Bots and the problem of prevalence

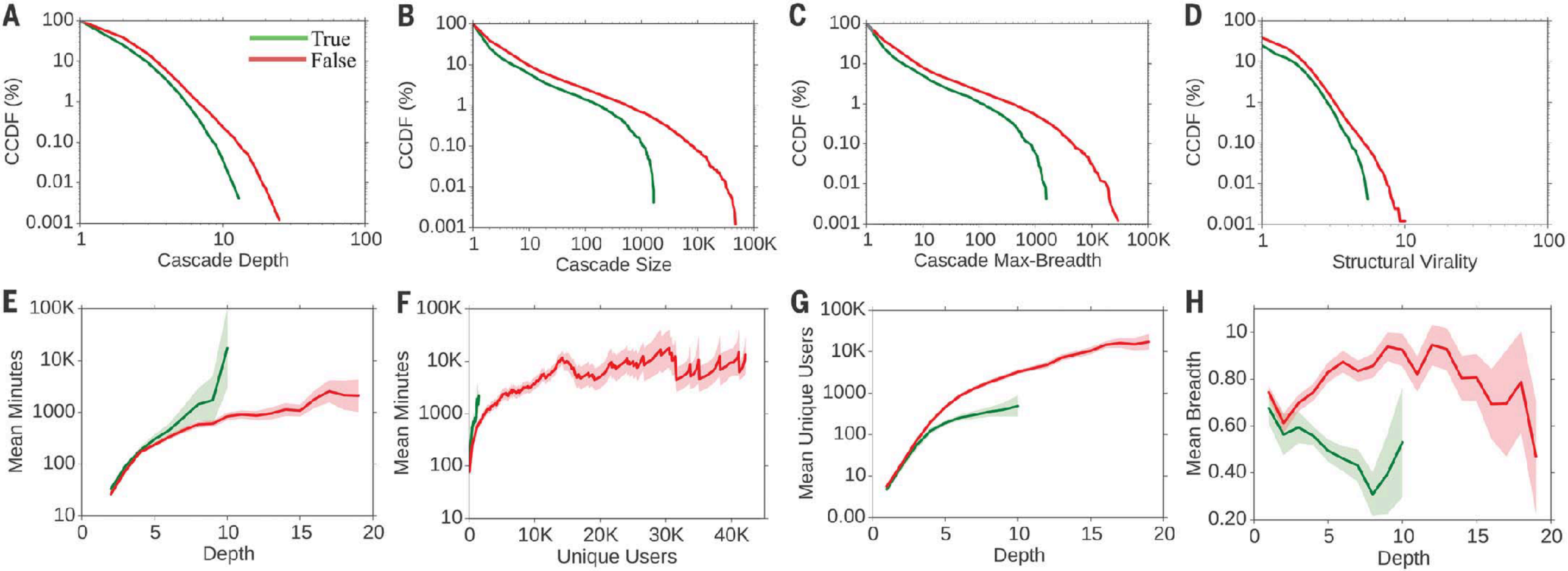
Prevalence

- Many observed that false stories in social media are more successful (in numbers and speed) than true stories
- *Which are the key factors?*
- *Who is to blame: bots or humans?*

Lies are faster than truth

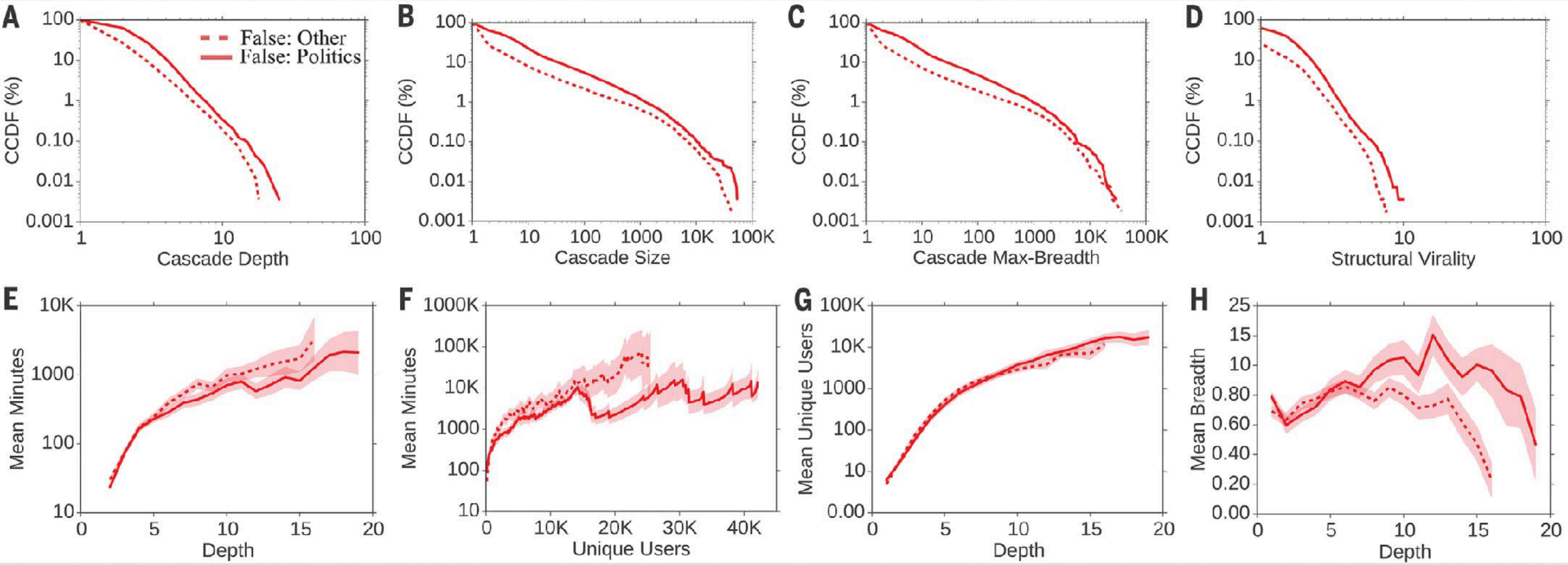
- Dataset: ~126,000 stories tweeted by ~3 million people more than 4.5 million times.
- News classified as true or false using six independent fact-checking organizations that exhibited 95 to 98% agreement on the classifications.

S.Vosoughi, D. Roy, S. Aral, The spread of true and false news online, in Science, 09 mar 2018: 1146-1151



- Falsehood diffused significantly **farther**, **faster**, **deeper**, and **more broadly** than the truth in all categories of information

S.Vosoughi, D. Roy, S. Aral, The spread of true and false news online, in Science, 09 mar 2018: 1146-1151

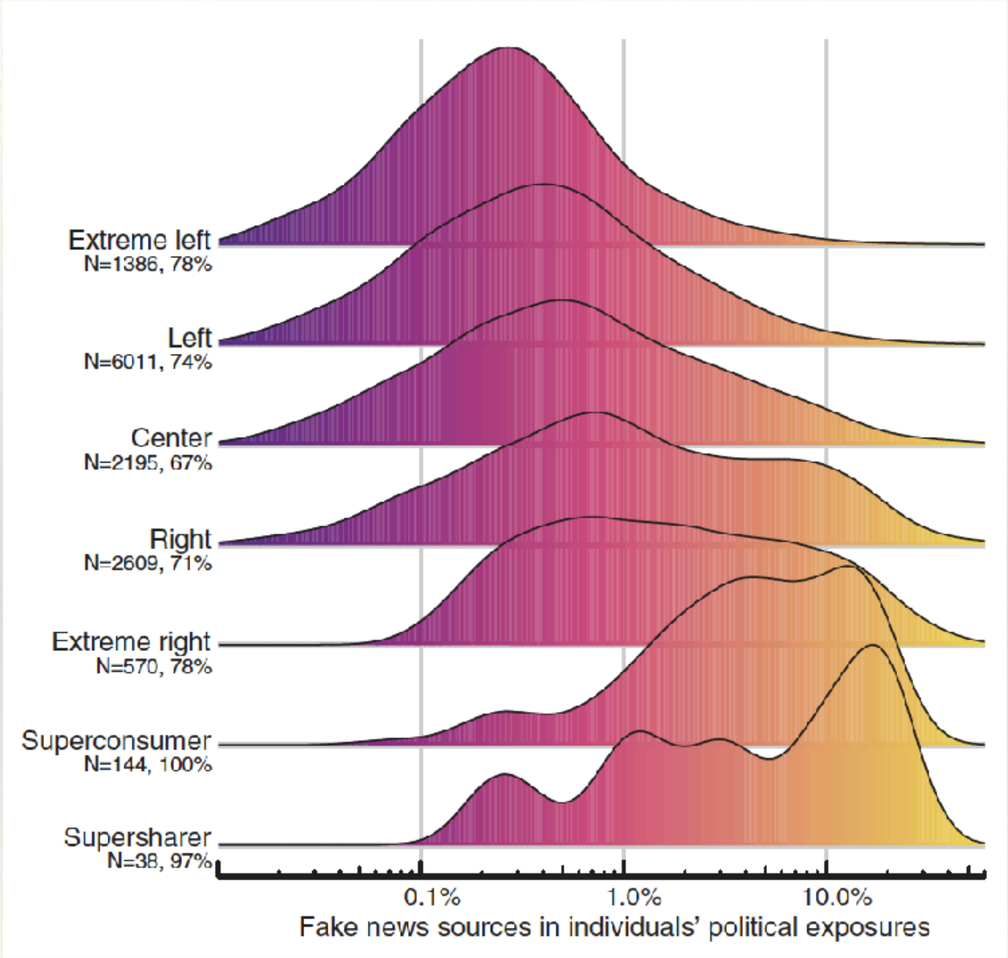


- Effects were **more pronounced for false political news** than for false news about terrorism, natural disasters, science, urban legends, or financial information.

S.Vosoughi, D. Roy, S. Aral, The spread of true and false news online, in Science, 09 mar 2018: 1146-1151

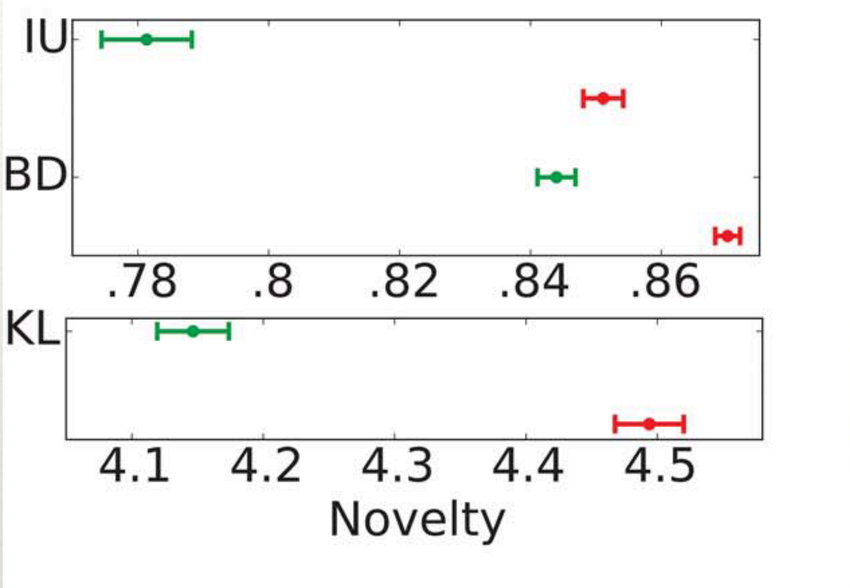
Fake-News and elections

- Engagement with fake news sources extremely concentrated in 2016 US presidential elections
- Only 1% of individuals accounted for 80% of fake news source exposures, and 0.1% accounted for nearly 80% of fake news sources shared.
- Individuals most likely to engage with fake news sources were conservative leaning, older, and highly engaged with political news.



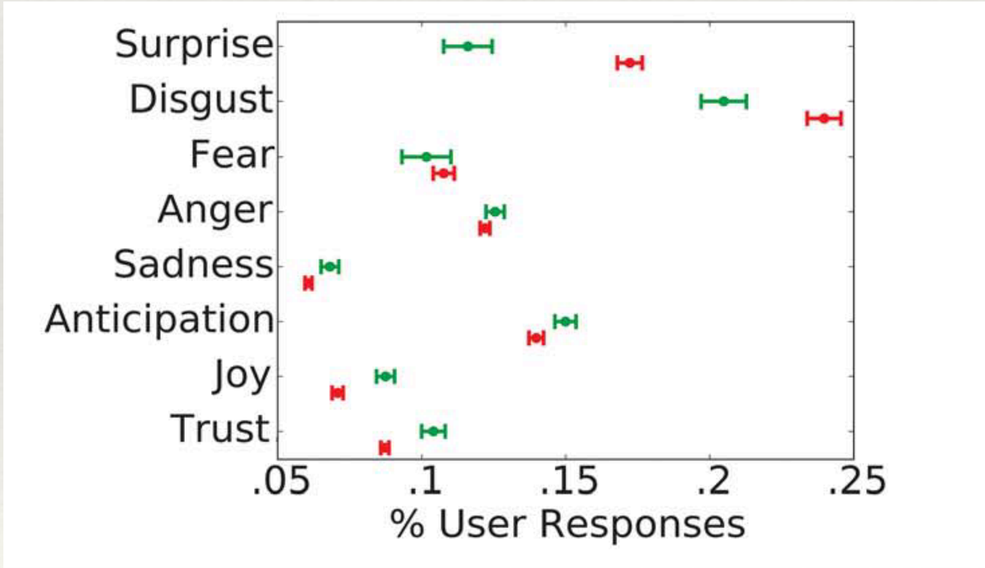
N. Grinberg, K. Joseph, L. Friedland, B. Swire-Thompson, D. Lazer, Fake news on Twitter during the 2016 U.S. presidential election, Science 25 Jan 2019:Vol. 363, Issue 6425, pp. 374-378 DOI: 10.1126/science.aau2706

Novelty and emotions



- False news **more novel** than true news, which suggests that people were more likely to share novel information

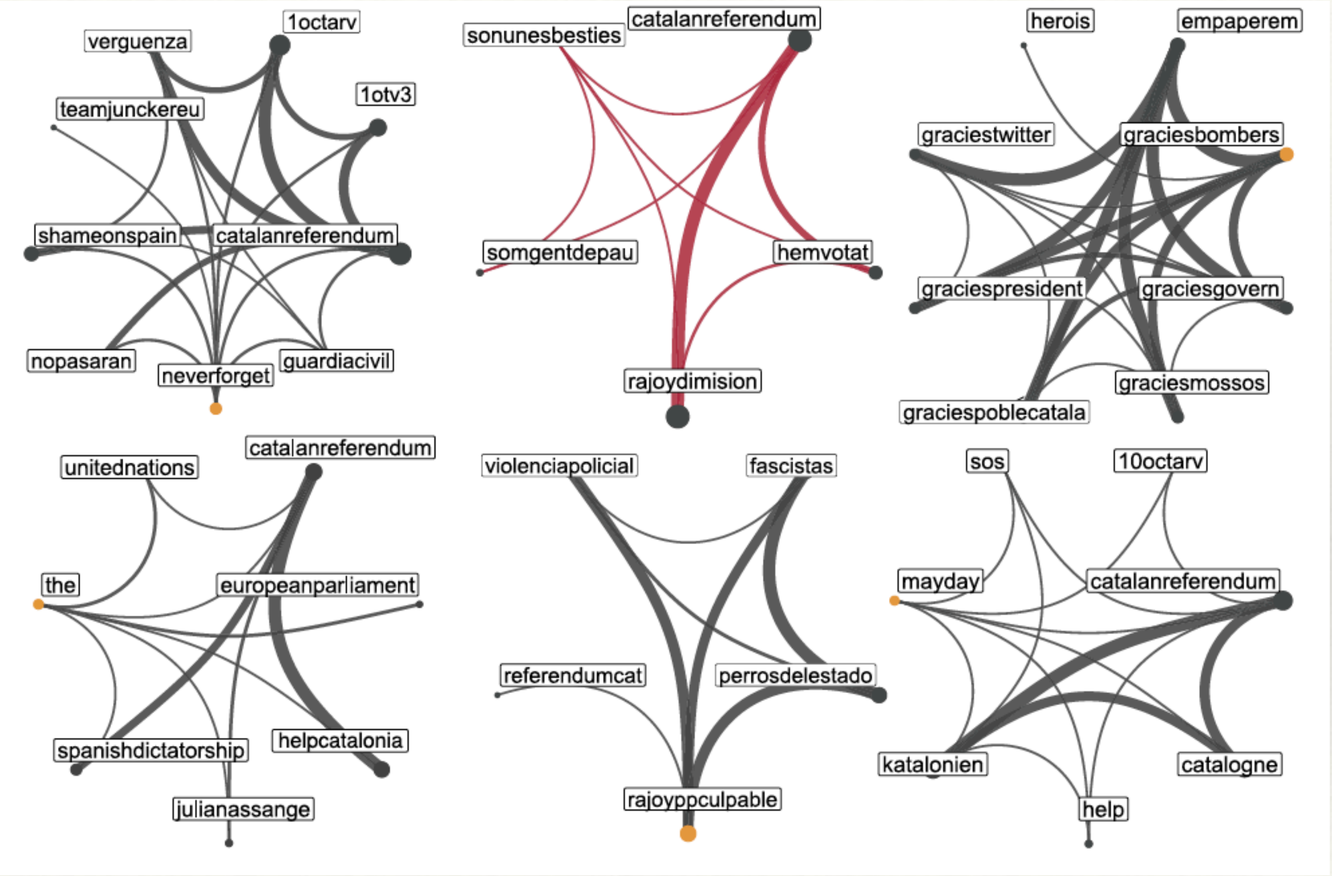
- False stories inspired **fear**, **disgust**, and **surprise** in replies, true stories inspired anticipation, sadness, joy, and trust.



S.Vosoughi, D. Roy, S. Aral, The spread of true and false news online, in Science, 09 mar 2018: 1146-1151

The role of emotions

- Large-scale social data collected during the **Catalan referendum for independence** on October 1, 2017, consisting of nearly 4 millions Twitter posts generated by almost 1 million users;
- Two polarized groups: **Independentists** vs **Constitutionalists**
- Structural and emotional roles played by **social bots**
  - Bots act from **peripheral areas** to target **influential humans** of both groups;
  - Bots bombard Independentists with **violent contents**, **increasing their exposure to negative and inflammatory narratives**, and exacerbating social conflict online.



M. Stella, E. Ferrara, M. Di Domenico, Bots increase exposure to negative and inflammatory content in online social systems, PNAS, Dec. 4, 2018, Vol. 115, no. 49, 12435–12440. www.pnas.org/cgi/doi/10.1073/pnas.1803470115

The role of social bots

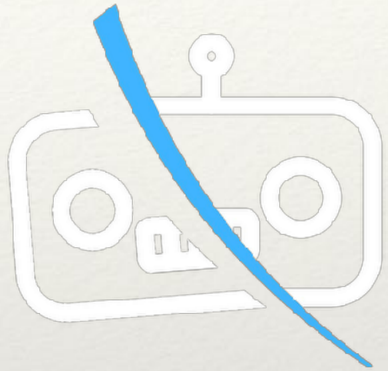
- 14 million messages spreading 400 thousand articles on Twitter during ten months in 2016 and 2017
- Social bots played a disproportionate role in spreading articles from low-credibility sources.
- Bots amplify such content in the early spreading moments, before an article goes viral.
- They also target users with many followers through replies and mentions. Humans are vulnerable to this manipulation, resharing content posted by bots.

Shao, C., Ciampaglia, G.L., Varol, O., Yang, K.C., Flammini, A., Menczer, F., The spread of low-credibility content by social bots. *Nat Commun* **9,** 4787 (2018). https://doi.org/10.1038/s41467-018-06930-7

BotSlayer and Botometer (IU)

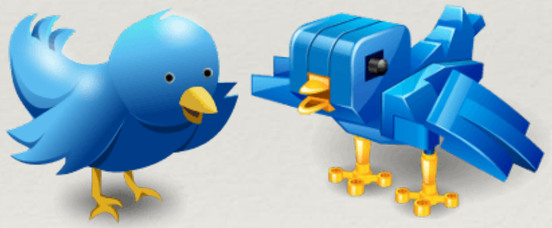
- **BotSlayer**: it tracks and detect potential manipulation of information spreading on Twitter

https://osome.iuni.iu.edu/tools/botslayer/

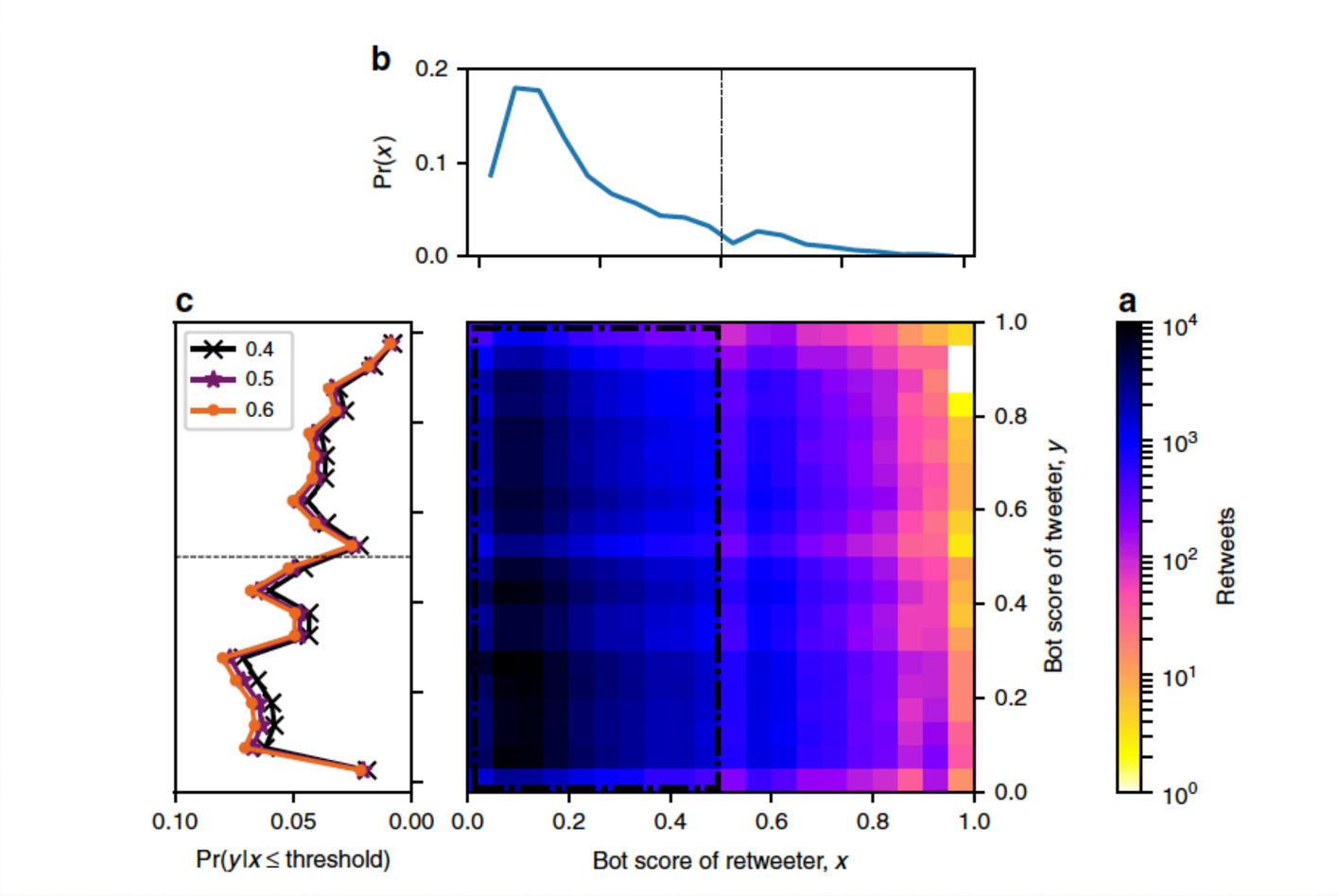


- **Botometer** (formerly known as BotOrNot) :checks the activity of a Twitter account and gives it a score. Higher scores mean more bot-like activity.

https://botometer.osome.iu.edu



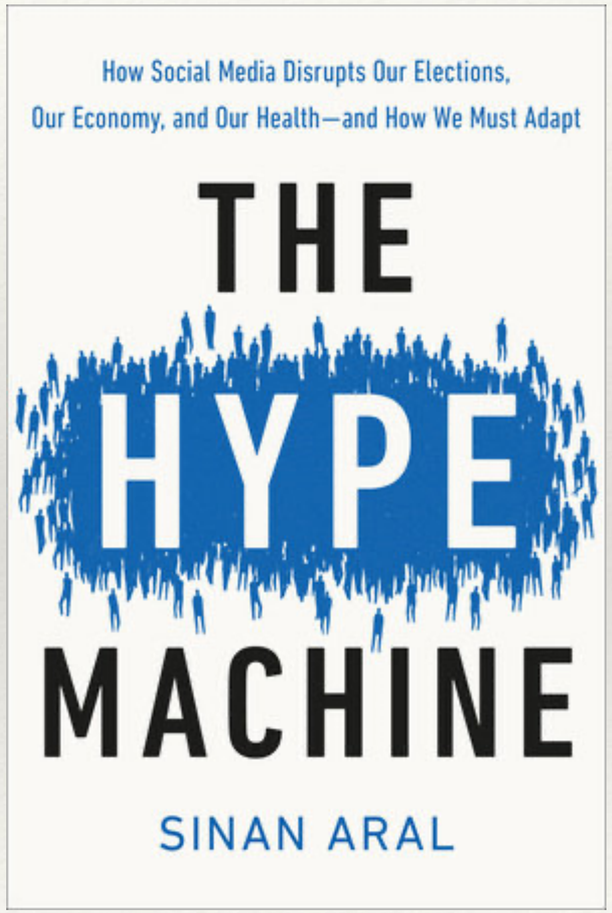
…but humans should be blamed the most



Shao, C., Ciampaglia, G.L., Varol, O., Yang, K.C., Flammini, A., Menczer, F., The spread of low-credibility content by social bots. *Nat Commun* **9,** 4787 (2018). https://doi.org/10.1038/s41467-018-06930-7

The Hype Machine

- Prevalence of fake-news and role of social bots in spreading misinformation
- Bots share **novel** fake news and retweet it broadly
- Bots **mention influential humans** incessantly
- The strategy works when influential people are fooled into sharing the content.
- **Misleading humans is the ultimate goal of any misinformation campaign**



https://www.salon.com/2020/09/27/fake-news-bots-spreading-misinformation-2020-election-propaganda/

Open Problems and Trends

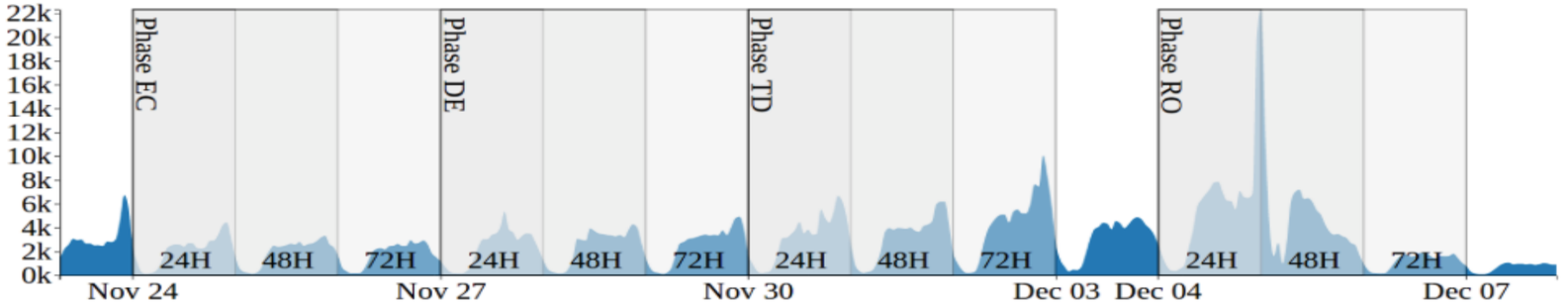
Language and network structure

Links to NLP

- Individual's opinions are often hidden
- Social Media provide much data for stance detection, emotion analysis, and so on
- Communication styles can be another trigger or just a reaction to news exposition and partisanships
- Relationships between structural segregation and opinion formation and polarization should be explored further by a joint effort between our scientific communities

Italian 2016 Constitutional Referendum

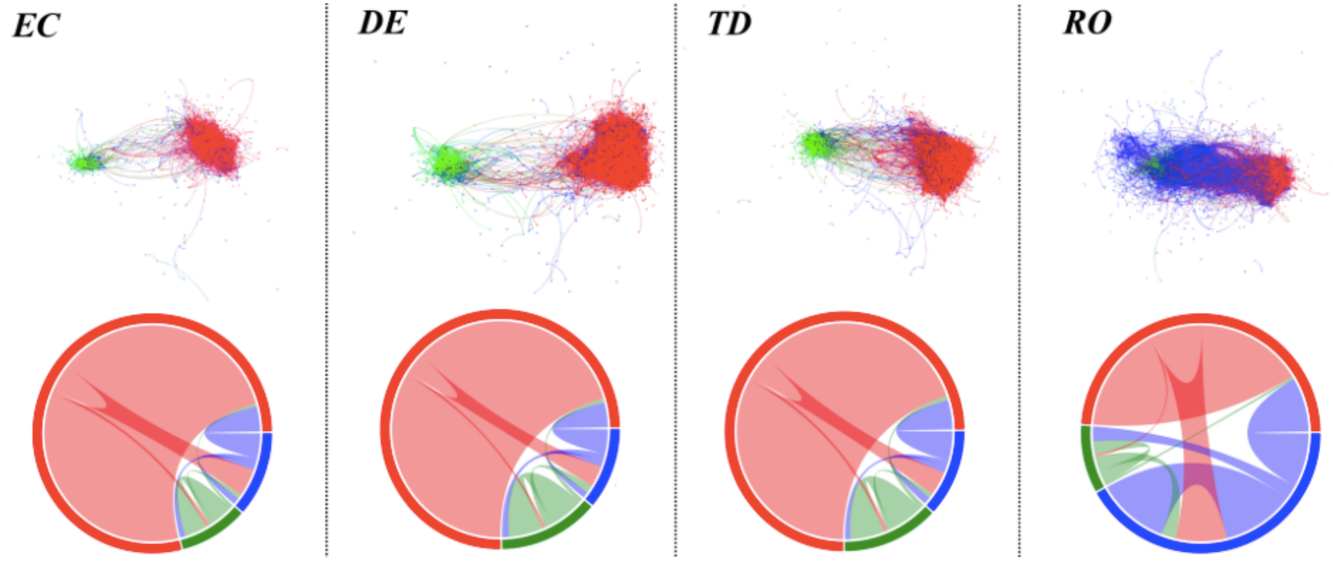
Collected Tweets



stance detected as **AGAINST**

stance detected as **IN FAVOR**

stance detected as **NONE**

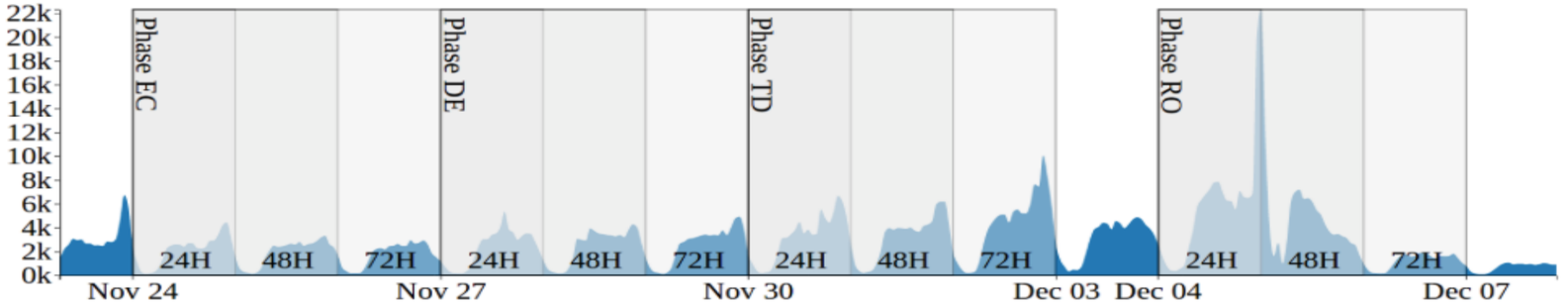


Retweet Network

strong signal of **homophily**

Italian 2016 Constitutional Referendum

Collected Tweets



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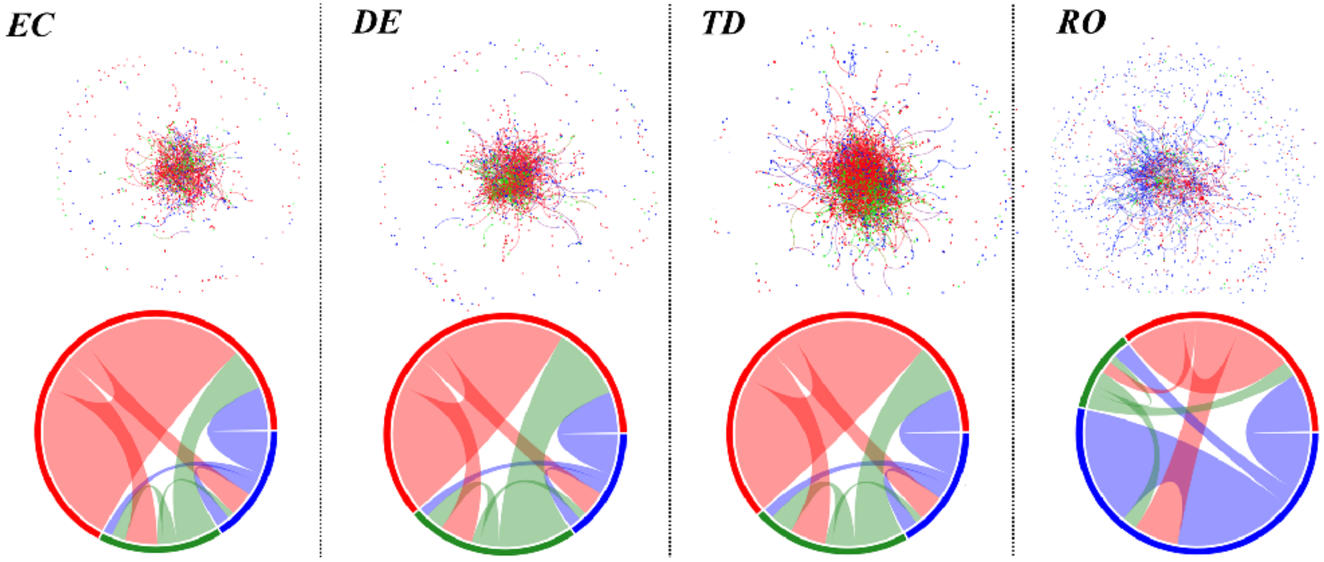


Mention Network

signal of **inverse homophily**

Stance detection and Network Homophily

- ML-based **stance detection** is a NLP tool extremely useful for computational social science analyses
- We need **approximation** of users' opinions
- Building networks that **evolve** when the polarizing debate takes place is an opportunity to study the **interplay between structure and opinions**
- Apparently in Twitter retweets and reply-to are used to respectively show agreement or disagreement. If you look for disputes, **dig mentions**

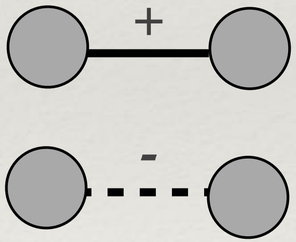
M Lai, M Tambuscio, V Patti, P Rosso, G. Ruffo, Stance Polarity in Political Debates: a Diachronic Perspective of Network Homophily and Conversations on Twitter, Data & Knowledge Engineering Journal, online: September 2019
https://www.sciencedirect.com/science/article/pii/S0169023X19300187

Balance in networks: algorithms and visualization

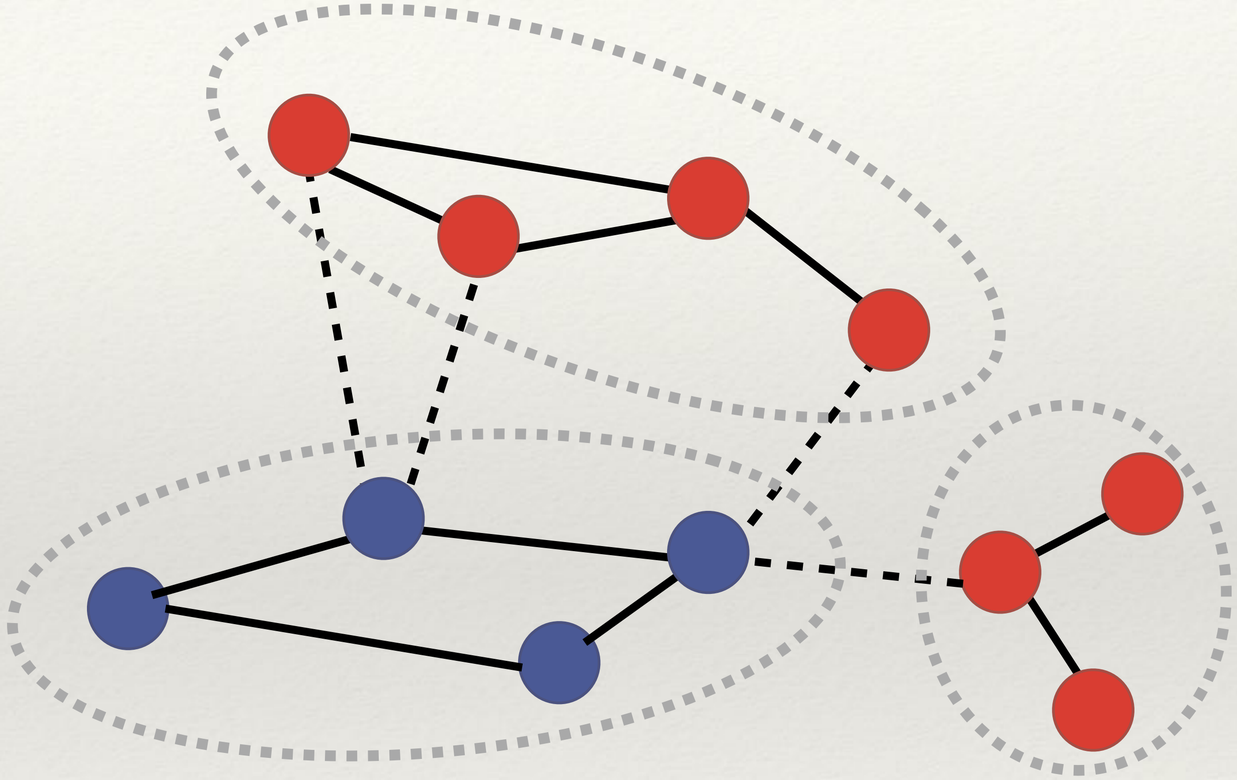
Signed nets

journalists

scientists



signs make explicit the type of the relationship

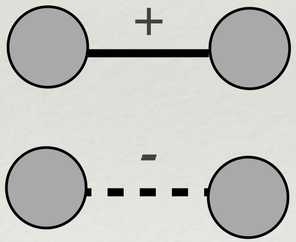


Balanced

Signed nets

journalists

scientists



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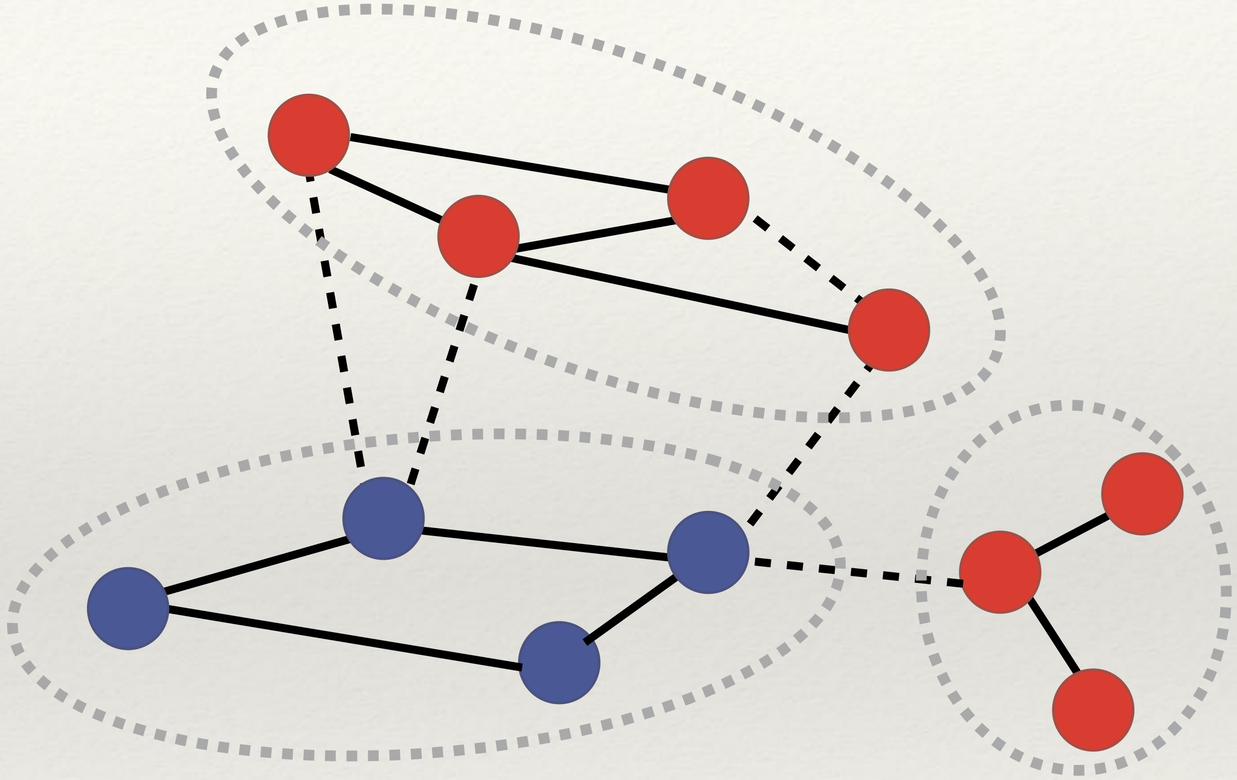
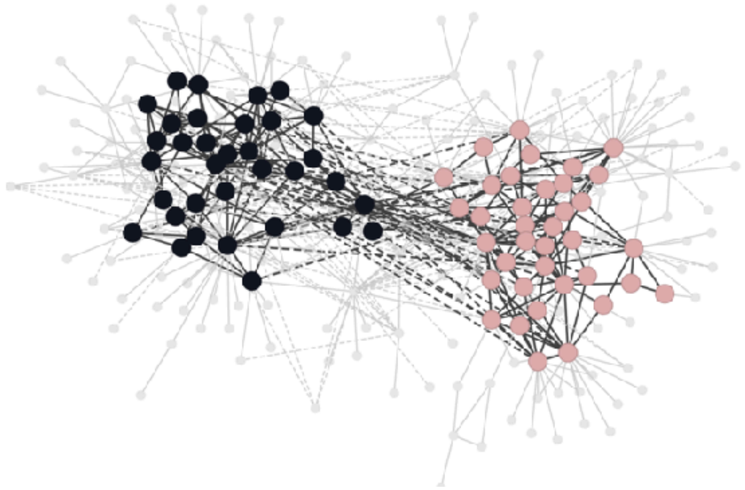


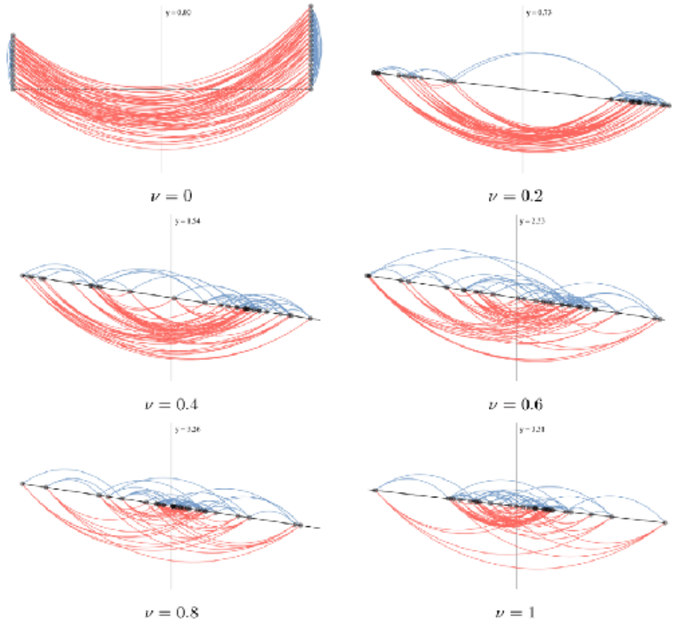
Not balanced

Balance in networks

- Balance is not always good: if journalists hate scientists and vice versa, we would live in a perfectly balanced world!
- There are different levels of balance when few negative edges cross boundaries
- Partial balance is a measure of polarization (or to predict a forthcoming egg war?) - *frustration index problem*
- Probably a great framework, not fully exploited so far, to better understand polarization and segregation dynamics in socio-political systems

Algorithms for communities detection and visualization





2-Polarized-Communities: an algorithm based on spectral properties of the graph

Stuctural-balance-viz: spectral properties used to emphasize balance/unbalance

F Bonchi, E Galimberti, A Gionis, B Ordozgoiti and G Ruffo, Discovering polarized communities in signed networks, in Proc. of CIKM 2019 (Beijing, China)

E Galimberti, C Madeddu, F Bonchi, and G Ruffo, Visualizing structural balance in signed networks, in Proc. of COMPLEX NETWORKS 2019 (Lisbon, Portugal)

Discussion and conclusions

Recap

- **Structural segregation** may be one of the main triggers of opinion **polarization**
- **Fake-news spreading**, especially when partisanship and antagonistic behavior reinforce the debate, is **facilitated** in segregated networks
- Fact-checking is needed and skeptics with links to more gullible (vulnerable) contacts can be recruited as **gatekeepers**
- **Network Analysis** and **NLP** are great tools for modeling and analyzing data in this domain
- **Balance theory** provides a so far neglected framework to study the interplay between opinion polarization and structural segregation: new **algorithms** and **visualizations tools** can be added to the analytical loop
- Beware of the **interplay**: segregation causes polarization and vice-versa

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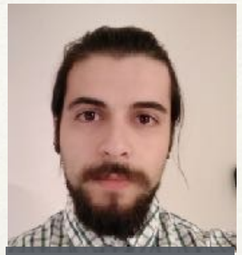
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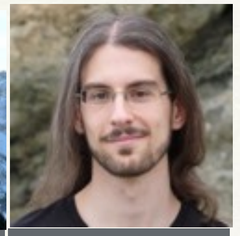
Marcella Tambuscio


André Panisson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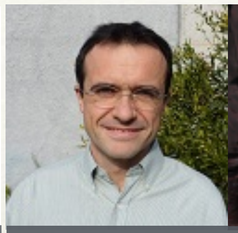
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http://www.di.unito.it/~ruffo/talks/2021_COINS.pdf


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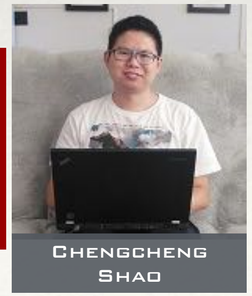
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