Analysis of Social Network Data: Some Empirical Studies

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Social Networks and National Economy

- Eagle et al. (Science, 2010) "Network diversity and economic development":
  - Hypothesis:
    - Social network theorists have long been interested in the relationship between network structure and economic activities.
    - One important hypothesis is that diversity of a network position that an individual occupies is positively correlated to the number of opportunities that the individual can explore.

Social Networks and National Economy

- Eagle et al. (Science, 2010):
  - Aims of the research:
    - However, such hypothesis has not been investigated at the "population" level before.
    - This paper is the first one to conduct such investigation.

Social Networks and National Economy

- Eagle et al. (2010):
  - Network data:
    - The authors collected mobile phone (communication network) data at the "national" level.
    - The data are collected during August 2005 in the UK, containing more than 90% of the mobile phones and 99% of the residential and business landlines and in the UK.
    - The resulting network has roughly 65×10^6 nodes and 368×10^6 links.
  - Economic development data:
    - The "Index of Multiple Deprivation" (IMD) contains information on income, employment, education, health, crime, housing and environment for total $32,482$ communities in the UK.

Social Networks and National Economy

- Eagle et al. (2010):
  - Method:
    - The social diversity of node i is defined by

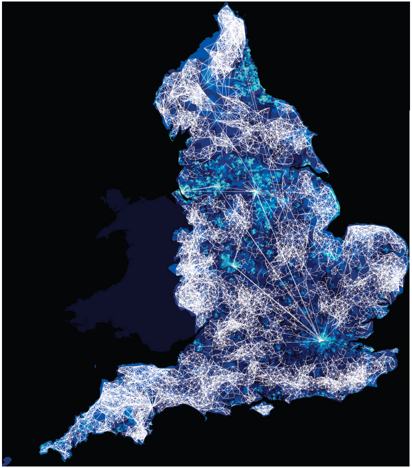
      $$D(i) = \frac{-\sum_{j=1}^{k} p_{ij} \log p_{ij}}{\log(k)},$$

      where $p_{ij} = v_{ij} / \sum_{j=1}^{k} v_{ij}$, and v_{ij} is the volume between node i and j. The higher $D(i)$ is, the more likely the individual will get opportunities for exploration.
    - A similar measure on spatial diversity is also defined.
    - The authors compared the IMD rank of each community with diversity metrics, i.e. $D(i)$, associated with each member's social network.

Social Networks and National Economy

- Eagle et al. (2010):
  - Results:
    - The author found network diversity and spatial diversity were strongly correlated with the IMD rank, $r = 0.73$ and 0.58, respectively.
    - These imply network diversity is positively related to the economic development.

Social Networks and National Economy



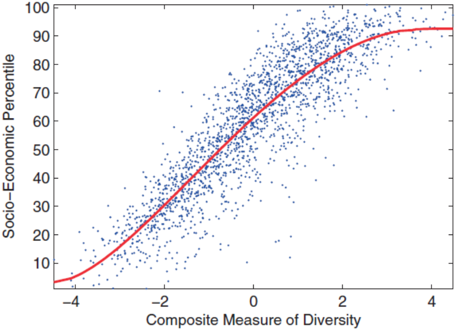


Figure: Sources: Eagle et al. (2010).

Social Networks and National Economy

- Eagle et al. (2010):
  - Quiz:
    - At the individual level, network diversity of an individual is negatively correlated with the social-economic opportunities the individual can explore.
    - At the population level, network diversity of an individual is positively correlated with the social economic rank of a community.

Social Networks in Public Transport

- Sun et al. (PNAS, 2013) "Understanding metropolitan patterns of daily encounters".
    - Motivation:
        - Understanding mechanisms behind daily face-to-face encounters are important as they may have further impacts on **information diffusion** and **spreading processes of various kinds of things**, e.g. transmission diseases.

Social Networks in Public Transport

- Sun et al. (PNAS, 2013) "Understanding metropolitan patterns of daily encounters".
    - Aims of the research:
        - Due to lack of large scale data set, understanding such mechanisms behind daily face-to-face encounters is still limited.
        - The authors investigated these mechanisms by analyzing travel card information on public buses in Singapore.
        - By analyzing the public bus data, the authors are able to construct a time-dependent social network.

Social Networks in Public Transport

- Sun et al. (2013):
  - Data:
    - The main data consist of more than 20 million bus trips from 2,895,750 users over 1 week (about 55% of the resident population) in Singapore.
    - The authors also used data from (a) population census and (b) national household interview travel survey (HITS).

Social Networks in Public Transport

- Sun et al. (2013):
  - Results:
    - Analysis showed that many quantities have regular patterns.
    - The distribution of inter-event time between consecutive encounters of paired individuals has temporal patterns with peaks.
    - The distribution of encounter frequencies is heavy-tailed.

Social Networks in Public Transport

- Sun et al. (2013):
  - Results (contd):
    - The distribution of the duration of an encounter between a pair of individuals has an exponentially decaying tail.
    - The distribution of the total durations of encounters between a pair of individuals displays a power-law tail.
    - In general encounter patterns are regular and an individual's encounter capability, i.e. the chance of an encounter, is a result of such regularity. In turn, these findings explain the "emergence of familiar strangers in daily life".

Social Networks in Public Transport

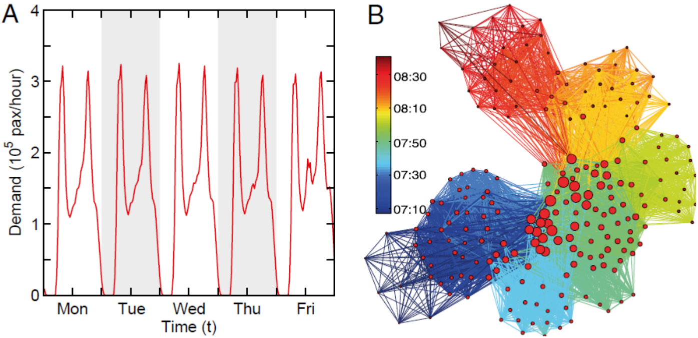


Figure: Left: Departure rate of city bus trips. Right: Time-resolved encounter network on one vehicle service (214 passengers). Sources: Sun et al. (2013).

Social Networks in Public Transport

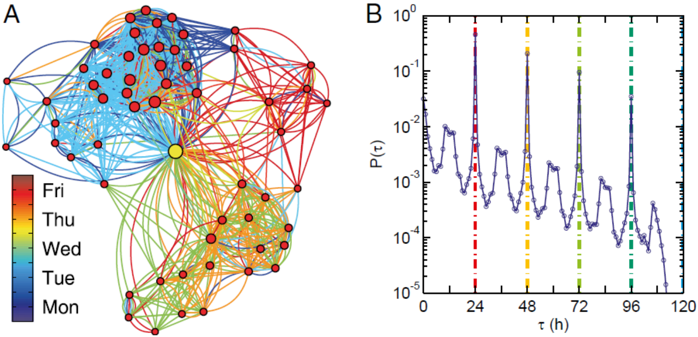


Figure: Left: A typical temporal contact network of one individual with his/her familiar strangers (encountered more than once). Right: Probability density function of inter-event time between two consecutive encounters of paired individuals. Sources: Sun et al. (2013).

Social Networks in Public Transport

- Sun et al. (2013):
  - A surprising finding:
    - Individuals with repeated encounters are NOT grouped into small communities, but become strongly connected over time, resulting in a large, but imperceptible, “small-world” contact network across the whole metropolitan area.
    - The authors called such phenomenon the “structure of co-presence”.

Social Networks in Public Transport

- Sun et al. (2013):
  - Quiz:
    - The authors found that there is no clear pattern in daily encounter frequencies between paired individuals.
    - The authors found the distribution of the total durations of encounters between a pair of individuals has a power-law tail.
    - Daily encounters do not form a small community, but rather become strongly connected over time, resulting in a "small-world" contact network.

Social Networks and Online News

- Schmidt et al. (PNAS, 2017) "Anatomy of news consumption on Facebook".
    - Assumptions:
        - Previous research shows that users tend to focus on specific narratives.
        - Such focuses lead users to form or join issue-specific groups. Users interactions in those groups lead to the "echo chamber" effect.
        - As a results of that, users are more likely to reinforce their worldview and dismissing contradictory information, even if pieces of content are deliberately false.
        - This leads to group polarization and negative emotion.

Social Networks and Online News

- Schmidt et al. (PNAS, 2017):
  - Aim of the research:
    - The authors investigated the above issue by exploring a data set containing news consumption patterns of 376 million users over a period between January 2010 to December 2015.
  - Data pre-processing:
    - **The number of likes** of each user can be used to approximate users' engagement with Facebook news pages.
    - **The length of time between the date of users' first comments and their last comments** can be used to approximate the lifetime of the users. Other key measures include the number of news sources a user interacts and the increasing levels of engagement.

Social Networks and Online News

- Schmidt et al. (PNAS, 2017):
  - Data pre-processing (contd):
    - (a) The "like" graph G_l^p by assigning a weighted edge between two pages if users likes both pages;
    - (b) The "comment" graph G_c^p of pages by assigning a weighted edge between two pages if users comments on both pages.
    - (c) The authors also created another graph N_p in which nodes are pages and links are pages liking each other.

Social Networks and Online News

- Schmidt et al. (PNAS, 2017):
  - Community detection on G_l^p, G_c^p and N_p and the findings:
    - The task was done by using the algorithm called "FastGreedy" algorithm.
    - Both G_l^p and G_c^p have a similar community structure.
    - The authors computed Rand Similarity Index between the community structure of G_l^p, G_c^p and N_p with the geographical location of the nodes. The Rand Similarity Index was 0.71 for G_l^p, 0.72 for G_c^p and 0.84 for N_p.

Censorship in Online Social Media

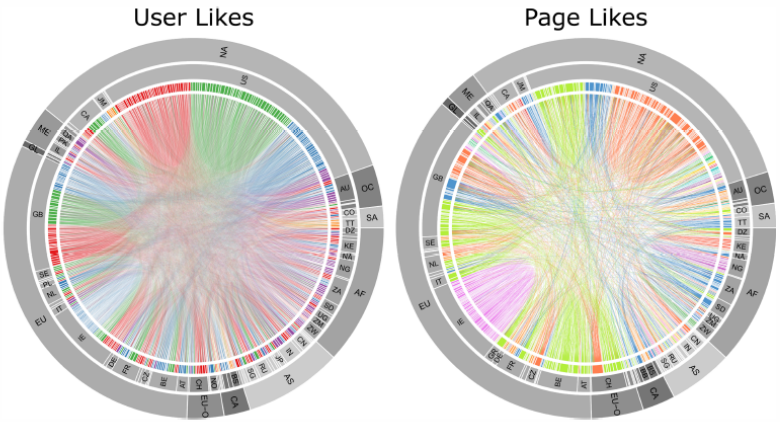


Fig. 4. Pages and users' communities and locations. Backbone of the projections on pages of the user likes reduced to the pages that appear in N_p (*Left*) and the network of pages liking each other (*Right*). Inner nodes represent the pages and their color indicates the Fast Greedy community, middle track marks the country, and outer track the region as established by the European Media Monitor. Order of the inner nodes in both plots is done by region, country, and community, in that order. AF, Africa; AS, Asia; CA, Central America; EU, European Union; EU-C, EU Candidate; EU-O, EU Other; GL, Global; ME, Middle East; NA, North America; OC, Oceania; SA, South America.

Figure: Sources: Schmidt et al. (2017).

Social Networks and Online News

- Schmidt et al. (PNAS, 2017):
  - Other findings:
    - The authors plotted the proportion of activity of user u in the largest 5 communities and the fraction of activity of the user in other communities. They found that users are strongly polarized and that their attention is confined to a single community of page.
    - News providers are more geographically confined than users.
    - The strength of user activity is positively associated with the number of news providers the user interacts.

Social Networks and Online News

- Schmidt et al. (PNAS, 2017):
  - A generative model for the community structure:
    - Users tend to focus on a limited source of news. Let c_p be the news opinion and θ_u be the user opinion.
    - The Bounded Confidence Model assumes

      $$\theta_u' = (1-\mu)\theta_u + \mu c_p$$

      if $|\theta_u - c_p|$ is below a threshold Δ (In this situation the user will click the "like" button on the news page).
    - To run the simulation, the authors randomly assigned a number of news sources to each user. The users will click on the "like" button on the news source only when $|\theta_u - c_p| \le \Delta$.
    - The authors run such the simulation for 50 iterations and investigated the relationship between simulated graphs and values of Δ.
    - The graph become fully connected (i.e. no isolated component) when $\Delta \sim 0.03$.

Social Networks and Online News

- Schmidt et al. (PNAS, 2017):
  - Summary:
    - Users tended to focus on a limited set of pages. This leads to sharp community structure. Such sharp community structure may be caused by **selective exposure** of the users.
    - Lack of fact-checked certifications may not be the key to misinformation diffusion. It is the polarization of users on specific narratives which causes misinformation diffusion.

Social Networks and Online News

- Schmidt et al. (PNAS, 2017):
  - Quiz:
    - According to the authors, news providers are more geographically confined than users.
    - According to the authors, misinformation diffusion may be due to lack of fact-checked certifications.

Social Networks and Wealth Inequality

- Nishi et al. (Nature, 2015) "Inequality and visibility of wealth in experimental social networks".
    - Previous research shows that the following mechanisms lead to wealth inequality:
        - **(1)** Difference in individual abilities.
        - **(2)** Difference in resource access opportunities.
        - **(3)** Difference in wealth accumulation processes.

Social Networks and Wealth Inequality

- Nishi et al. (Nature, 2015) "Inequality and visibility of wealth in experimental social networks".
    - Aim of the research:
        - The authors investigated the dynamic relationship between social networks and wealth inequality.
        - In particular, the authors wanted to investigate **(4)** whether an individual's wealth is **visible** to the community has an impact on the wealth distribution of the community.

Social Networks and Wealth Inequality

- Nishi et al. (2015):
  - Experimental Idea:
    - At beginning of each round, subjects are asked whether they would like to reduce their own wealth by 50 dollars in order to increase wealth of their neighborhoods by 100 dollars.
    - All subjects need to make the decision simultaneously.
    - After that, a subject can decide whether to break old ties with her neighbors or form new ties with other subjects.
    - All subjects then enter into the next round.
  - The authors run the experiment for 10 rounds and record (1) how wealth changes in all subjects and (2) how the network changes during each round.

Social Networks and Wealth Inequality

- Nishi et al. (2015):
  - Experimental settings:
    - The authors considered different inequality conditions, i.e. Gini coefficients equal to 0 (none), 0.2 (low) and 0.4 (high), respectively.
    - They also considered different wealth visibility conditions. i.e. revealed to neighbors (visible) or not revealed to neighbors (invisible).
  - Data collection:
    - There are $n = 1,462$ subjects divided into roughly 80 sessions.
    - The network is generated from the Erdös-Rényi random graph model. The corresponding graph has around 30% dyads that have ties between two sides of the dyad.

Social Networks and Wealth Inequality

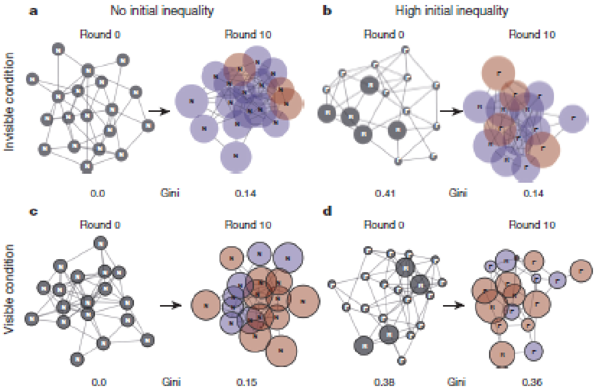


Figure: Sources: Nishi et al. (2015).

Social Networks and Wealth Inequality

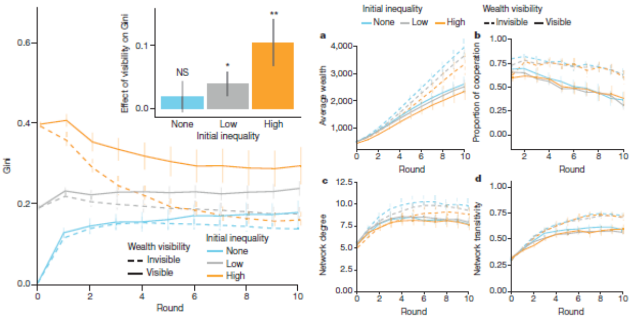


Figure: Sources: Nishi et al. (2015).

Social Networks and Wealth Inequality

- Nishi et al. (2015):
  - Results:
    - At the global level, overall wealth is significantly lower in the visible conditions than in the invisible conditions.
    - Such lower level is due to lower cooperation rates and lower social connectivity, both measures are higher in the invisible conditions.
    - In addition, low social connectivity also cause changes in network topology such as degree of nodes and possibly transitivity of nodes.
    - Moreover, the Gini coefficients seemed to converge when wealth is not visible to the community.

Social Networks and Wealth Inequality

- Nishi et al. (2015):
  - Conclusion:
    - The authors concluded that wealth inequality along has little impacts on overall wealth, interconnectedness and cooperation.
    - The authors provided several psychological mechanisms for such wealth visibility: (a) It is a signal of social position; (b) It may be perceived as a competition; and (c) It causes fear of being near last place. All these reduce cooperation.

Social Networks and Wealth Inequality

- Nishi et al. (2015):
  - Quiz:
    - Visibility of wealth can increase the Gini coefficient, and therefore deepens wealth inequality in the community.
    - The Gini coefficients will converge in the long run given that wealth of individuals is not visible to the community.
    - When wealth is visible, people will be more likely to cooperate with other people.

Censorship in Online Social Media

- King et al. (Science, 2014) “Reverse-engineering censorship in China: Randomized experimentation and participant observation”.
  - Assumptions:
    - Censorship is an important tool to maintain regime stability, an ultimate goal recognized by the Communist Party of China.
    - What are the mechanisms behind the online social media censorship in China?
    - Previous research suggested two criteria for censoring an online social media message: **(1) anti-government critics** or **(2) collective action potential**.

Censorship in Online Social Media

- King et al. (2014):
  - Aim of the research: The authors wanted to know how censoring technology works, so they
    - Created many accounts in different social media sites, randomly posted different types of posts, and saw which kind of posts were more likely to be censored.
    - Purchased URL, built social media site, asked Chinese security software firms to implement censoring software, and conducted actual censoring on their own posts by consulting those firms for censoring tips.

Censorship in Online Social Media

- King et al. (2014):
  - Experimental conditions:
    - Each post is either (a1) pro or anti government, and either (a2) with or without collective action potential.
    - Each post is controlled under (b1) the same keywords; (b2) the same writing style; (b3) length of posts between 100 to 200 Chinese characters.
    - The whole experiments were approved by IRB at Harvard University.

Censorship in Online Social Media

- King et al. (2014):
  - Data collection:
    - The authors considered 100 social media sites.
    - These include the biggest 97 sites such as Sina Weibo, Tensent Weibo, and Sohu Weibo.
    - The 100 sites contain 87% blog posts in China.
    - About 20% of them are run by government, 25% of them are run by state-own-enterprises, and 55% of them are run by private firms.
    - In total, 1200 posts were written and submitted to the 100 top Chinese social media sites.
    - In practice, three rounds of experiments were conducted (post sent at three different time periods).

Censorship in Online Social Media

- King et al. (2014):
  - Results:
    - Texts which criticize the government, its leaders, and their policies are more likely to be allowed to be published.
    - Texts about collective action potential are more likely to be censored, no matter these texts are pro or anti-government.
    - The authors found no clear censorship of posts about (a) collective action events outside mainland China, (b) collective action events occurring online, (c) critiques of top leader, and (d) highly sensitive topics.

Censorship in Online Social Media

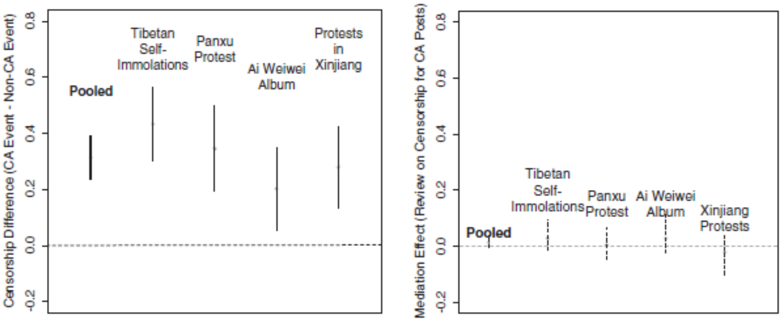


Figure: Sources: King et al. (2014).

Censorship in Online Social Media

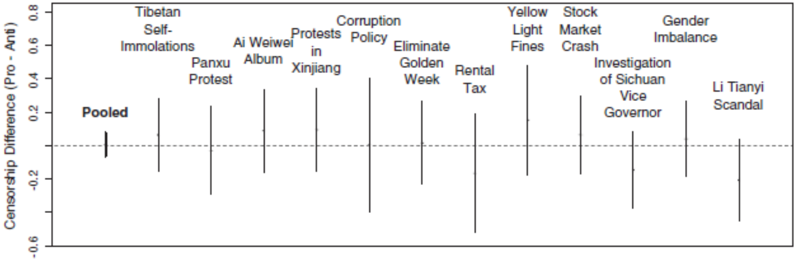


Figure: Sources: King et al. (2014).

Censorship in Online Social Media

- King et al. (2014):
  - Discussion:
    - The Chinese censorship system detects threads on social media, and if a thread has a potential to trigger collective action, then the whole thread will be removed.
    - Although about $2/3$ of Chinese social media sites implement automated review based on keyword list, as censoring mechanism, they are not effective.
    - Chinese social media sites are diverse and do not always consistent in censoring.

Censorship in Online Social Media

- King et al. (2014):
  - Discussion (contd):
    - However, government is still able to control as it employs a large number of human coders to censoring the posts.
    - As pointed out by the authors, the Chinese leaders seem to use those critique texts to monitor performance of government officials.
    - Collective action events outside mainland China, occurring online, or posts criticizing top leaders or about sensitive issues are less likely to be censored.

Censorship in Online Social Media

- King et al. (2014):
  - Quiz:
    - According to the authors, online social media in China tend to censor posts that criticize Chinese top leaders than posts that encourage collective actions.
    - The authors sent posts with length of words between 500 to 10,000 in their experiment because they think length of words of a post may have impacts on the censoring chance of the post.
    - According to the authors, posts on collective actions outside China have the same chances of being censored as the posts on collective actions inside China.

Social Networks and Robots

- Shirado and Christakis (2017) (Nature, 2017) "Locally noisy autonomous agents improve global human coordination in network experiments".
    - Theory behind the research: Adding randomness to a system may lead the system to achieve global optima. Examples include
        - Mutation, which has an essential role in evolution;
        - Random (e.g. white Gaussian) noises, which may facilitate information search;
        - Deviant behavior, which may be beneficial for cooperation.
    - Aim: Test whether above assumption works in doing human-tasks.

Social Networks and Robots

- Shirado and Christakis (contd):
    - The authors focused on the **color coordination game** on a network:
        - The goal is to ask each node (participant) to have different colors from their neighborhood.
        - Three colors were available for the game.
        - Each network game was globally solvable (Tested before the exact experiments).

Social Networks and Robots

- Shirado and Christakis (contd):
  - The key idea is to assigned robots on the network according to the following conditions:
    - Three strategies: (a1) Zero randomness: deterministic greedy strategy that tries to minimize the color conflict as hard as possible; (a2) Greedy strategy with 10% randomness; and (a3) Greedy strategy with 30% randomness.
    - Three network positions: (b1) high-degree positions: the positions that had the largest number of neighbors; (b2) low-degree positions: the positions that had the lowest number of neighbors; and (b3) random positions.
  - The whole experiment has $3 \times 3 + 2 = 11$ experimental conditions. The rest of two conditions are (c0) The control condition that did not involve any bots; and (d0) The experimental setting with three-fixed colors.

Social Networks and Robots

- Shirado and Christakis (contd):
  - More details on the experiment:
    - 230 networks of 20 nodes were generated from a preferential attachment model.
    - 4000 participants randomly assigned to the 230 networks.
    - Bots were sometimes allocated according to the 9 experimental conditions. The maximum number of bots in each network was 3.

Censorship in Online Social Media

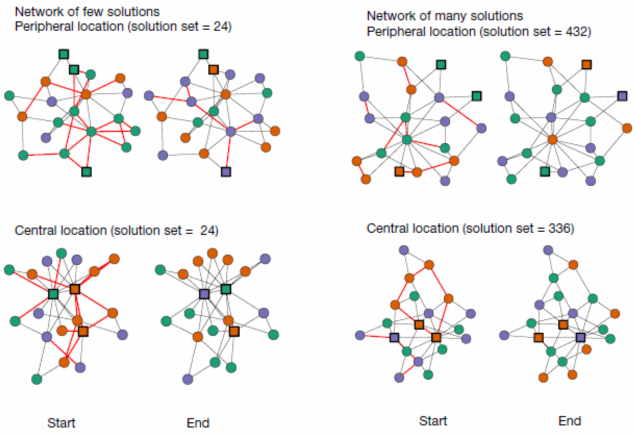


Figure: Sources: Shirado and Christakis (2017). Central location = high degree position; Peripheral location = low degree position.

Social Networks and Robots

- Shirado and Christakis (contd):
  - Experimental results:
    - Networks with bot conditions (a2) 10% randomnness and (b1) high-degree positions were the most likely to be solved within the allotted 5 min (17 out of 20 sessions, or 85%, compared with 20 out of the 30 control sessions, or 67%, with humans alone).
    - The solution was achieved 129.3 seconds faster (that is, 55.6% faster) than sessions involving just humans (median time = 103.1 seconds (IQR 49.5-170.1) vs 232.4 seconds (IQR 143.7-300.0)).

Social Networks and Robots

- Shirado and Christakis (contd):
  - More details on experimental results:
    - When placed at high-degree positions, the bots with 0% randomness reduced the number of conflicts but increased the duration of unresolvable conflicts.
    - The bots with 30% randomness decreased the duration of unresolvable conflicts but increased overall conflicts.
    - Only the bots with 10% randomness decreased both the number of conflicts and the duration of unresolvable conflicts, compared with the control sessions.
    - By contrast, when placed at low-degree positions, the bots were less likely to influence the entire network of humans, regardless of their randomness.

Social Networks and Robots

- Shirado and Christakis (contd):
  - Implication:
    - Randomness bots makes people connected with each other easier.
    - Bots affect people when people interact with each other in the group. Such interactions lead to cascades of benefit.
    - Applying simple strategies into social systems may make it easier for groups of humans to achieve global optima for complex tasks.
  - Possible applications:
    - Simple artificial intelligence (AI) may serve as a teaching function, changing the strategy of their human counterparts and modifying humanhuman interactions. For example, one may use AI to reduce online racist comments.

Social Networks and Robots

- Shirado and Christakis (contd):
  - Quiz:
    - According to the authors, bots in low degree positions have the same chances to influence the whole network as the bots in high degree positions, without considering bots' coloring strategies.
    - According to the authors, bots with the "0% randomness" strategy can both reduce the number of conflicts and decrease the duration of unresolvable conflicts.

Social Networks and Environment

- Barnes et al. (PNAS, 2016) “Social networks and environmental outcomes”.
    - Environmental outcomes–Shark bycatch rates:
        - Bycatch means “fish or other sea creatures that are caught unintentionally by people who are trying to catch other types of fish” (source: Cambridge Dictionary).
        - High shark bycatch rates are bad as shark play a role in balancing ecosystem.
        - Also shark bycatch is cost and dangerous, not economically desirable. It should be avoided.

Social Networks and Environment

- Barnes et al. (PNAS, 2016):
  - Differences in shark bycatch rates in Hawaii fishery industry:
    - The authors targeted all tuna loneliness fishery industry in Hawaii. It contains three ethnic groups: European-Americans (E-A), Korean-Americans (K-A) and Vietnamese-Americans (V-A).
    - The authors examined shark bycatch rates between the three groups based on a 5-year period data set. They found no difference between Vietnamese and Korean, but the differences between European and two other groups are statistically significant.

Social Networks and Environment

- Barnes et al. (PNAS, 2016):
  - Aim of the research:
    - The authors tried to understand how social networks make behaviors different, and how such difference further have impacts on environmental outcomes, by investigating information-sharing networks in the tuna fishery industry in Hawaii.

Social Networks and Environment

- Barnes et al. (PNAS, 2016):
    - Results and explanations:
        - As compared with the E-A network, V-A and K-A networks were highly clustered among nodes with similar attributes.
        - High clustering leads to segregated networks, restricting information flow from other networks.
        - In a highly competitive industry such as fishery industry, behavioral differences will have large impacts on competition results, and therefore making impacts on the environment.

Social Networks and Environment

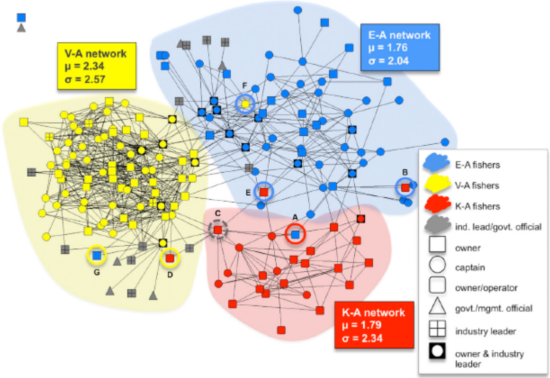


Figure: Sources: Barnes et al. (2016).

Social Networks and Environment

- Barnes et al. (PNAS, 2016):
    - Possible confounding factor: Ethnicity-related cultural norm.
    - How to distinguish the confounding factor effect from the information-sharing network effect?
        - As shown in the data, ethnicity is highly correlated to the information-sharing network.
        - The authors tested the cultural norm hypothesis by looking at outlier nodes, i.e. those who have the same ethnicity but are tied to different ethnic groups.
        - They found in general, these nodes behave more likely to the group they are connected with (rather than the group they are not connected with).

Social Networks and Environment

- Barnes et al. (PNAS, 2016):
  - Limitations and future research directions:
    - Due to data structure, it is impossible to establish the causal relationship between information-sharing networks and environmental outcomes. Further collection on dynamic network data is necessary.
    - For policy makers: homophily-driven information-sharing network seems to prevent information diffusion. It is worth to investigate ways for diffusing information this situation.

Social Networks and Environment

- Barnes et al. (PNAS, 2016):
  - Quiz:
    - The authors found no difference in shark bycatch rates between the three ethnic groups in the tuna loneliness fishery industry in Hawaii.
    - According to the authors, there is no correlation between information-sharing networks and ethnicity.
    - According to the authors, the differences in bycatch rates can be fully explained by the ethnicity-related cultural norm.

Social Networks and Finance

- Banerjee et al. (Science, 2013) "The diffusion of microfinance".
    - Two mechanisms behind innovation diffusion:
        - Information passing: Individuals have known the new product before adopting it, and they may learn to adopt it from their friends.
        - Endorsement: Individuals may adopt the new product by referring decisions made by their friends.

Social Networks and Finance

- Banerjee et al. (2013):
  - Possible **initial injection point** approach for information-passing:
    - A node in the network represents a household.
    - At the first stage initial set of households is informed;
    - Informed households to decide whether to adopt or not;
    - Informed households pass information to others;
    - Newly informed households to decide whether to adopt or not.
  - Simulation-based study confirmed **initial injection point** approach.
  - However, it has not been verified by real world data.

Social Networks and Finance

- Banerjee et al. (Science, 2013) "The diffusion of microfinance".
  - Aim of the research:
    - The authors wanted to investigate relationship between network position and innovation diffusion (new product adoption).
    - They wanted to verify whether (a) Information passing or (b) endorsement work for innovation diffusion.
  - Contributions of the paper:
    - Collects real world data for investigating network position and innovation diffusion.
    - Develops models for distinguishing main effects for innovation diffusion.

Social Networks and Finance

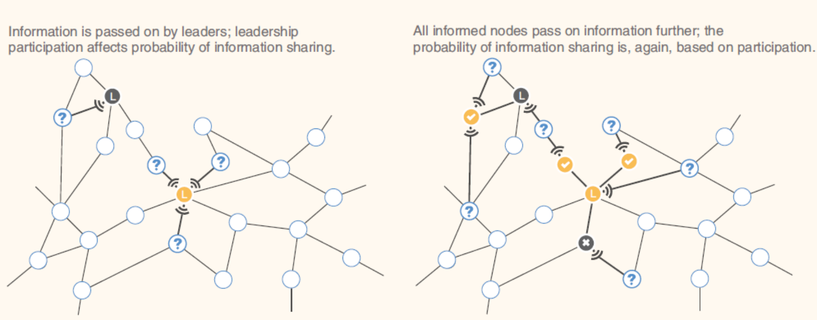


Figure: Sources: Banerjee et al. (2013).

Social Networks and Finance

- Banerjee et al. (2013):
  - Data collection:
    - They collected the data in 43 villages in Karnataka, India. They introduced microfinance service called Bharatha Swamukti Samsthe (BSS).
    - They asked invited leaders to pass the information.
    - They did not rely on the mass media or ads to spread the information.
    - They relied on word-of-mouth communication to spread the information.

Social Networks and Finance

- Banerjee et al. (2013):
  - Model and estimation:
    - A participant household will pass information with probability q^P.
    - A nonparticipant household will pass information with probability q^N.
    - The probability that an informed household will adopt the microfinance service is a function of the number of neighbors who have adopted the service, denoted as F_{it}. The coefficient of F_{it} is a measure on endorsement.
    - The authors adopted a moment-based approach to estimating the model.

Social Networks and Finance

- Banerjee et al. (2013):
  - Key findings:
    - Adopters are seven times more likely than informed non-adopter to pass information to others.
    - The authors found no evidence of endorsement effects. It is possible because information passing may decrease the endorsement effects.
    - Information passing is not restricted to those who have already adopted but also those who do not adopt.

Social Networks and Finance

- Banerjee et al. (2013):
  - Communication and diffusion centralities:
    - The authors developed a measure called communication centrality to identify how effective a node can spread the information.
    - The communication centrality relies on network structure of the targets and information provided by the sample.
    - The diffusion centrality is a simplified version of the communication centrality, and is defined as

$$DC(g; q, T) = \left[\sum_{t=1}^{T} (qg)^t \right] \cdot 1,$$

where g is the adjacency matrix, q is the passing probability, and T is the number of iterations.

Social Networks and Finance

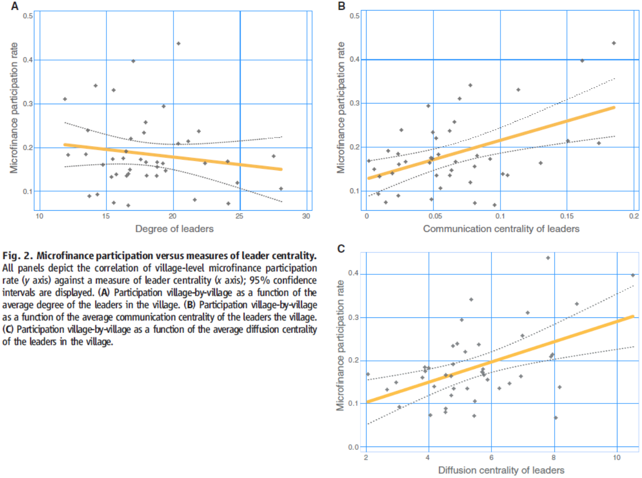


Fig. 2. Microfinance participation versus measures of leader centrality. All panels depict the correlation of village-level microfinance participation rate (*y* axis) against a measure of leader centrality (*x* axis); 95% confidence intervals are displayed. **(A)** Participation village-by-village as a function of the average degree of the leaders in the village. **(B)** Participation village-by-village as a function of the average communication centrality of the leaders the village. **(C)** Participation village-by-village as a function of the average diffusion centrality of the leaders in the village.

Figure: Sources: Banerjee et al. (2013).

Social Networks and Finance

- Banerjee et al. (2013):
  - Quiz:
    - According to the author, endorsement refers to a process in which individuals adopt a new product by referring decisions made by their neighbors.
    - According to the author, diffusion centrality of a leader is positively correlated to the innovation adoption rate of the village the leader belongs to.

Social Networks, Science and Public Policy

- Edelmann et al. (PNAS, 2017) "Disparate foundations of scientists' policy positions on contentious biomedical research":
  - Aim of the research:
    - What social network factors influence opinion expression from scientists.
  - Some background:
    - Gain-of-function research, i.e. potentially deadly pathogens are produced in laboratories for study. Support it or not?
    - Two camps: Supporters are called "Scientists for Science" (SFS), while the opponents are called the "Cambridge Working Group" (CWG).
    - Scientists are asked to sign petition associated with the two camps.

Social Networks, Science and Public Policy

- Edelmann et al. (PNAS, 2017):
  - More details on the research:
    - Whether supports the issue or not is difficult to investigate because the stake is high.
    - Whether a scientist's support the issue or not may be influenced by the scientist's **social networks** and **scientific specialization**.
    - Different social processes are more likely to drive support for or against the issue.
    - Key explanatory variables: (a) peer effect and (b) research specialization.

Social Networks, Science and Public Policy

- Edelmann et al. (PNAS, 2017):
  - Data collection:
    - The data set was collected by exploring publications of the 378 scientists from both SFS and CWG petitions.
    - The number of such publications are 19,257. These publications are indexed in Medline or Web of Science.
    - Collaborators of these scientists were identified by exploring publications of these scientists.
    - A collaboration network was established.

Censorship in Online Social Media

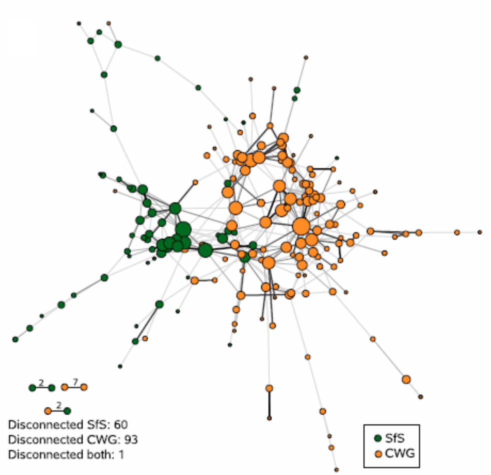


Figure: Sources: Edelmann et al. (2017).

Censorship in Online Social Media

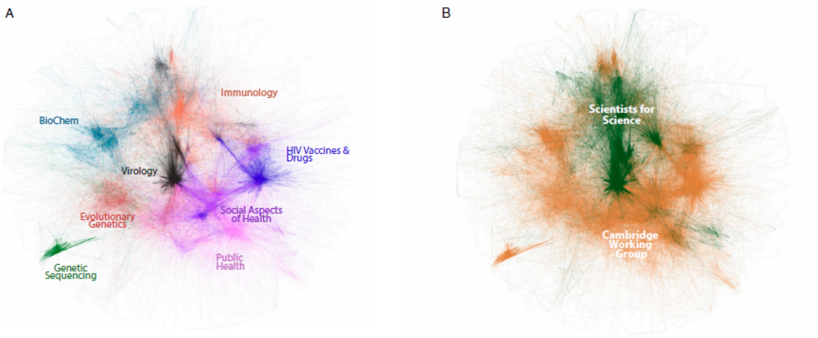


Figure: Sources: Edelmann et al. (2017).

Social Networks, Science and Public Policy

- Edelmann et al. (PNAS, 2017):
    - Statistical modelling:
        - The authors then modelled the probability of signing a petition as a function of (a) past collaborators and (b) research specialization.
        - Controlled variables: (c) the total number of collaborators, (d) the total number of publications, (e) degree of specialization, (f) gender, (g) highest academic degree, (h) time since degree was obtained, and (i) country of residence and (j) country of obtaining the degree.

Social Networks, Science and Public Policy

- Edelmann et al. (PNAS, 2017):
  - Results:
    - Scientists whose research fields directly related to gain-of-function research–where potentially deadly pathogens are produced in laboratories for study.
    - Scientists in Virology, Immunology, and (to a lesser degree) Cellular Biochemistry are more likely to give public support (SFS camp) than those whose research fields related to potential pathogenic risks such as Evolutionary Genetics, Public Health, HIV Vaccines and Drugs, and the Social Aspects of Health Care and so on.
    - The peer effect is higher for opponents (CWG camp) than supporters (SFS camp).

Social Networks, Science and Public Policy

- Edelmann et al. (PNAS, 2017):
  - Explanation on the results:
    - According to the authors, the supporters (SFS camp) are usually embedded in in a tight-knit scholarly community. They trust each other. In contrast, the opponents (CWG camp) are embedded federation of widely varying academic specializations.
    - In addition, compared with the supporters, the opponents are lack of day-to-day familiarity with laboratory risk.

Social Networks, Science and Public Policy

- Edelmann et al. (PNAS, 2017):
  - Summary:
    - The authors suggested that it is important to understand how scientists social embeddedness shapes their policy actions. It is key to interpret both supporters and opponents' position accurately. Such interpretation may avoid echo-chamber effects and protect the role of scientific expertise in social policy.

Social Networks, Science and Public Policy

- Edelmann et al. (PNAS, 2017):
  - Quiz:
    - According to the authors, the peer effect on supporting the gain-of-function research is higher than on opposing the research.
    - According to the authors, research specialization have an impact on the probability of signing petition for supporting the gain-of-function research.