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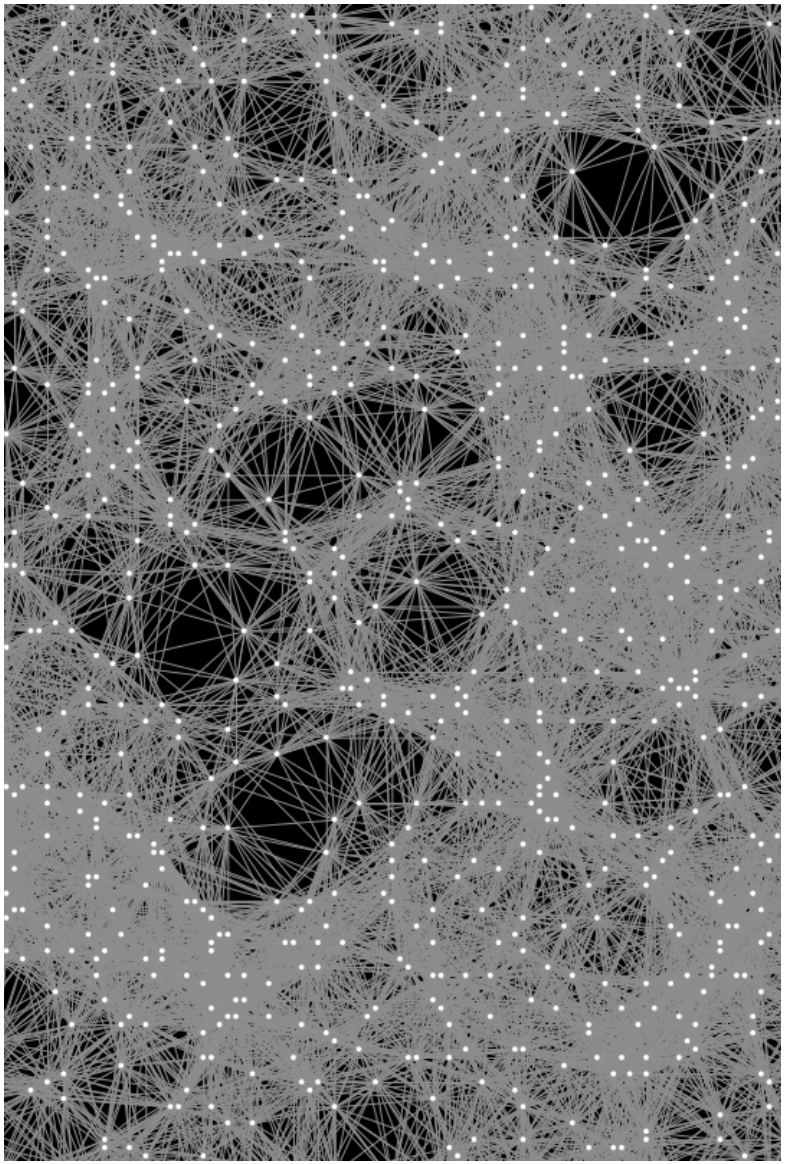
Structural Inertia to Social Media Silence: A Multilevel Analysis of the Network Topology Effects on Participation

Dongyoung Sohn
Yong Suk Choi

Center for Computational Social Sciences (C^2S^2)
Hanyang University, Seoul, Korea

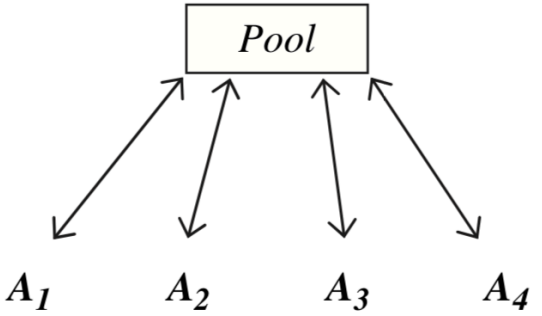


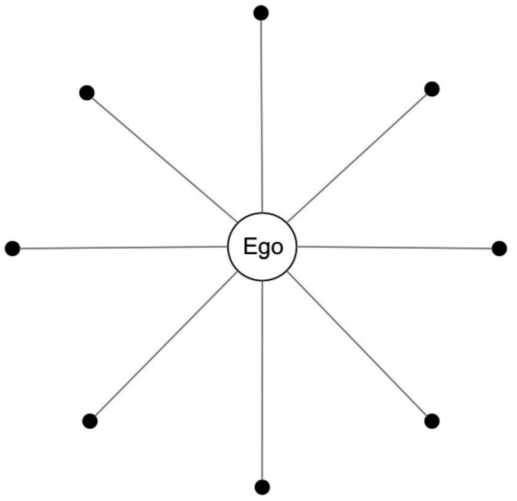
Silent Majority in Social Media

- Degrees of communication through posting messages exhibit significant disparities across individuals
  - The top 1% of social media users produce more than 70% of the posts (Heil & Piskorski, 2005; van Mierlo, 2014)
  - Less than 1% of Wikipedia users perform more than half of all edits (Swartz, 2006)
  - More than 80% of social media users think themselves as being idle rather than active in communication (Williams et al., 2012)
- The silent majority called *lurkers* has attracted much scholarly attention (Na, Rau, & Ma, 2014)
- The ubiquity of lurking behaviors leads to a question – <u>what makes such disparities in individuals' voluntary participation in communication so prevalent?</u>

Communication Dilemmas in Networks

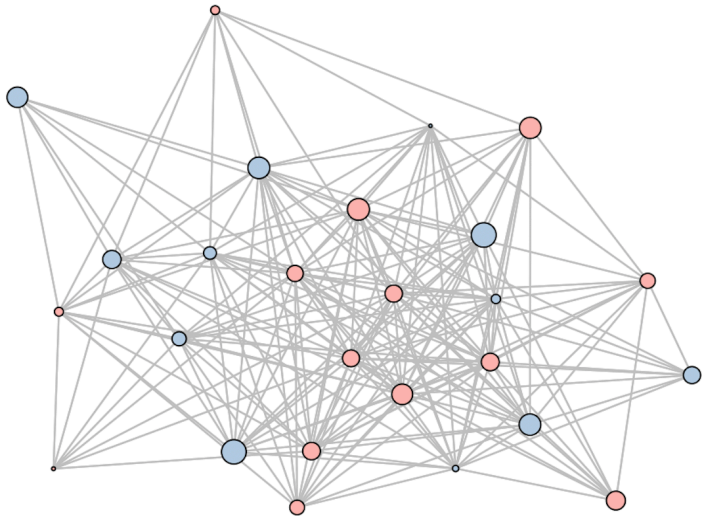
- Voluntary cooperation among social media users is often subject to an incentive structure that gives rise to *communication dilemma* – a state in which "it is in the collective interest of network members to communicate, but in each separate interests to hoard information"(Bonacich, 1990, p. 448)
- Individual motivation to post messages may vary depending on their positions in networks



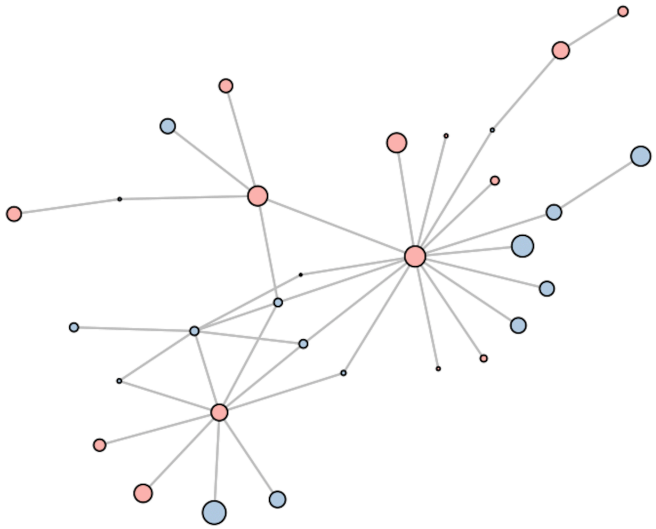


Communication Dilemmas in Networks

- Communication in network structures



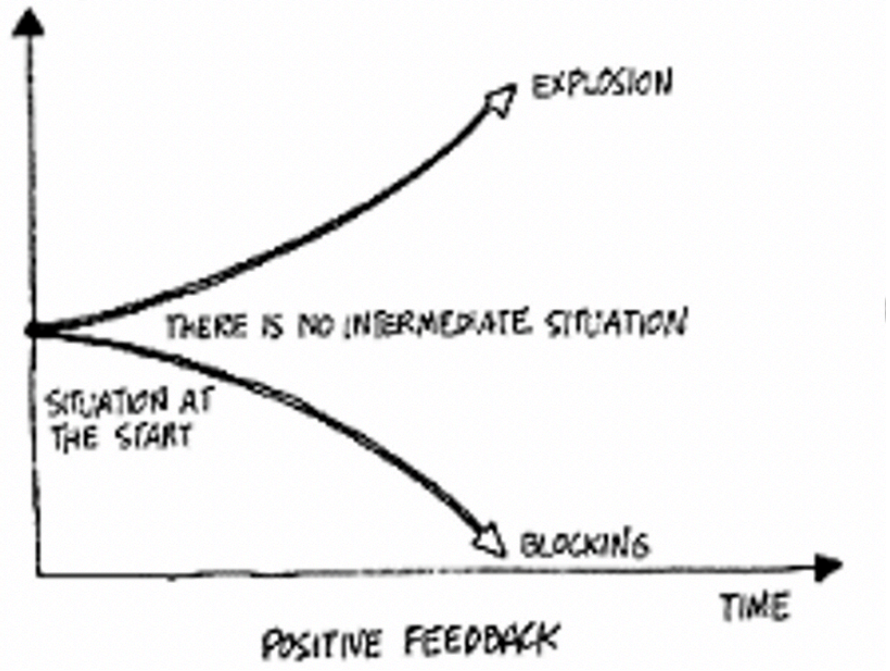
a) Sub-Network with
Higher Level of Communication



b) Sub-Network with
Lower Level of Communication

Communication Dilemmas in Networks

- Initial small differences can be compounded through network structures (DiMaggio & Garip, 2012), widening the gap between those active and inactive in communication
- This *path-dependent process* (aka. Matthew effect) can be observed in any situation where individual behaviors are conjoined by those of others
- A highly skewed distribution of voluntary posting of messages we see might have been emerging through such a *structural path-dependent process*



Communication Dilemmas in Networks

- Do the cumulative count of messages posted vary depending on the individual positions in networks (e.g., direct/indirect centrality)?
- Do the cumulative count of messages posted vary depending on *the structural characteristics of networks* they are part of?
- Are there significant cross-level interactions between the effects of individual- and network-level structural properties on the cumulative message counts?

Communication Dilemmas in Networks

- The behavioral data of 15,633 Facebook users nested in 73 local networks were collected and analyzed
- The main dependent variable was the individuals' cumulative amount of messages posted; individuals' gender and age of account were also included
- Actor-level positional characteristics as well as network-level structural characteristics were calculated and incorporated together

Communication Dilemmas in Networks

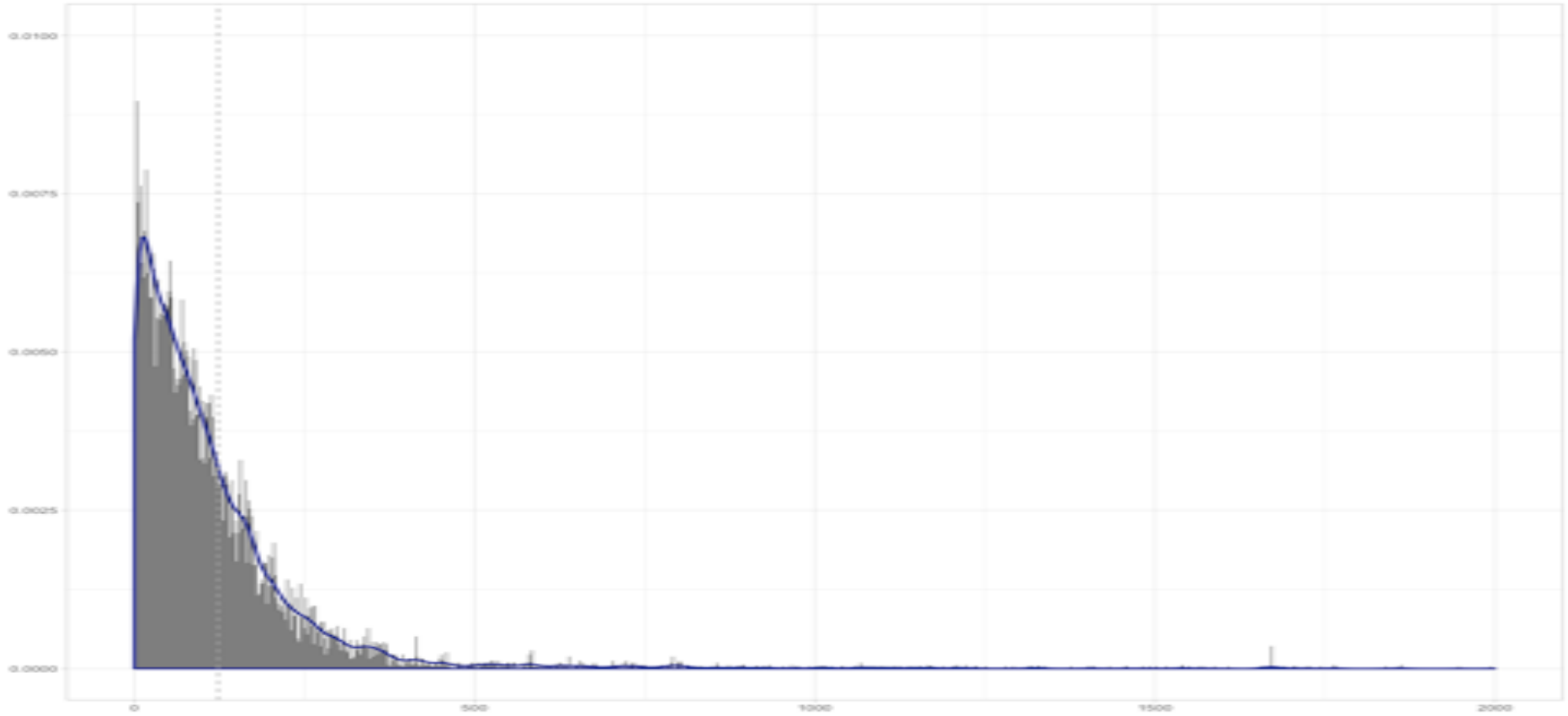
Table 1. Descriptive Statistics of Individual and Network-Level Characteristics

	N	Mean	SD	Max	Min
Individual-Level					
Cum. Message	15,633	123.9	236.13	8,500	0
Degree	15,633	41.22	44.91	414	0
PageRank Centrality (PRC)	15,633	.0047	.0047	.0662	.0003
Network-Level					
Gender-BDI[a]	73	.46	.061	.50	.096
Size	73	291	126.77	510	29
Degree (Group Mean)	73	41.22	12.43	77.14	6.04
PRC (Group Mean)	73	.0047	.0036	.0345	.0020
Transitivity (%)	73	52.66	14.07	87.34	27.78
Component Ratio (%)	73	6.76	3.77	27.69	.68
Density (%)	73	9.1	6.45	55.62	3.18
Diameter	73	8.04	2.30	14	2

Note: Shown above are the descriptive statistics of the key variables prior to normalization.

a. The maximum value of Gender-BDI is 0.5, indicating that the gender distribution is maximally heterogeneous.

Communication Dilemmas in Networks



Distribution of Message Contribution

Communication Dilemmas in Networks

- Cumulative message counts of FB users follow a highly skewed distribution confirming the presence of serious disparity in participation
- To consider the overdispersion, a *negative binomial* (NB) distribution was used; NB allows an extra variation of variance with θ parameter:

$$NB_{var} = \lambda + \lambda^2 \,/\, \theta$$

- We set $\theta = 0.85$ to closely approximate the actual distribution shown on the right

Communication Dilemmas in Networks

- The generalized multilevel linear models constructed shared the following basic form:

$$\log(Y_{ij}) = \beta_0 + \zeta_{0j} + (\beta_1 + \zeta_{1j})x_{1ij} + \beta_2 x_{2j} + \beta_3 x_{1ij}x_{2j} + \varepsilon_{ij}$$

Cumulative message count of a person *i* nested in a *j*th network

Random individual-level effects

Fixed network effects

Cross-level interaction effects

- Likelihood ratio tests confirmed a statistically significant difference existing between models with and without a random intercept, $\chi^2(2) = 1715.29, p < .001$
- The intra class correlation (ICC) was 0.1451, meaning that the between-network variance accounted for 14.51% of the total variance in the data, which justified the need for a multilevel analysis

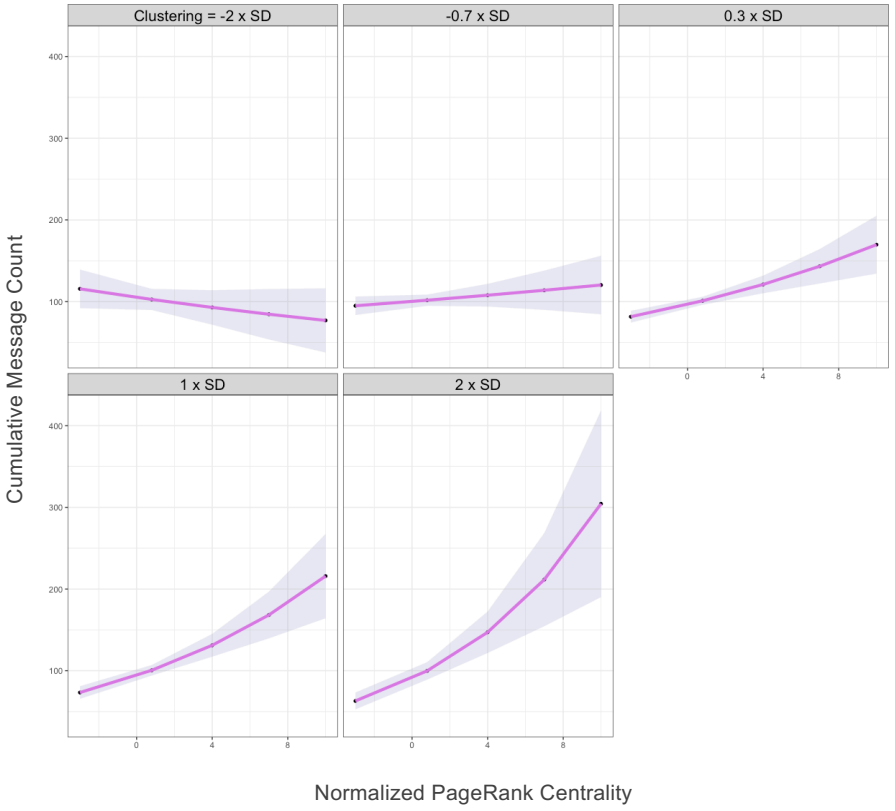
Communication Dilemmas in Networks

- Multilevel statistical analyses results

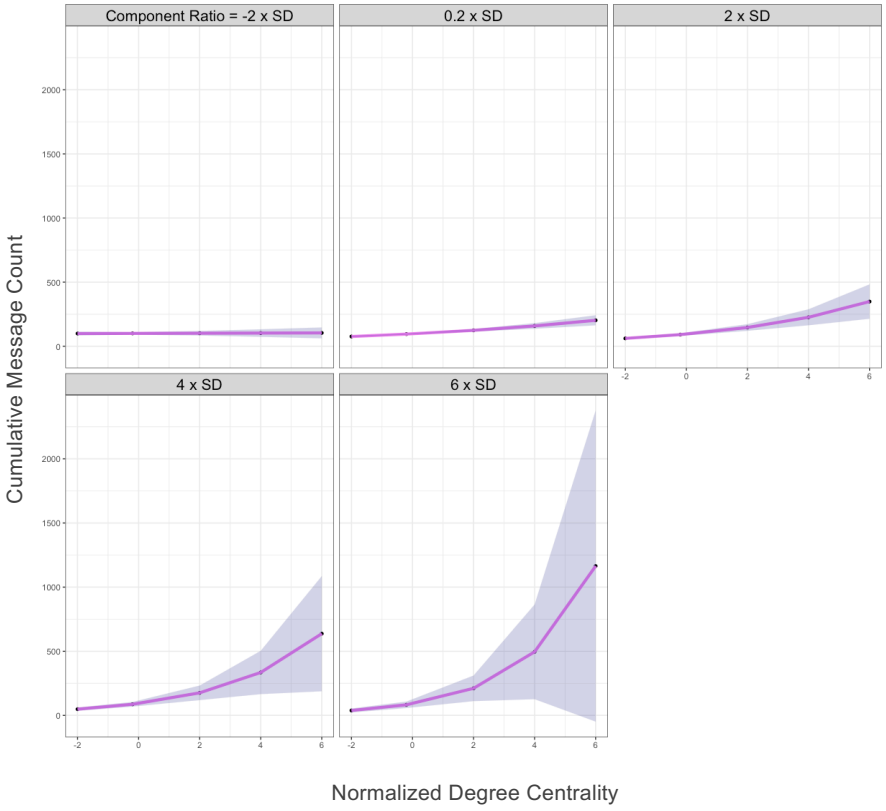
	Model I	Model II	Model III	Model IV	Model V
Individual-Level Predictors					
Use Length	1.41 (.03)***	1.46 (.10)***	1.41 (.10)***	1.42 (.10)***	1.42 (.10)***
Gender (male)	-.18 (.02)***	-.20 (.03)***	-.20 (.03)***	-.20 (.03)***	-.20 (.03)***
Degree	.12 (.01)***	.08 (.03)**	.21 (.05)***	.21 (.05)***	.22 (.05)***
PageRank Centrality (PRC)	-.01 (.01)	.04 (.02)	.14 (.04)***	.14 (.04)***	.12 (.04)***
Individual-Level Interactions					
Gender x Degree			-.06 (.02)**	-.06 (.02)**	-.06 (.02)**
Use Length x Degree			-.17 (.06)**	-.15 (.06)**	-.16 (.06)**
Use Length x PRC			-.15 (.06)**	-.16 (.06)**	-.14 (.06)*
Network-Level Predictors					
Gender-HHI				-.24 (.53)	-.14 (.50)
Degree (Group Mean)				.13 (.04)**	.14 (.05)**
PRC (Group Mean)				-.08 (.03)*	-.22 (.06)***
Clustering				-.05 (.05)	-.04 (.05)
Component Ratio				.02 (.04)	-.01 (.05)
Cross-Level Interaction					
Degree x Clustering					-.04 (.03)
Degree (Group) x Clustering					-.03 (.05)
PRC x Clustering					.04 (.02)*
PRC (Group) x Clustering					.09 (.03)**
Degree x Component Ratio					.05 (.03)*
Degree (Group) x Component Ratio					-.01 (.03)
PRC x Component Ratio					-.03 (.02)
PRC (Group) x Component Ratio					.03 (.02)

Communication Dilemmas in Networks

- Multilevel statistical analyses results



a) Actor PageRank Centrality x Network Clustering



b) Actor Degree Centrality x Network Component Ratio

Communication Dilemmas in Networks

- The findings confirm that individual cumulative participation in communication may be closely related with the kinds of networks they are part of and their positions therein – network structure matters.
- This suggests that a mechanism in which individuals are locked in such a path-dependent process may also be at work, leading a great majority of social media users to silence.
- Social media users might be reluctant to post messages partly because the surrounding social fabrics and dynamics have not encouraged them to do so.
- Further studies are necessary for illuminating the cumulative effects of networks on social outcomes.