Project 9: Beyond Rational Herding

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Outline

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- Baseline Model
- Our Setup
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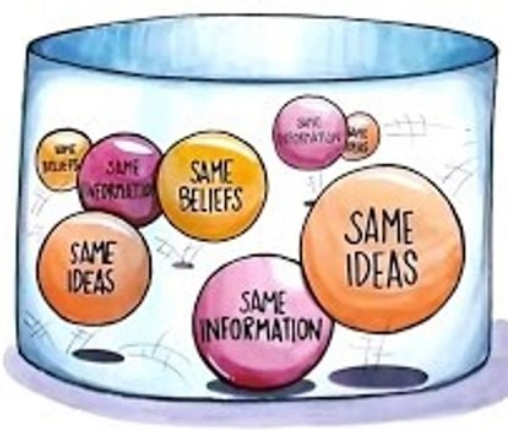
Introduction

Information Bubble

- People receive information that is tailored to fit the pre-existing ideologies or interests (Geschke, Lorenz, & Holtz, 2019)
- Linked to rapid societal changes, e.g., Brexit and the polarization of the US American society
- Damage healthy civic discourse and open-minded deliberation



Possible factors

- Selective exposure (Frey 1986) and homophily (Centola, 2011; Marsden, 1988)
- Social influence (Friedkin, 2006)
- Reinforced by algorithmic personalisation, personalised recommender systems, and personalized search engines (Bozdag & van den Hoven, 2015; Del Vicario et al., 2016)

Introduction

Aim: *Propose an alternate social model to explain the systematic formation of information bubbles*

Baseline Model

The Social Climbing Game (Bardoscia et al. 2013)

Key features:

- An undirected network where agents can use their links to contact more "influential" members of the society

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- Utility of agents depend on their centrality and their neighbours' centrality, i.e.

$$u_i = \sum_{j=1}^{N} a_{ij} k_j + \mu k_i$$

where k_i is the centrality(or degree) of agent i, and μ is the relative weight of i's centrality with respect to that of i's neighbours

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the link (i, j) is replaced with (or rewired to) link (i, l), where Δu_i is the corresponding change in i's utility.

Social Climbing Game (Bardoscia et al. 2013)

The more efforts we put in to become influential in society (higher β), the more hierarchical the society becomes (right-side figure).

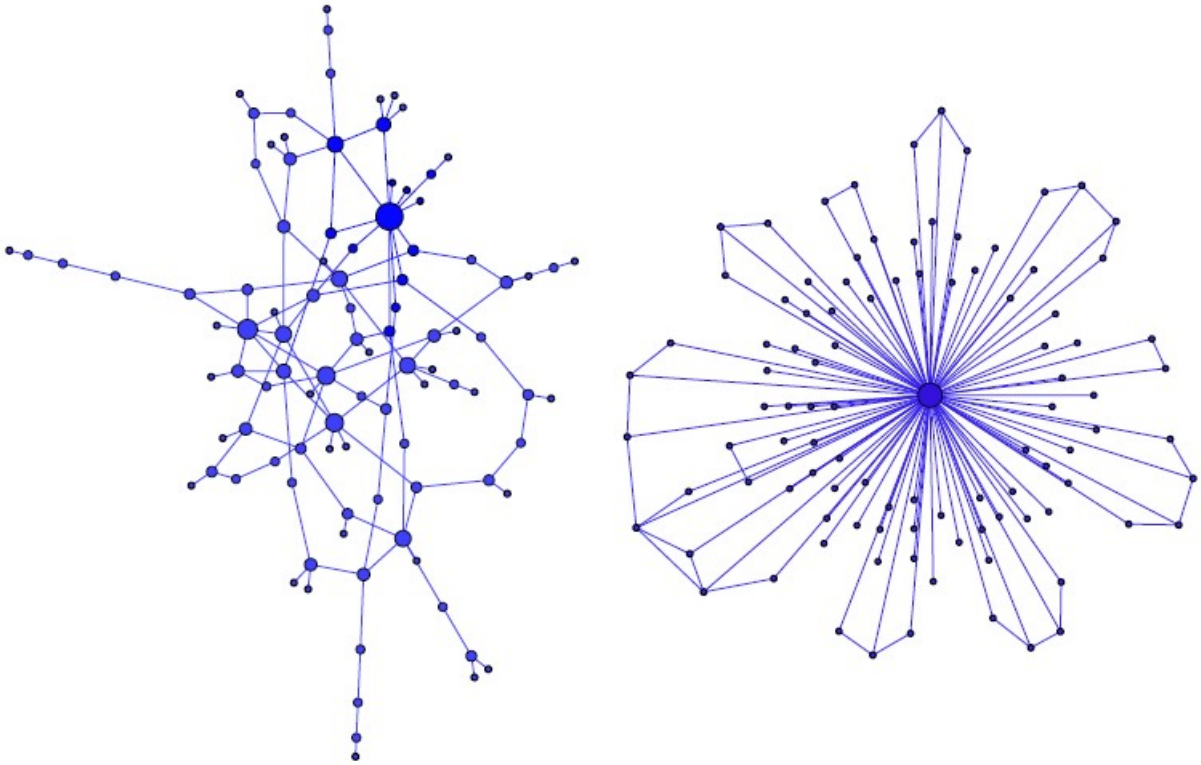
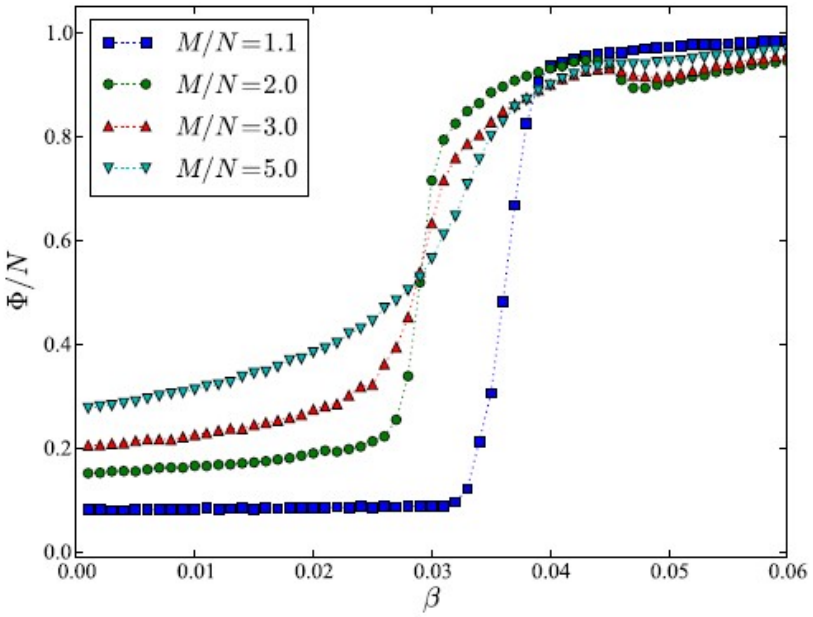


Fig. 1 Snapshot of networks of the social climbing game for $N = 100$, $M = 125$ for $\beta = 0.03$ (*left panel*) and $\beta = 0.1$ (*right panel*). Size of the nodes is proportional to the degree

Social Climbing Game (Bardoscia et al. 2013)

Fig. 2 Dependence of the largest degree Φ (divided by N) in the social climbing network as a function of the inverse temperature (or intensity of choice parameter) β. The *different curves* refer to $N = 100$ and $M = 110, 200, 300, 500$. For each value of β the reported values of Φ are obtained by averaging over 100 networks. An abrupt change in is observed in all curves after a threshold value of β, with Φ/N going from low values to values close to one, signaling the emergence of a star, i.e. a link with $\mathcal{O}(N)$ links, in the network



Our Model (Extension of The Social Climbing Game)

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- Utility depends on centrality and social norm (or comfort)

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- Static strategy: λ fraction of people reveal their personal ideology: $\{R_i \in \{0, 1\}\}_{i=1}^{N}$
- Measure social norm:

$$\text{for 'left' agents, } s_i = \frac{\sum_{j=1}^{N} a_{ij} I_{\{P_i = R_j * P_j\}} + \theta * \sum_{j=1}^{N} a_{ij} I_{\{R_j * P_j = 0\}}}{k_i}$$

$$\text{for 'right' agents, } s_i = \frac{\sum_{j=1}^{N} a_{ij} I_{\{P_i = R_j * P_j\}} + (1-\theta) * \sum_{j=1}^{N} a_{ij} I_{\{R_j * P_j = 0\}}}{k_i}$$

Our Model Setup

Utility:

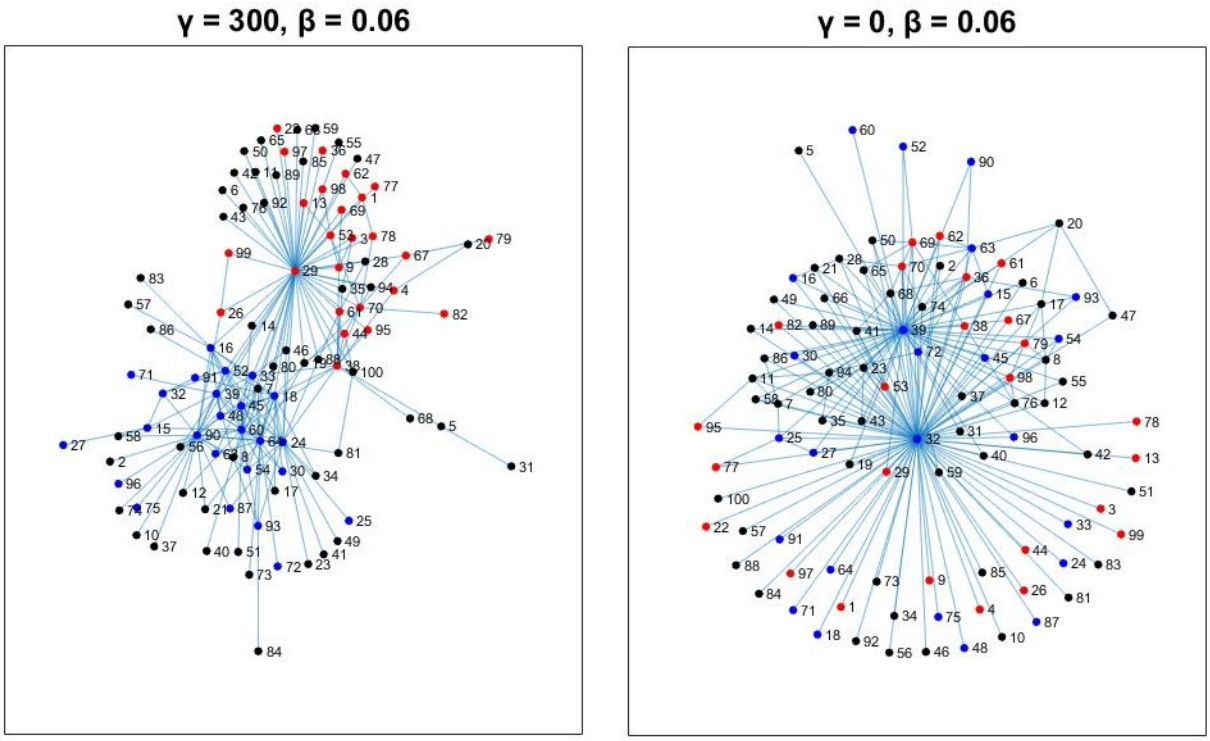
$$u_i = \sum_{j=1}^{N} a_{ij} k_j + \mu k_i + \gamma s_i$$

where γ captures the relative importance of social norm (or comfort) in society. The first two terms together capture the importance of popularity.

Dynamics is same as that in the social climbing game.

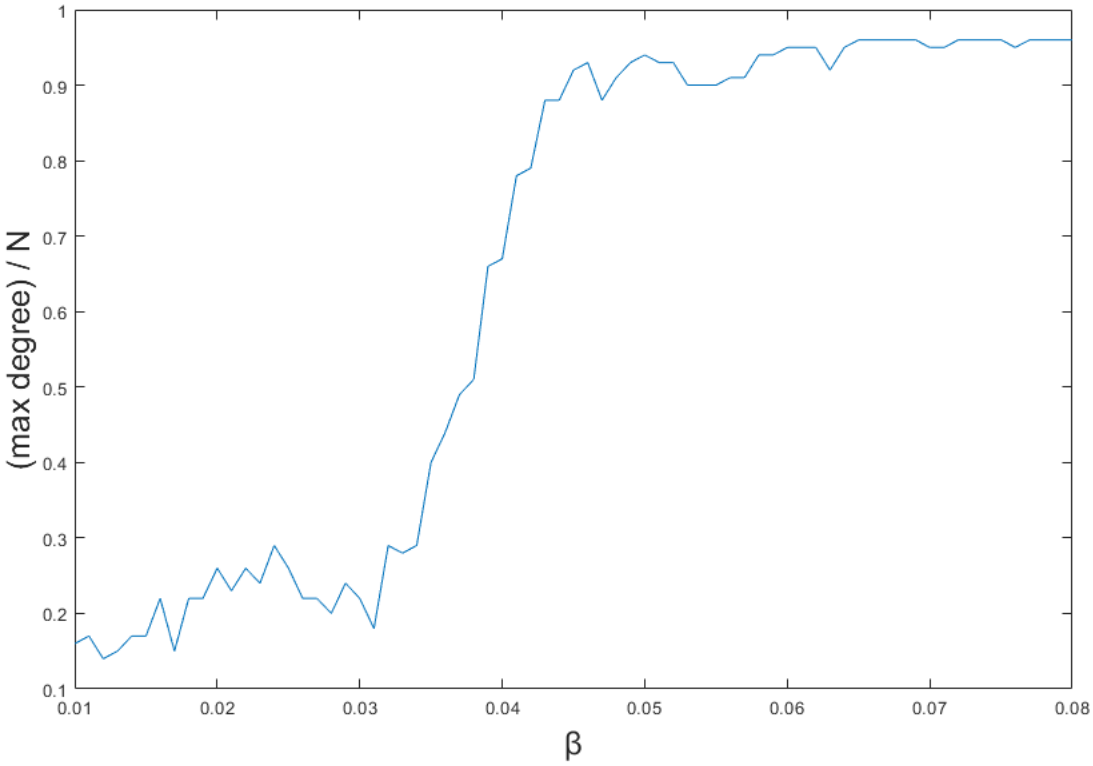
Results

Snapshots of the evolved network with a network segregated into two clusters (left panel) and a network with no segregation (right panel)



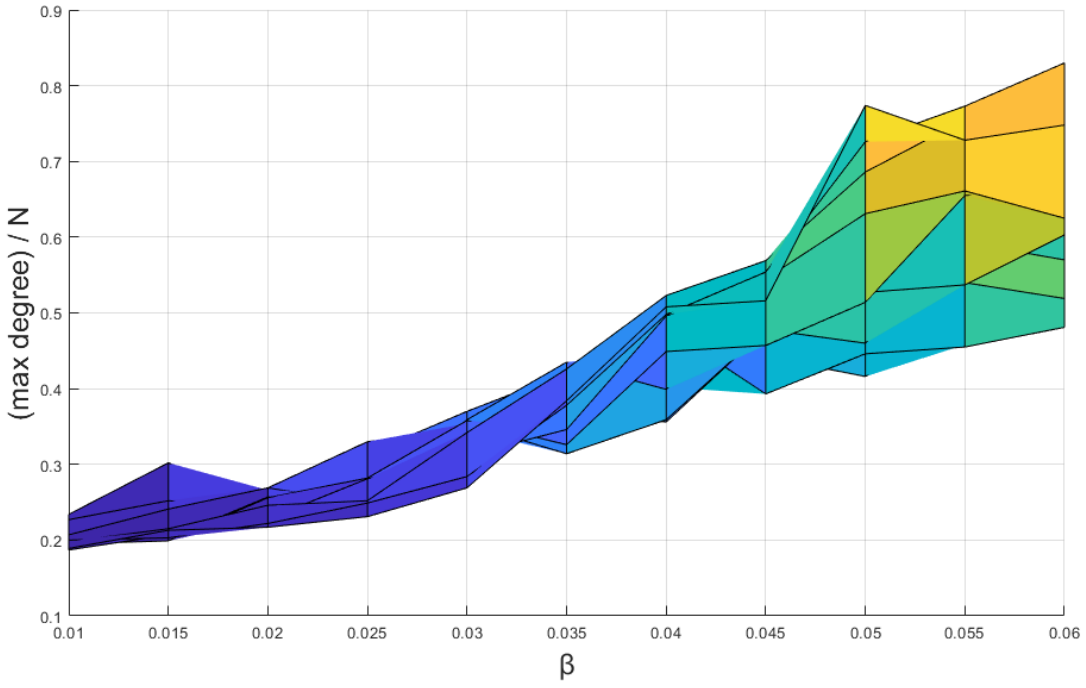
Results

$\gamma = 0$ gives the result of the social climbing game as expected



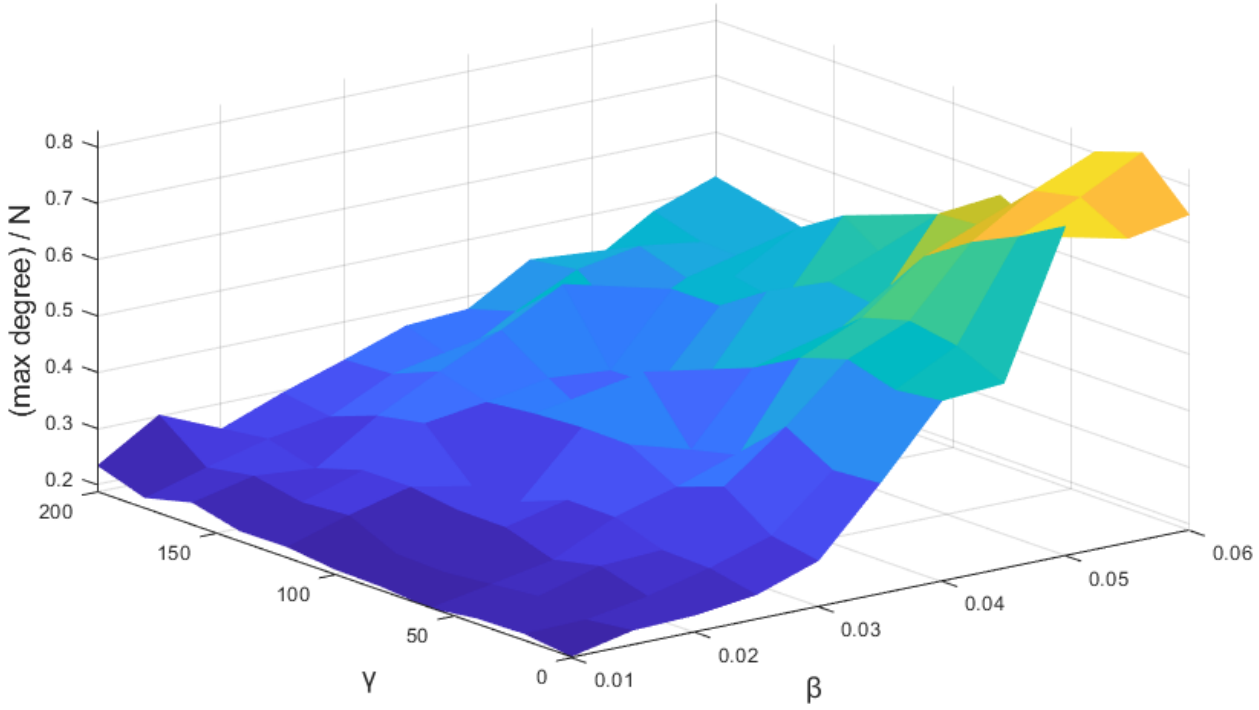
Results

As γ increases, the max degree of the network reduces and have an upper limit of 50 when γ is very large.



Results

Dependence of the maximum degree (divided by N) in the social network as the function of β (intensity of efforts) and γ (relative importance of social norm/comfort)



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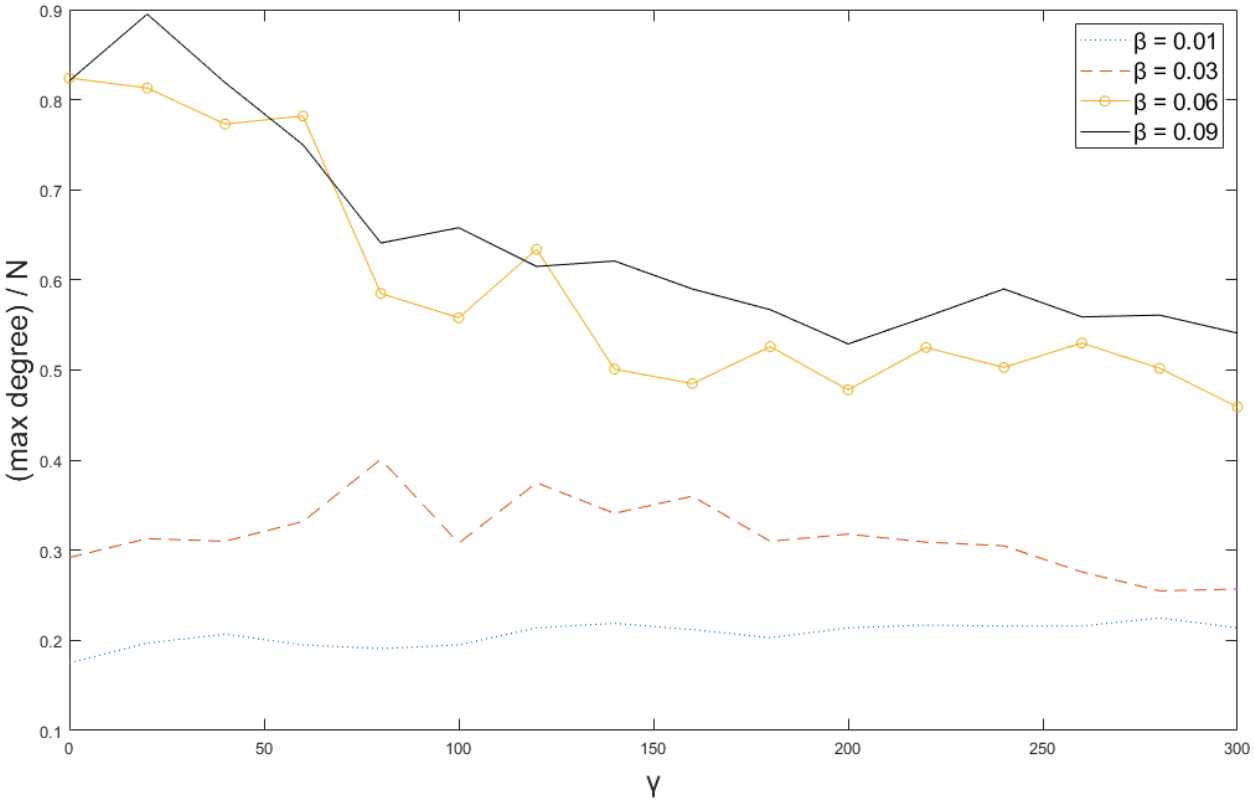
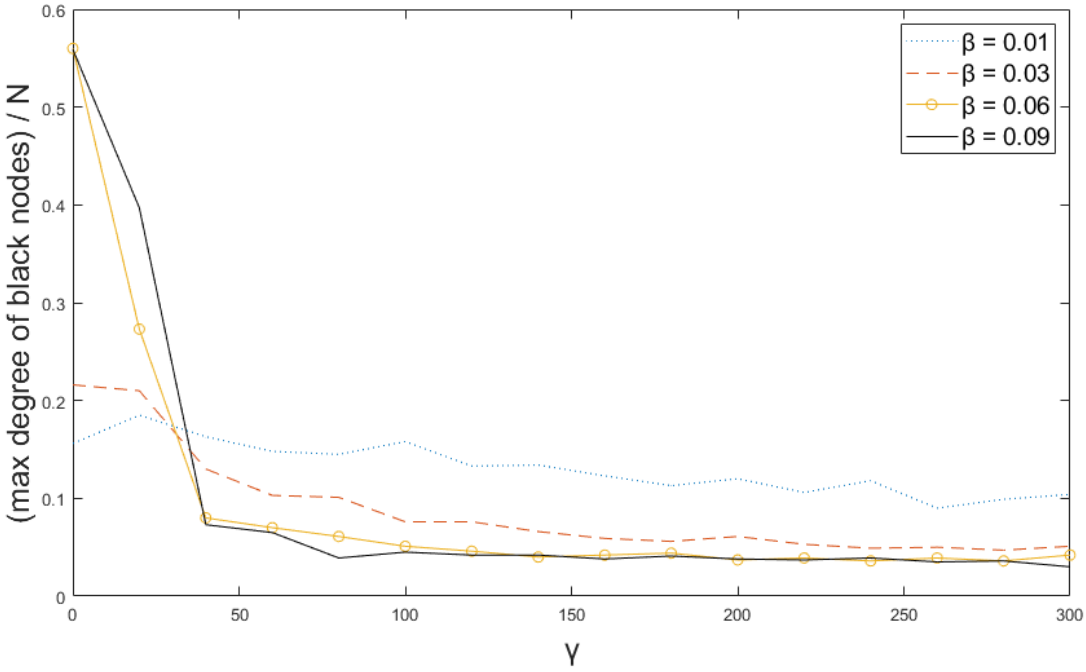
The maximum degree of the network converges to 50 as we increase γ.



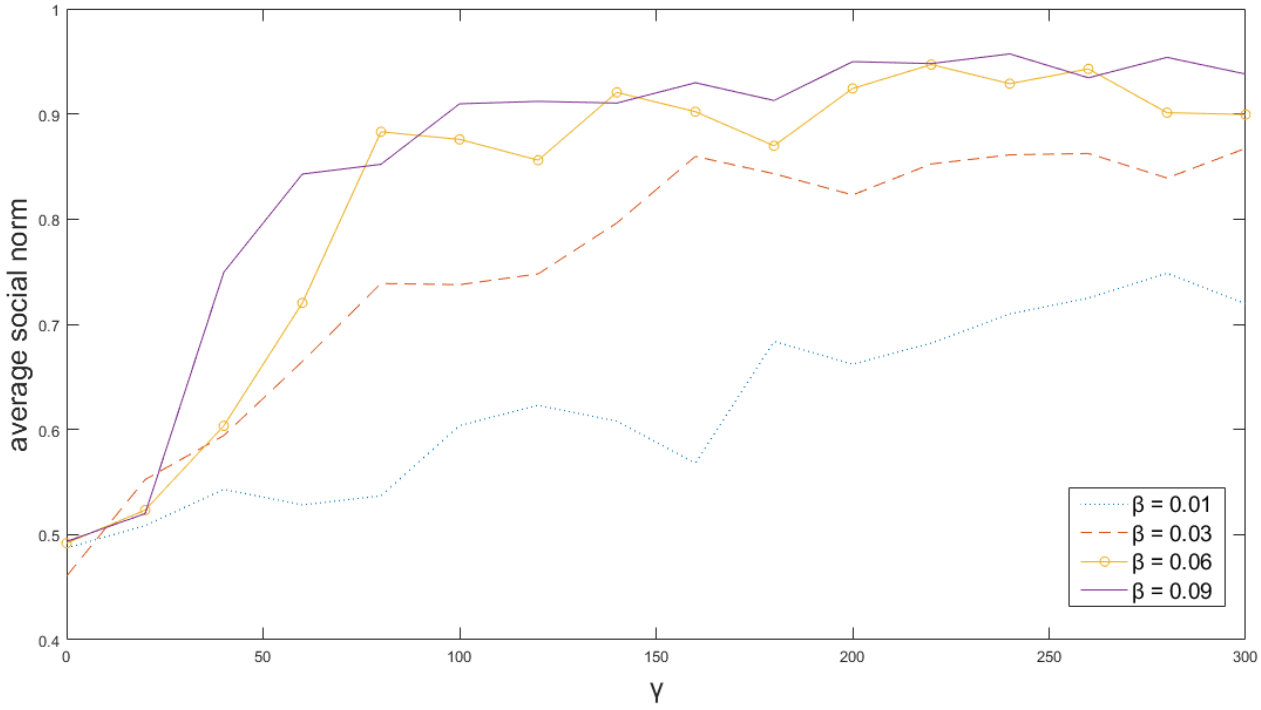
Results

However, the agents who do not reveal their ideology publicly tend to lose their influence in society significantly



Results

Overall social norm increases as we increase the γ. The rate of this increase steepens if β is high.



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On the contrary, if all our friends advocate for the same ideology, we will start advocating publicly too.

Inspired from such social situations, we change the dynamics in the following way.

Possible Extension (To try)

New Dynamics:

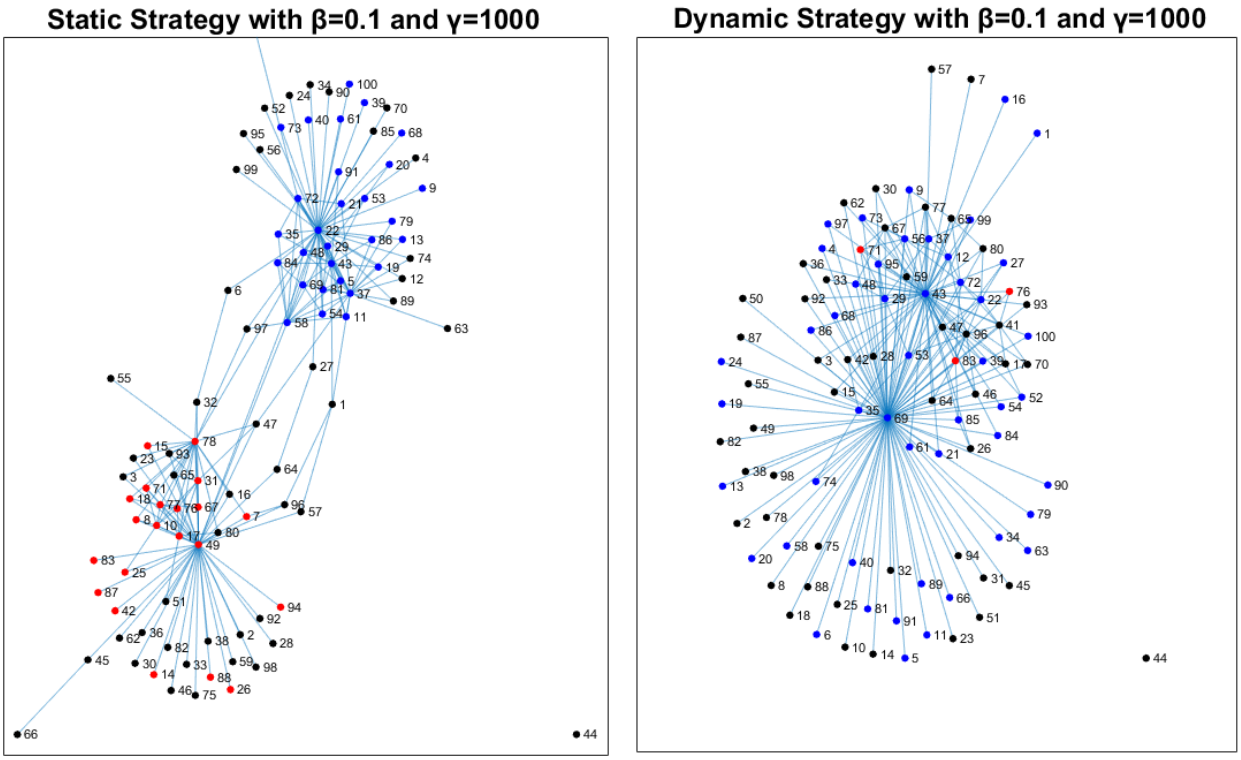
- At any time, an agent i is picked at random together with one of her neighbours, j. Then, a neighbour l of j is selected at random, $l \neq i$
- If social norm of agent i is 0, then R_i will change to 0 if it was 1. If social norm of agent i is 1, then R_i will change to 1 if it was 0.
- If l is already connected to i, nothing happens. Otherwise, with probability

$$p_{(i,j)\to(i,l)} = \frac{e^{\beta \Delta u_i}}{1 + e^{\beta \Delta u_i}},$$

the link (i, j) is replaced with (or rewired to) link (i, l), where Δu_i is the corresponding change in i's utility.

Possible Extension (To try)

With this dynamic strategy, the social network evolves to have a dominant group of one ideology (right panel)



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- The relative importance for comfort with social norm with respect to popularity may moderate the intensity of information bubbles and also the social hierarchies within those information bubbles
- Not revealing our ideology publicly may reduce our social influence (or popularity) in the social network
- If we change our decision to publicly advocate for our ideology when our social norm is opposite, it might lead to dominance of one political side.

Future Research Directions

- Increase psychological foundations of assumptions about individuals' ideologies and strategies. For example, use a spectrum to represent ideologies, rather than a binary relation.
- Test the role of social influences, whereby people form or adjust their (expressed) ideologies according to social norms.
- Explore the dynamic strategy of revealing ideology publicly or not, more comprehensibly for deeper understanding
- Possibly do some empirical study on this mechanism and compare insights with our results

Thank you!

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