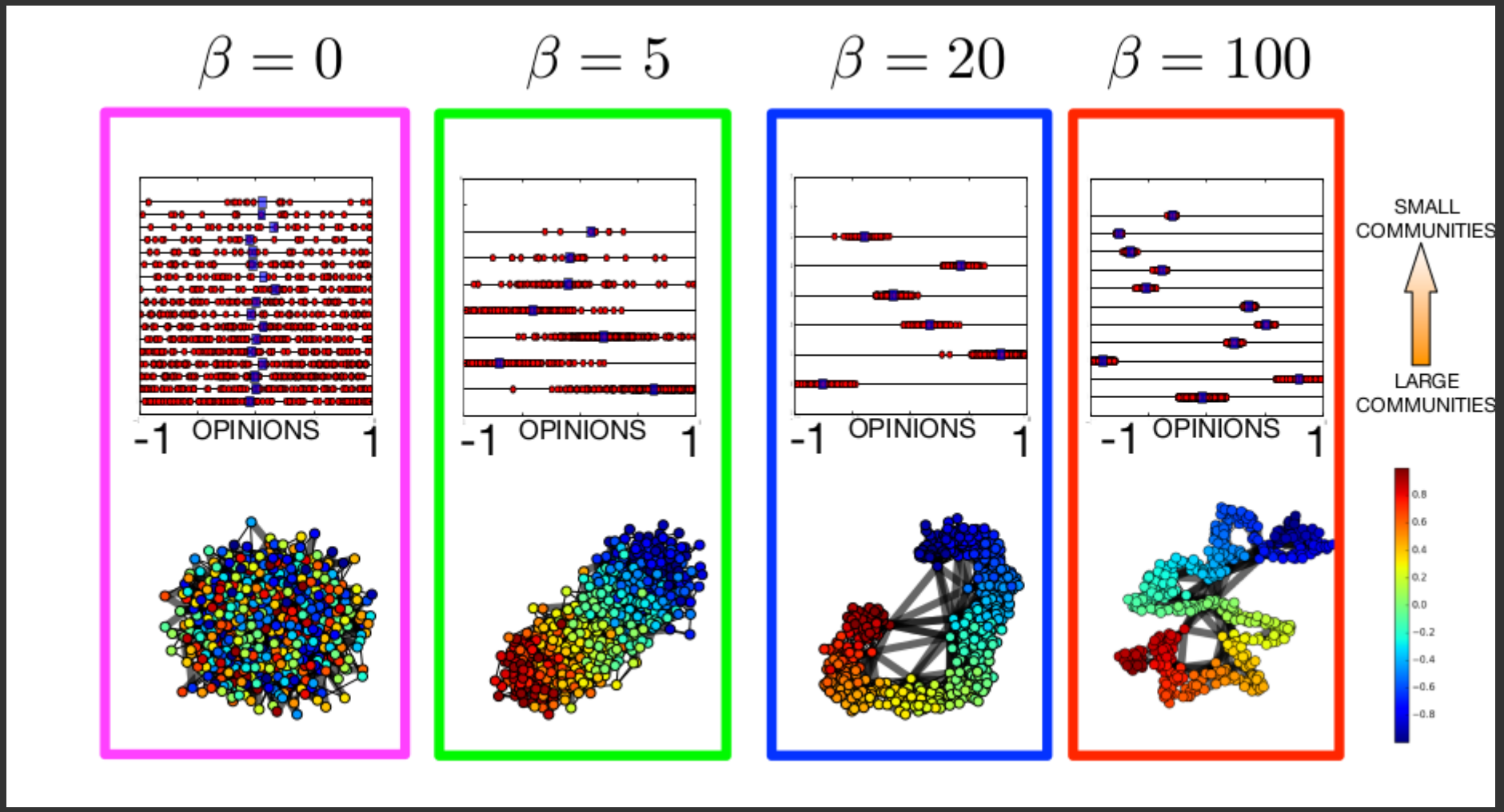
Preferential attachment with homophily:
New nodes will preferentially connect to highly connected nodes and similar opinion

$$P_{N \to I} \sim k_I e^{-\beta |\theta_N - \theta_I|}$$

The coefficient beta tunes homophily:

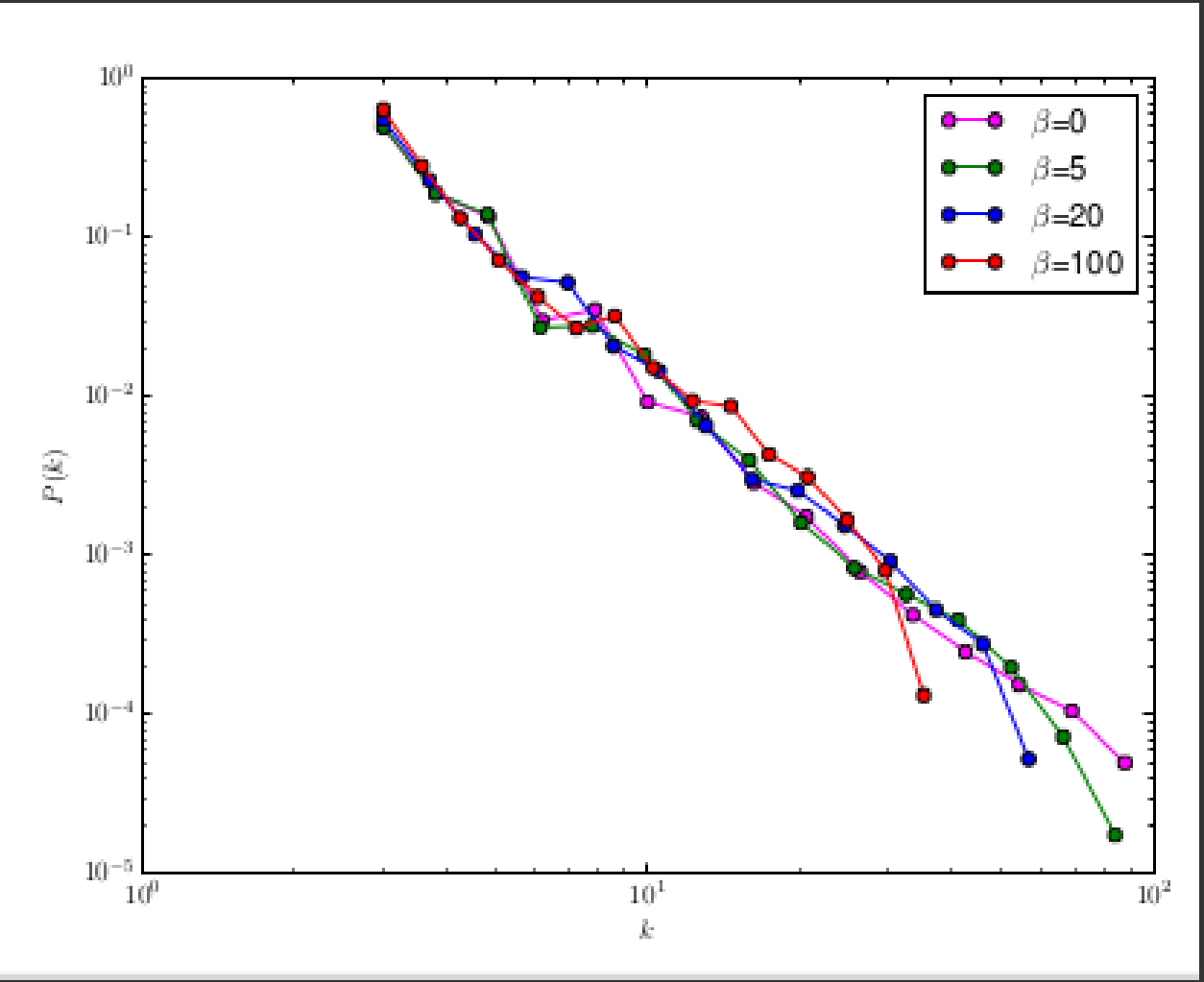
$\beta = 0$ degree preferential attachment

$\beta \to \infty$ only opinion matters


$\beta = 0$
$\beta = 5$
$\beta = 20$
$\beta = 100$
-1
OPINIONS
1
SMALL COMMUNITIES
LARGE COMMUNITIES
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
−0.8

Homophily model:

Topological Characterization



Power law degree distribution.

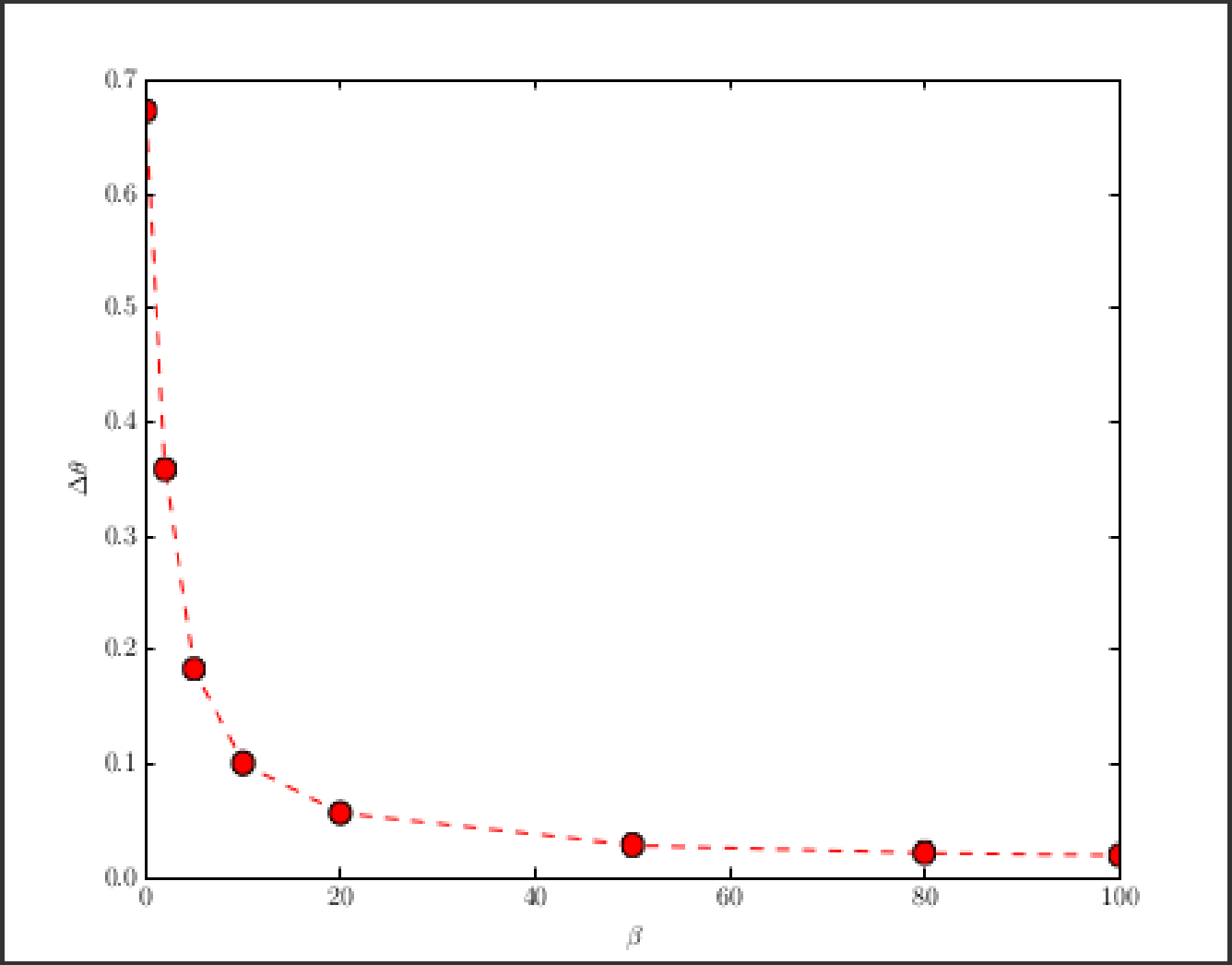
- Same slope
- lower max degree

Homophily model:

Topological Characterization

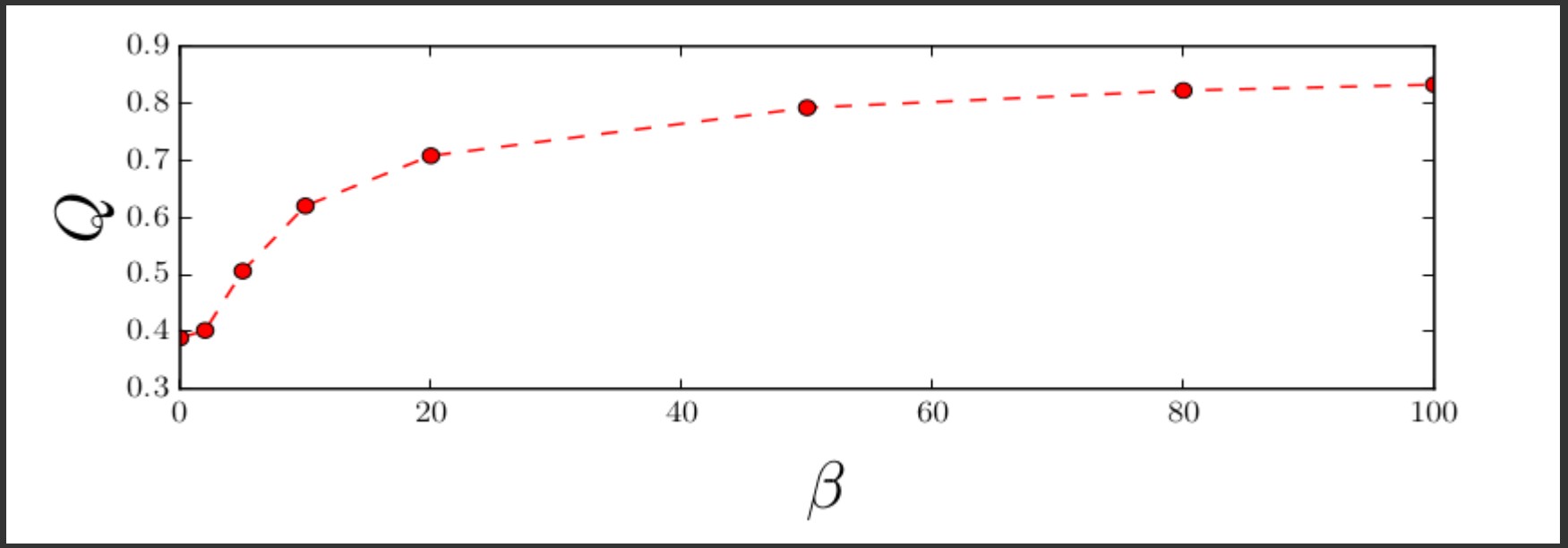
Average opinion distance between connected nodes:

As the homophily parameter increases, the links connect more similar nodes

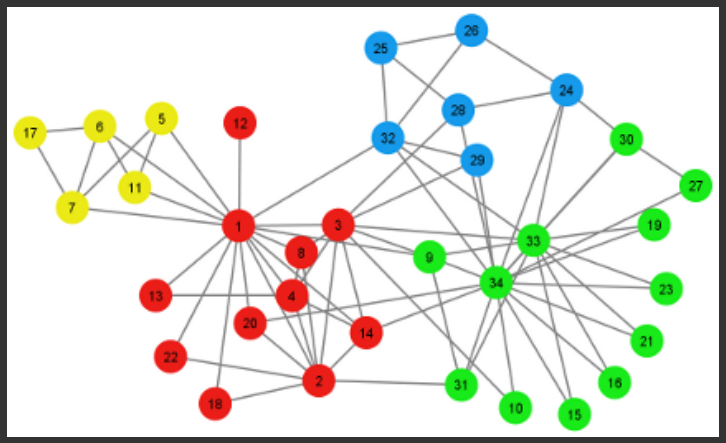


Homophily model:

Topological Characterization



Community modularity as a function of β. The results are the average values of 100 replicas of the morphogenesis process, for a network with N = 1000. Modulatity increases with β, meaning that more significant community structures are formed



Community: set of nodes with more links between them than with the rest of the network.

Leuvan Method (optimizing Modularity can be interpreted both, as optimizing a particular stochastic block models and a particular diffusion process on the network)

Schaub MT, Delvenne J, Rosval M, Lambiotte R (2017) The many facets of community detection in complex networks. Applied Network Science 4.

At each time step:

1) Select an Agent I

2) Select a second agent J in the neighborhood of I

3) Opinion update

Confirmation bias $\quad if \quad |\theta_I - \theta_J| < \varepsilon$

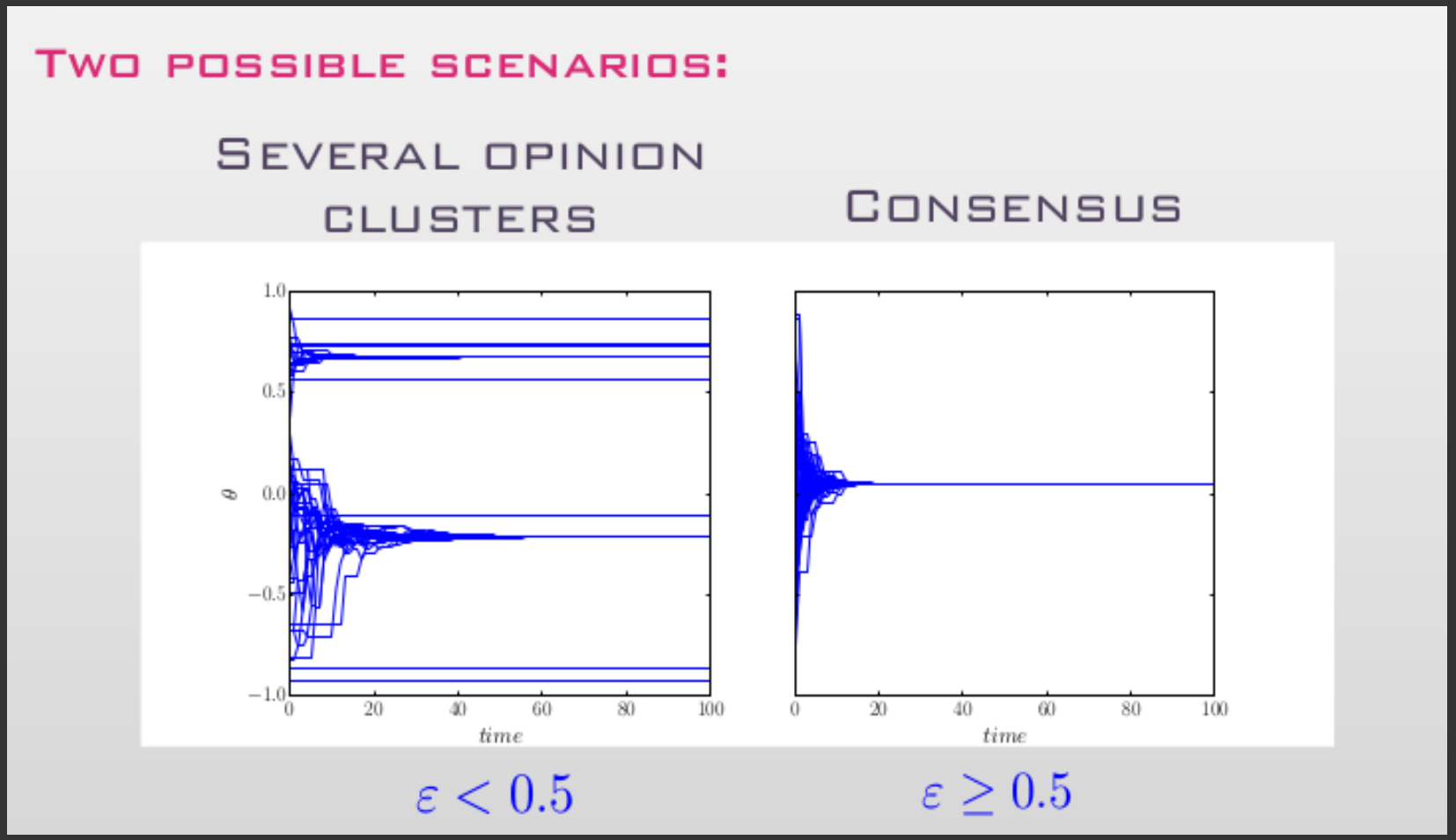
Cognitive dissonance

$$\langle\theta\rangle_{IJ} = (\theta_i + \theta_J)/2$$

$$\theta_I = \theta_J = \langle\theta\rangle_{IJ}$$

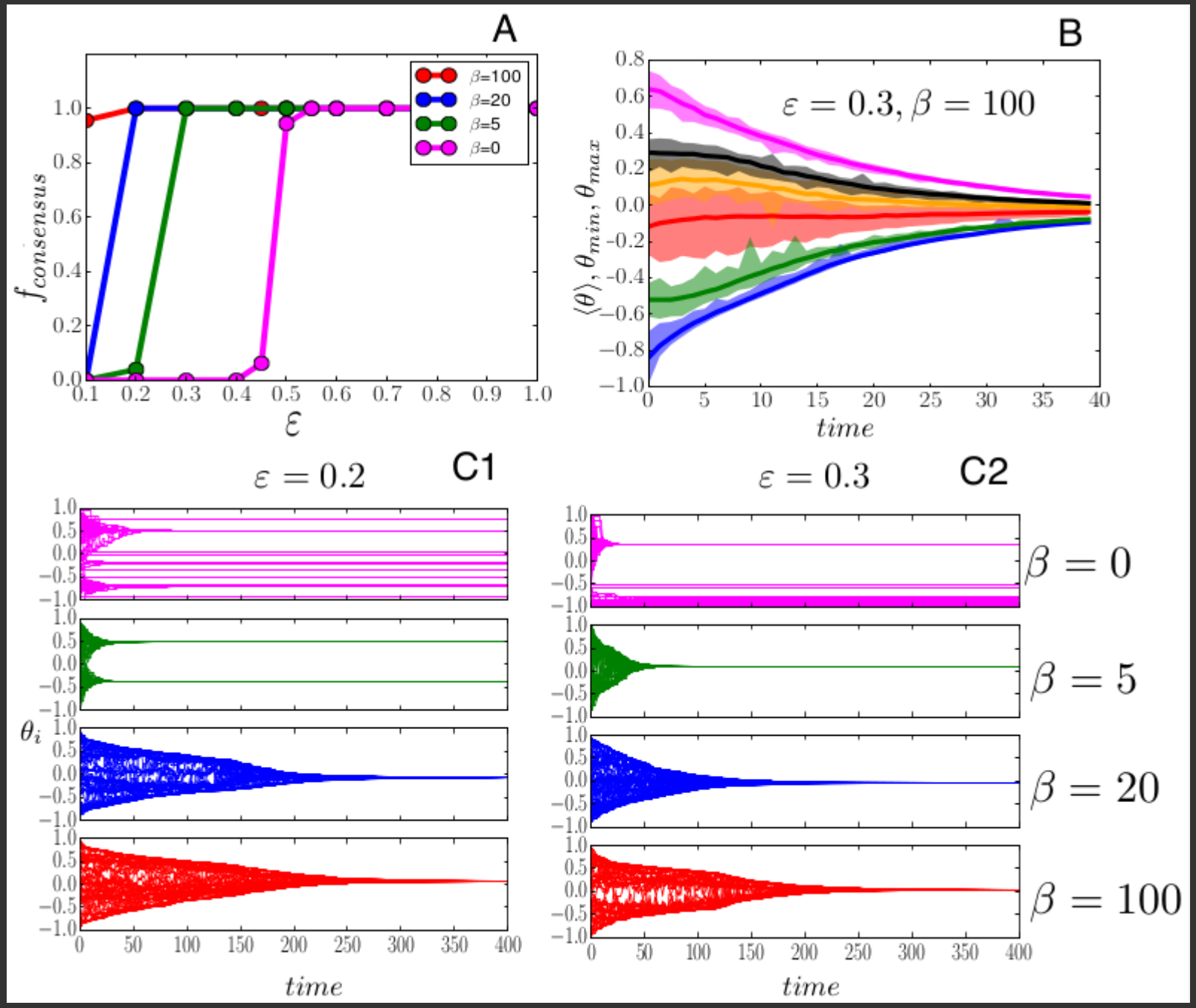
DEFFUANT G., NEAU D., AMBLARD F. and WEISBUCH G. (2000)
Mixing beliefs among interacting agents. Advances in Complex Systems, 3. pp. 87-98.

Original (Deffuant) model



Homophily model:

Opinion dynamics



The role of mass media

- Support/condemn to an opinion

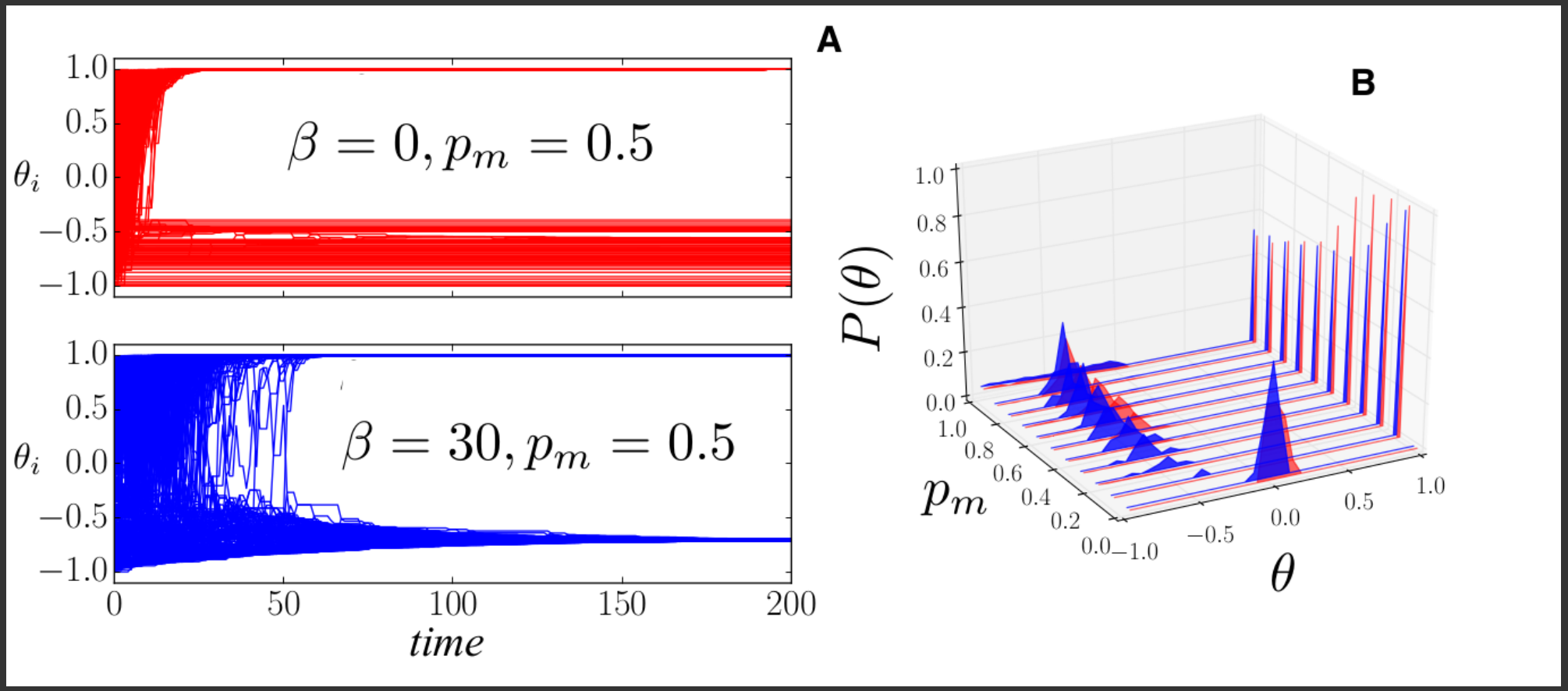
$$\Theta_M \in [-1, 1]$$

- Diffuse opinion, without changing

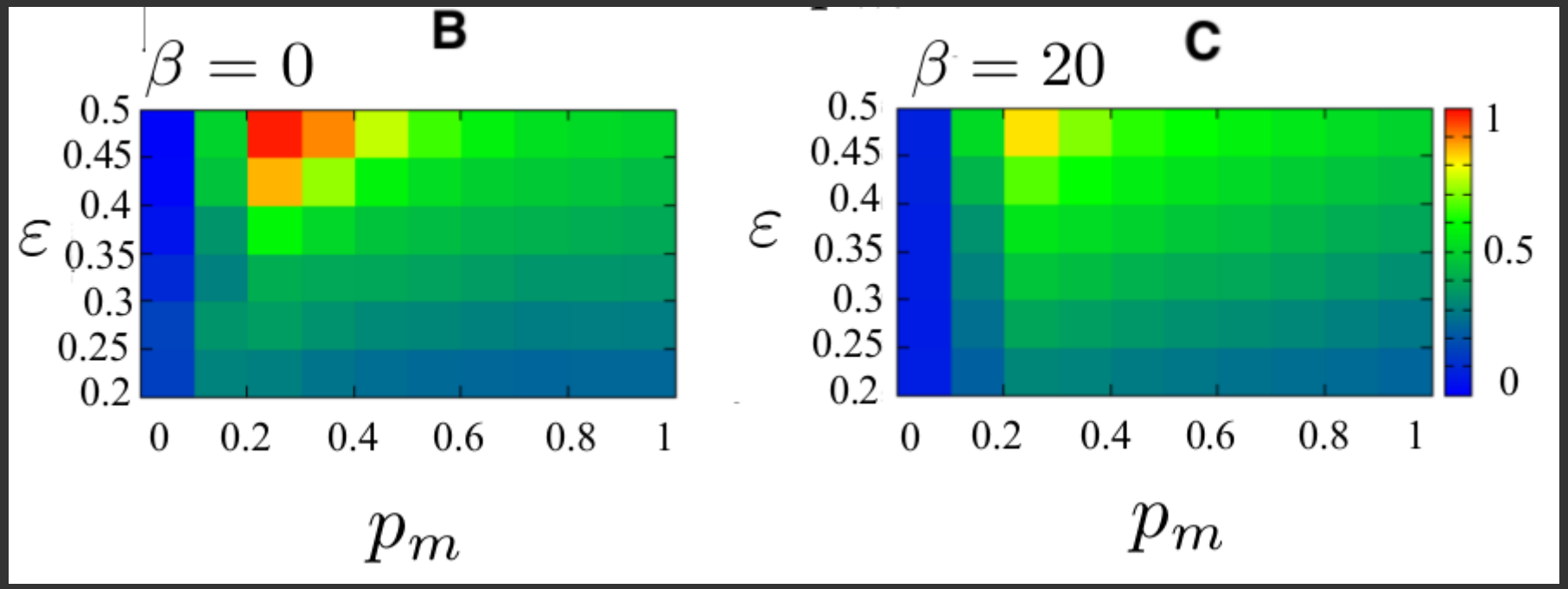
$$if \quad |\theta_I - \theta_M| < \varepsilon$$

$$\langle\theta\rangle_{IM} = (\Theta_M + \theta_I)/2 \quad \begin{cases} \theta_I = \langle\theta\rangle_{IM} \\ \Theta_M = \Theta_M \end{cases}$$

A. Single replica evolution of the system



B. Distribution for the final state (20 replicas)
Red shapes represent the case for β = 0,
Blue shapes represent the case for β = 30



Averaged proportion of agents aligned with the imposed mass media

Homophily model:

Work in progress

By *Jure Leskovec*

STANFORD UNIVERSITY

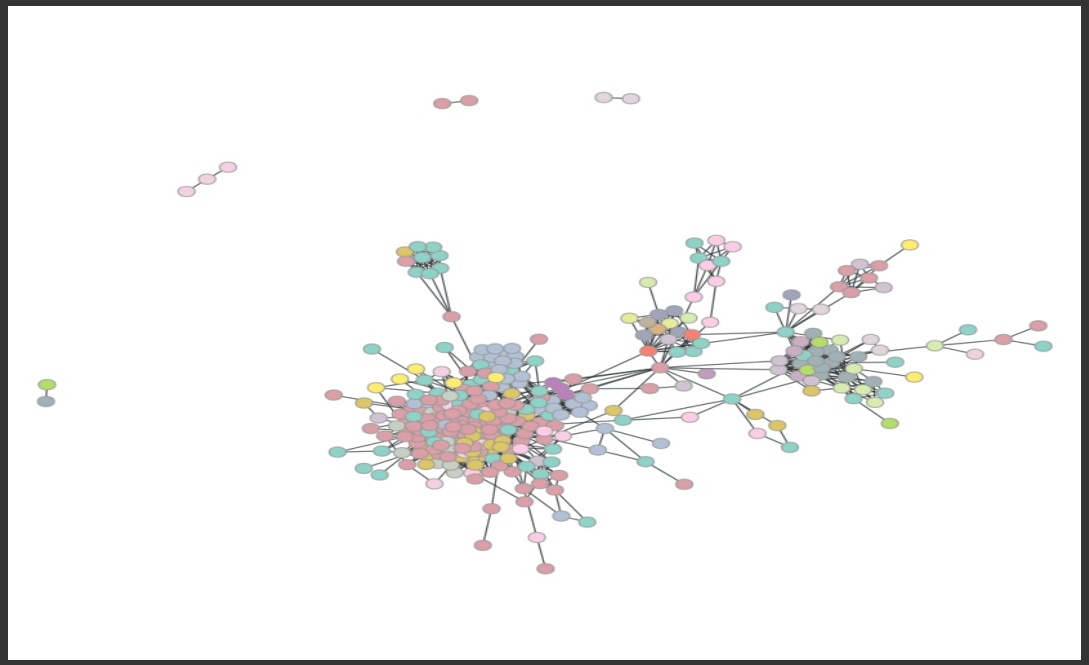
Stanford Large Network Dataset Collection

Social networks

Name	Type	Nodes	Edges	Description
ego-Facebook	Undirected	4,039	88,234	Social circles from Facebook (anonymized)
ego-Gplus	Directed	107,614	13,673,453	Social circles from Google+
ego-Twitter	Directed	81,306	1,768,149	Social circles from Twitter
soc-Epinions1	Directed	75,879	508,837	Who-trusts-whom network of Epinions.com
soc-LiveJournal1	Directed	4,847,571	68,993,773	LiveJournal online social network
soc-Pokec	Directed	1,632,803	30,622,564	Pokec online social network
soc-Slashdot0811	Directed	77,360	905,468	Slashdot social network from November 2008
soc-Slashdot0922	Directed	82,168	948,464	Slashdot social network from February 2009
wiki-Vote	Directed	7,115	103,689	Wikipedia who-votes-on-whom network
wiki-RfA	Directed, Signed	10,835	159,388	Wikipedia Requests for Adminship (with text)

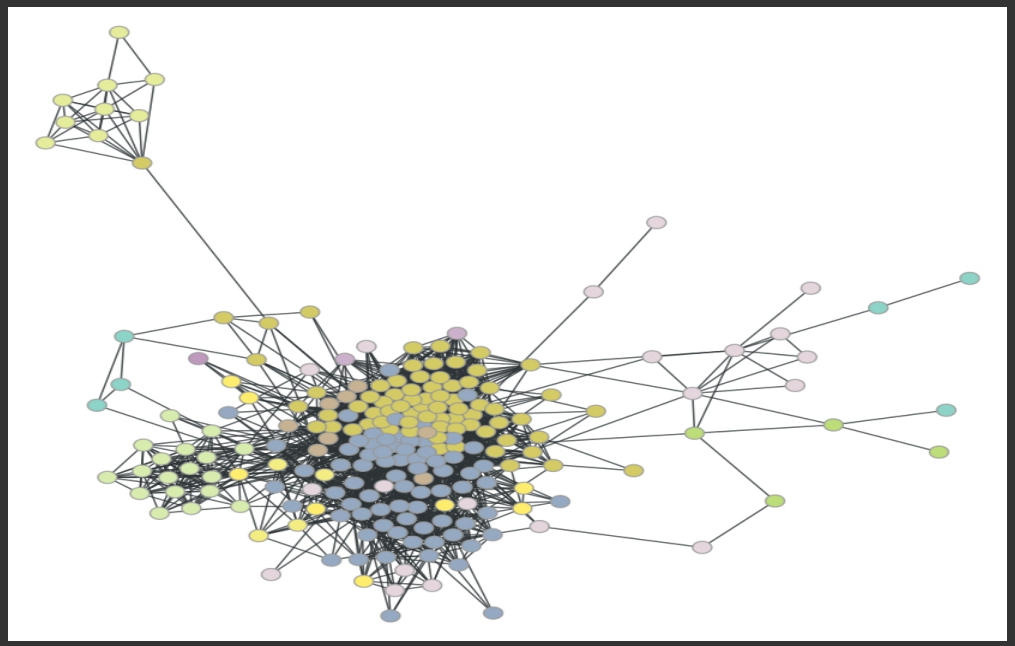
Homophily model:

Work in progress



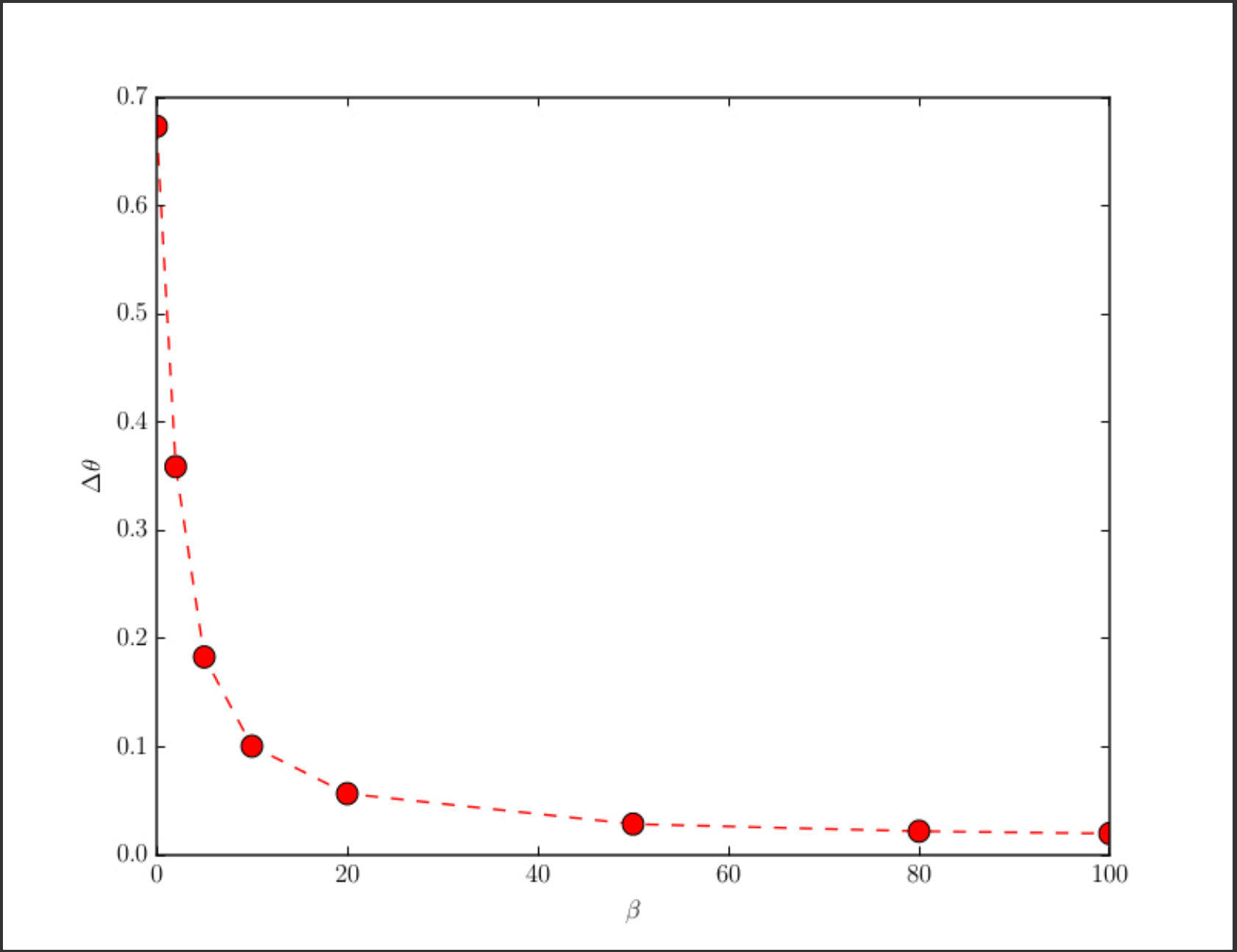
Ego-networks: for several users, friends are divided by circles and the data contains some preferences of these users, like political inclination.

Two examples



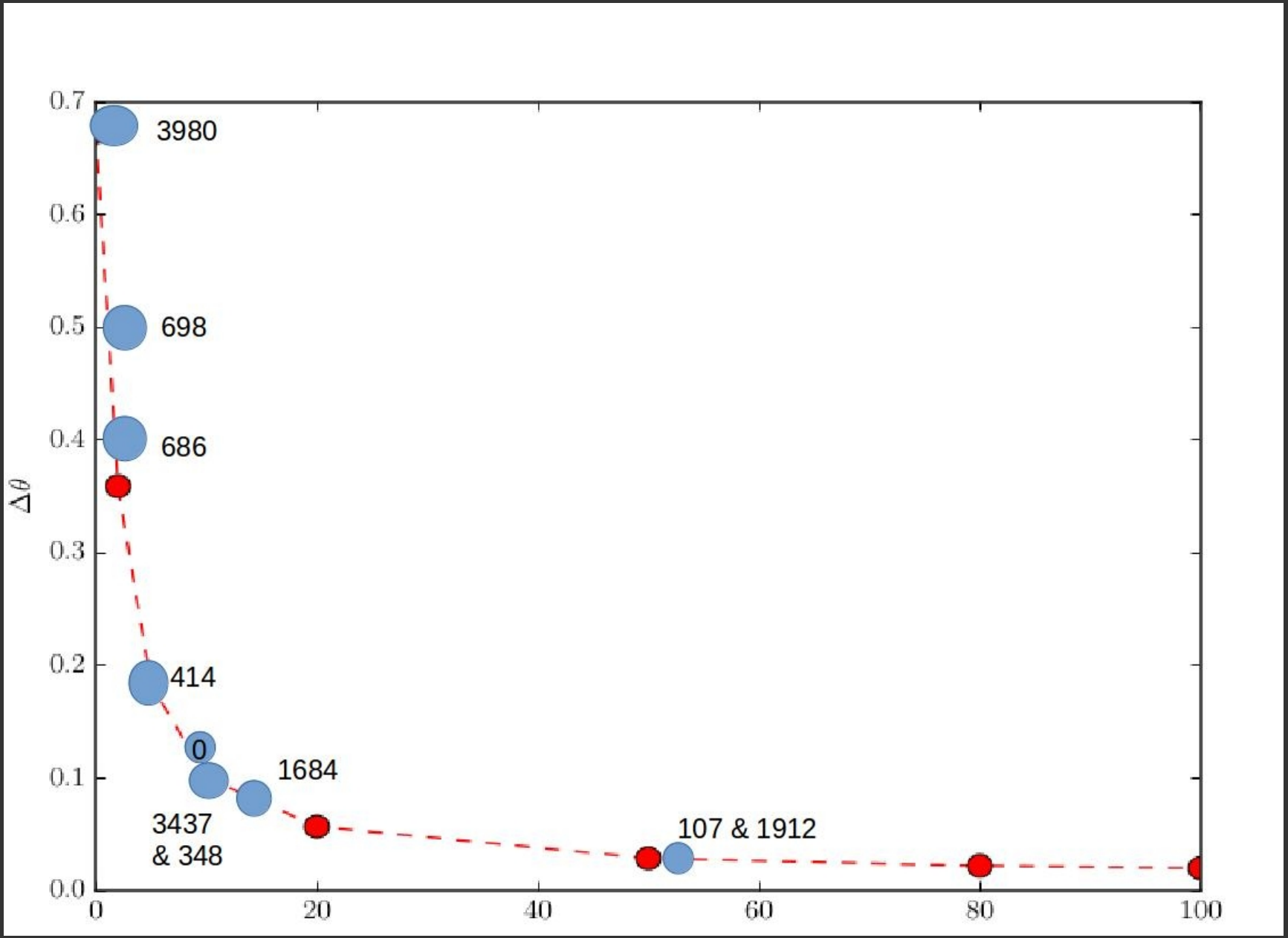
Homophily model:

Work in progress



Homophily model:

Work in progress



Conclusions

Three related subjects:

- Network morphogenesis: preferential attachment mechanism and homophily effect → networks with the same power-law degree distribution as the BA networks, but with marked communities of nodes sharing similar opinions

- The bounded confidence model on such topology showing that, contrary to established ideas, homophily in social networks favors consensus formation.

- Tthe critical value of tolerance (= 0.5), previously reported as the threshold for BC models to shift between total consensus and different opinions, loses its "universal" character when considered in more realistic networks, as the ones formed with community structures.

Conclusions

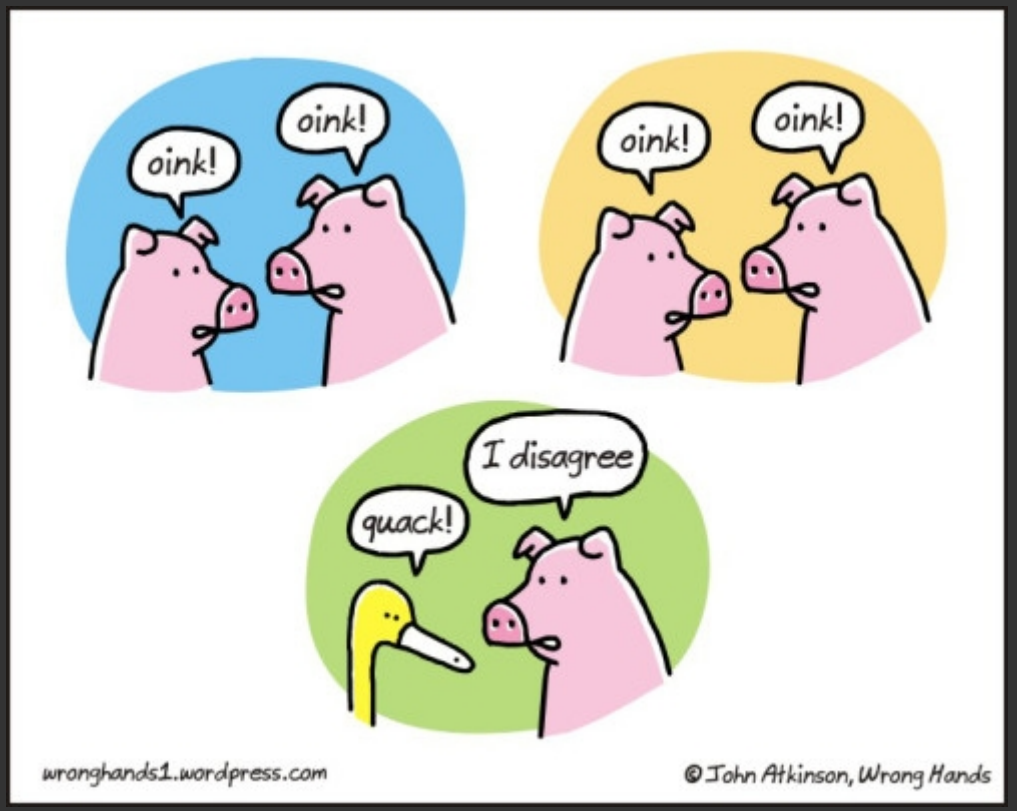
- Mass media over the BC models with homophily scale-free networks.

- homophily has a double effect: first, it decreases the effectiveness of the media pressure, facilitating the emergence of counter opinions also for lower values of the media pressure.

On the other hand, when the community structures (typical of homophily-based networks) face dominant messages, disaggregated non-aligned states converge into just one (or few) strong counter-opinion cluster, representing a strong polarization of the opinions in the societies.

- The strong polarization against the dominant message is promoted by low values of tolerances.

Thank you!!!



ygandica@gmail.com

https://yerali.wordpress.com