



Polarization in Social Media

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What is Polarization?

Oxford Reference: "Splitting of a society in two distinct group"

social polarization 

The splitting of a society into two distinct groups that are different ends of a spectrum, such as rich and poor, or white and black. It can also refer to divisions within a city (see GLOBAL CITY). In Marxist terms, social polarization on an axis of wealth divided people into bourgeoisie (the owners of production) and proletariat (the workers for production). Such polarization was ameliorated by the rise of the middle class. Social polarization is often racialized with black members of society in Europe and North America much more likely to be poor. In all cases, polarization weakens social cohesion and leads to patterns of segregation.



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Agenda

- What is Polarization on Social-Media?
- Some social theories behind polarization
- Some Findings from prior research
 - Which networks are useful
 - Ways to measure polarization
- Demo: Polarization on Twitter using ORA



The biggest threat to democracy? Your social media feed



The internet was meant to spread democracy. Could it be having the opposite effect?

Image: REUTERS/Melissa Fares

Source: The World Economic Forum

<https://www.weforum.org/agenda/2016/08/the-biggest-threat-to-democracy-your-social-media-feed/>



Polarization Example: Blog Writings

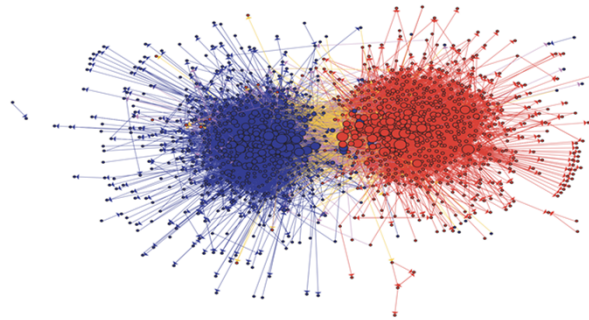


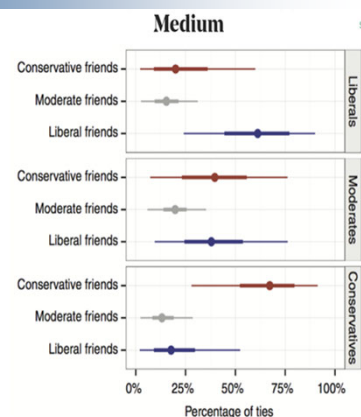
Figure 1: Community structure of political blogs (expanded set), shown using utilizing the GUESS visualization and analysis tool[2]. The colors reflect political orientation, red for conservative, and blue for liberal. Orange links go from liberal to conservative, and purple ones from conservative to liberal. The size of each blog reflects the number of other blogs that link to it.

Source: Lada A. Adamic and Natalie Glance. 2005. The political blogosphere and the 2004 U.S. election: divided they blog. In Proceedings of the 3rd international workshop on Link discovery (LinkKDD '05). ACM, New York, NY, USA, 36-43. DOI=<http://dx.doi.org/10.1145/1134271.1134277>

Why Study Polarization?

Polarization decreases exchange of ideas

- Polarization can have 'real' adverse effects like impacting election decisions ^{1,2} !!
- Understanding polarization can suggest ways to reduce polarization



Subsequent studies confirmed that the percent of clicks on cross-cutting content of Facebook users is substantially lower; only 17% of conservative users and 6% of liberal users click on cross-cutting content, according to the graph below.



Some Theories on What leads to polarization?

Individual Level:

- Confirmation Bias, Selective Exposure and Cognitive Dissonance, Filter Bubble

Group Level:

- Homophily, Social Identity and Group Think



Why Polarized Groups on Social Media at the Individual Level

Technology leads to **'Information overload'** which triggers our **'biases'** that are magnified by **'Algorithmic Filters'** resulting in **'Filter Bubbles'** leading to **'Polarization'** on Social Media



Information Overload



Image source: <https://img.huffingtonpost.com/asset/585c0d571600002400bdf381.jpeg>

[More data](#) has been created in the past two years than in the entire previous history of the human race.

Source: www.forbes.com

Human Biases: Confirmation Bias

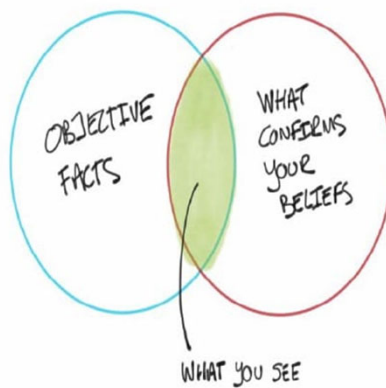


Image Source: <https://wp-media.patheos.com/blogs/sites/777/2017/07/C7216228-3C0F-4946-B2F6-1DE8271F4A3E.jpeg>

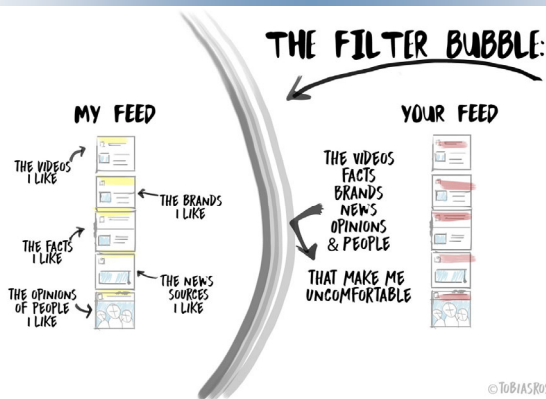
Information Overload Triggers Our Biases

- Our brain tries to pick information that are more likely to confirm to our prior beliefs



Heatmap of Attention on a New York Times article

Algorithmic Filters Magnify These Biases..



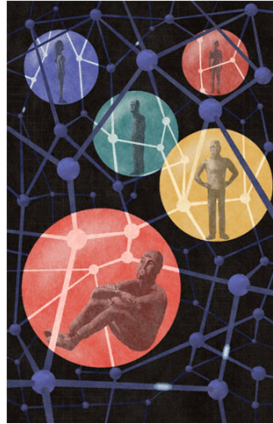
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"Instead of giving the public what it needs to hear, we're giving the public, news that it wants to hear"

Ted Koppel



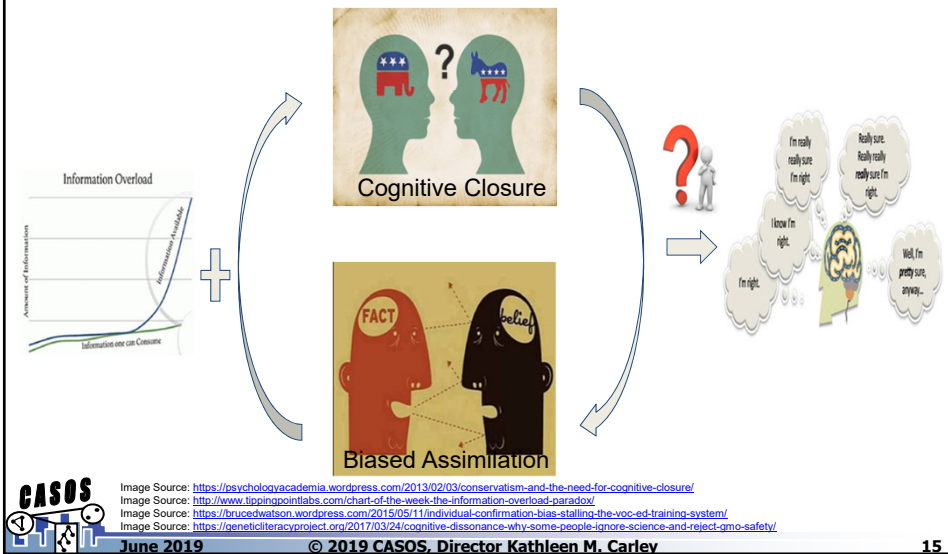
Our 'biases' are magnified by 'Algorithmic Filters' resulting in 'Filter Bubbles'



Filter Bubbles Obstructs Information Diffusion Leading to Polarized Communities



Individual's Polarization Model



Technology leads to **Information overload** which triggers our **biases** that are magnified by **Algorithmic Filters** resulting in **Filter Bubbles** leading to **Polarized Communities** on Social Media (where **Fake-news** flourish)



Group Polarization Model

Homophily:

People tend to associate with similar other



Group Polarization Model

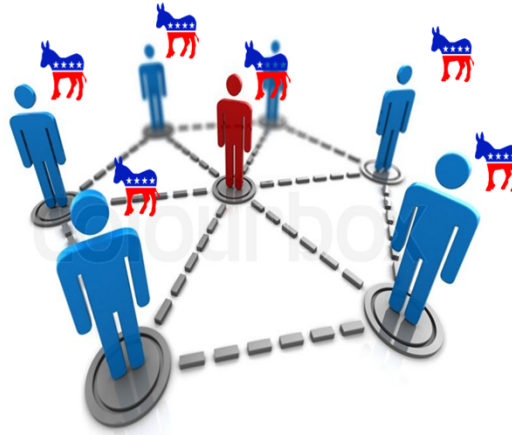
Social Influence:

Dissimilarity of their initial opinions is reduced by social influence process

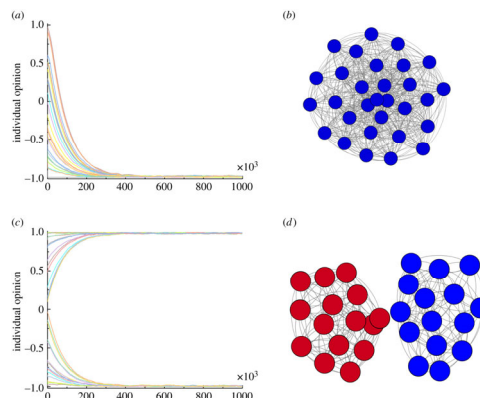


Group Polarization Model

Group Think:
Members try to
minimize conflict



Group Polarization Model: Initial Disagreements lead to polarization



Source: Evans, Tucker, and Feng Fu. "Opinion formation on dynamic networks: identifying conditions for the emergence of partisan echo chambers." *Royal Society open science* 5, no. 10 (2018): 181122.



Example: Political Polarization on Twitter

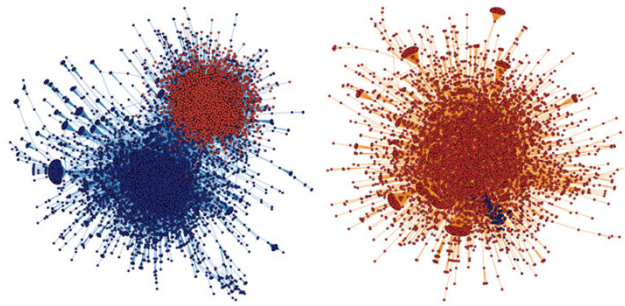


Figure 1: The political retweet (left) and mention (right) networks, laid out using a force-directed algorithm. Node colors reflect cluster assignments (see § 3.1). Community structure is evident in the retweet network, but less so in the mention network. We show in § 3.3 that in the retweet network, the red cluster A is made of 93% right-leaning users, while the blue cluster B is made of 80% left-leaning users.

Prior Research Findings on Social Media Polarization

Finding 1: Modularity is not a Great Metric for Polarization

- Modularity is not a great metric to measure antagonism **as non-polarized networks may also be divided in modular communities**¹
- Low concentration on popular nodes along the boundary could be used as a metric¹
- Random walks on networks can be used to design a metric². This uses the probability of starting in a partition and ending in another partition.

1. Guerra, Pedro Henrique Calais, Wagner Meira Jr, Claire Cardie, and Robert Kleinberg. "A Measure of Polarization on Social Media Networks Based on Community Boundaries." In ICWSM. 2013.
2. 2018, Garimella, Kiran, Gianmarco De Francisci Morales, Aristides Gionis, and Michael Mathioudakis. "Quantifying Controversy on Social Media." *ACM Transactions on Social Computing* 1, no. 1 (2018): 3.



Finding 2: Retweets Exhibit Partisan Structure

- Users tend to interact with like minded others → Exposure to alternate views are rare¹. This leads to polarized groups.
- Strong attitude based homophily in retweet networks^{1,2}

1. 2015, Williams, Hywel TP, James R. McMurray, Tim Kurz, and F. Hugo Lambert. "Network analysis reveals open forums and echo chambers in social media discussions of climate change." *Global Environmental Change* 32 (2015): 126-138.
2. 2011, Conover, Michael, Jacob Ratkiewicz, Matthew R. Francisco, Bruno Gonçalves, Filippo Menczer, and Alessandro Flammini. "Political polarization on twitter." *ICWSM 133* (2011): 89-96



Finding 3: Follower-Network Exhibit Partisanship Structure

- But to a lesser extent ^{1,2}

1. 2015, Williams, Hywel TP, James R. McMurray, Tim Kurz, and F. Hugo Lambert. "[Network analysis reveals open forums and echo chambers in social media discussions of climate change.](#)" *Global Environmental Change* 32 (2015): 126-138.
2. 2011, Conover, Michael, Jacob Ratkiewicz, Matthew R. Francisco, Bruno Gonçalves, Filippo Menczer, and Alessandro Flammini. "Political polarization on twitter." *ICWSM 133* (2011): 89-96



Finding 4: Mention Networks do not exhibit partisan structure

- Politically motivated users provoke interaction by injecting partisan content²
- Primary target of such content are ideologically opposed users²

1. 2015, Williams, Hywel TP, James R. McMurray, Tim Kurz, and F. Hugo Lambert. "[Network analysis reveals open forums and echo chambers in social media discussions of climate change.](#)" *Global Environmental Change* 32 (2015): 126-138.
2. 2011, Conover, Michael, Jacob Ratkiewicz, Matthew R. Francisco, Bruno Gonçalves, Filippo Menczer, and Alessandro Flammini. "Political polarization on twitter." *ICWSM 133* (2011): 89-96



Finding 5: A minority of influential users propagate their opinion

- A minority of influentials (leaders) propagate their opinion ³

1. 2015, Williams, Hywel TP, James R. McMurray, Tim Kurz, and F. Hugo Lambert. "[Network analysis reveals open forums and echo chambers in social media discussions of climate change.](#)" *Global Environmental Change* 32 (2015): 126-138.
2. 2011, Conover, Michael, Jacob Ratkiewicz, Matthew R. Francisco, Bruno Gonçalves, Filippo Menczer, and Alessandro Flammini. "Political polarization on twitter." *ICWSM 133* (2011): 89-96
3. Morales, A. J., Javier Borondo, Juan Carlos Losada, and Rosa M. Benito. "Measuring political polarization: Twitter shows the two sides of Venezuela." *Chaos: An Interdisciplinary Journal of Nonlinear Science* 25, no. 3 (2015): 033114



ORA Live Demonstration



Example: Fake-News Tweets related to US Politics

Dataset creation steps:

- Collect recent Politifact fake news-headlines related to politics
- Search these headlines on Twitter (daily for a few days)
- Combine the collected tweets as one dataset



Useful References

1. 2015, Williams, Hywel TP, James R. McMurray, Tim Kurz, and F. Hugo Lambert. "[Network analysis reveals open forums and echo chambers in social media discussions of climate change.](#)" *Global Environmental Change* 32 (2015): 126-138.
2. 2011, Conover, Michael, Jacob Ratkiewicz, Matthew R. Francisco, Bruno Gonçalves, Filippo Menczer, and Alessandro Flammini. "[Political polarization on twitter.](#)" *ICWSM* 133 (2011): 89-96
3. Morales, A. J., Javier Borondo, Juan Carlos Losada, and Rosa M. Benito. "[Measuring political polarization: Twitter shows the two sides of Venezuela.](#)" *Chaos: An Interdisciplinary Journal of Nonlinear Science* 25, no. 3 (2015): 033114



Thank You!!

Questions?



Echo-chamber

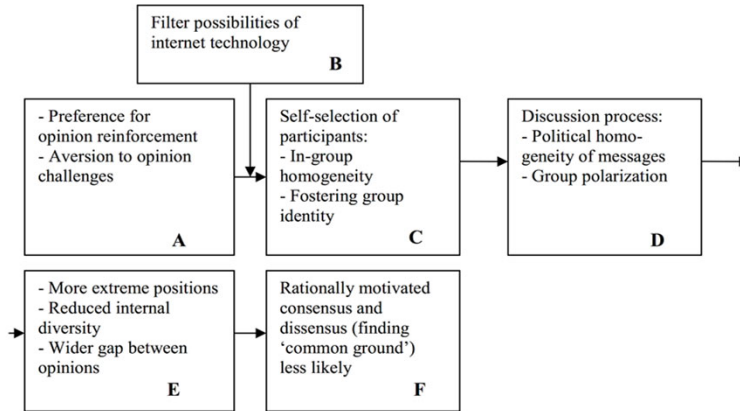
- A group of nodes that have nearly all-to-all communications, and they are talking about the same topic.
- GroupThink Theory: Feeding what each other said, and each happen to have the same influence. Suppressing dissenting viewpoints, Isolating from outside influence
- Social Influence model: For structurally equivalent actors, dissimilarity of their initial opinions is reduced by social influence process



An echo-chamber need not be polarized.



Opinion Formation Model



Sunstein's Group Polarization Model

Filter Bubble

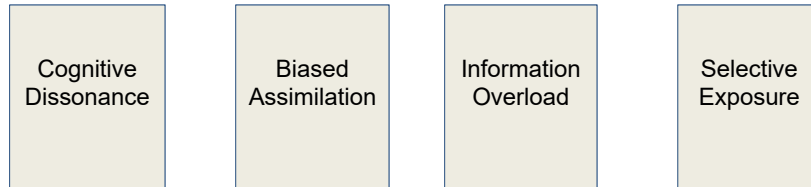
Personalized algorithms recommends what a user would like to see..

The truth about Brexit didn't stand a chance in the online bubble

Emily Bell



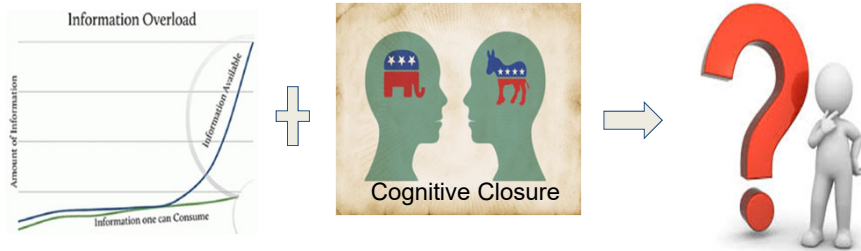
Group Polarization Model



Cognitive Closure: Individual's desire for a firm answers to a question

Source: Kruglanski, A. W.; Webster, D. M. (April 1996). "Motivated closing of the mind: 'Seizing' and 'freezing'". *Psychological Review*. **103** (2): 263–83
Source: Edwards, A. "(How) do participants in online discussion forums create 'echo chambers'?: The inclusion and exclusion of dissenting voices in an online forum about climate change." (2013)

Group Polarization Model



Group Polarization Model

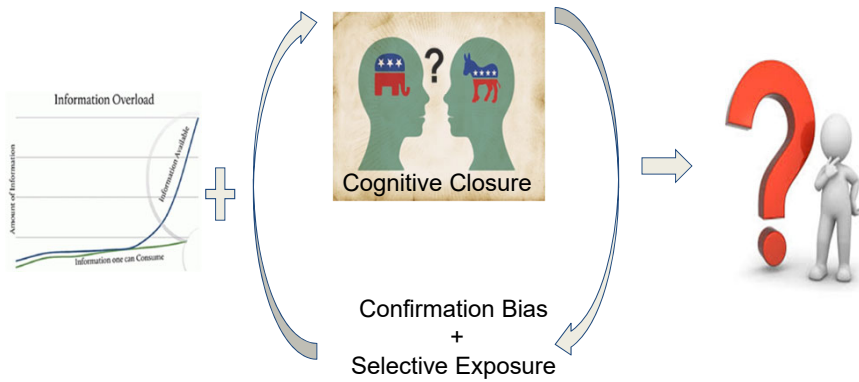


Image Source: <https://psychologyacademia.wordpress.com/2013/02/03/conservatism-and-the-need-for-cognitive-closure/>
 Image Source: <http://www.tippingpointlabs.com/chart-of-the-week-the-information-overload-paradox/>

Group Polarization Model

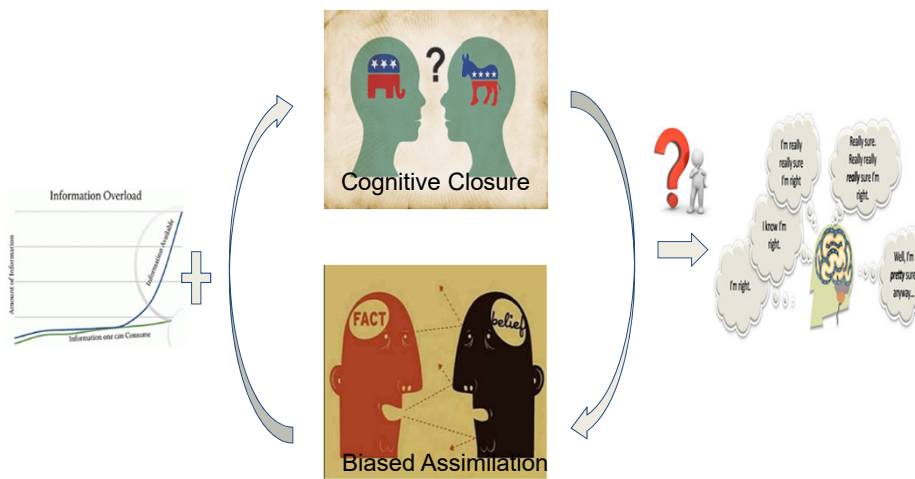


Image Source: <https://psychologyacademia.wordpress.com/2013/02/03/conservatism-and-the-need-for-cognitive-closure/>
 Image Source: <http://www.tippingpointlabs.com/chart-of-the-week-the-information-overload-paradox/>
 Image Source: <https://brucedwatson.wordpress.com/2015/05/11/individual-confirmation-bias-stalling-the-voc-ed-training-system/>
 Image Source: <https://genetoliteracyproject.org/2017/03/24/cognitive-disonance-why-some-people-ignore-science-and-reject-gmo-safety/>



Ways to Measure Polarization

Three questions are commonly asked:

1. How polarized is a discussion?
 - a. Content based evaluation
2. How polarized is a group?
 - a. Network and Content based metrics
3. How biased is an Individual?
 - a. Network position and content based metric



How polarized is a discussion?

- Sentiment Variance



How polarized is a group?

- Network Structure of Interactions
- Modularity as a metric
- Members at the Community Boundary

How biased is an individual?

- Network position and users content based analysis
- Label propagation approach could be used

Different Networks on Twitter: Which among these are useful for studying polarization?

- Follower Networks
- Retweet Network
- Mentions Networks
- Hashtag Networks



Prior Research on Polarized Groups on Twitter

- Users tend to interact with like minded others → Exposure to alternate views are rare¹. This leads to polarized groups.
- Strong attitude based homophily in follower¹ and retweet networks^{1,2}
- Much less consistent homophily in mention network.¹ Ideologically opposed users interact at a much higher rate in mention network.²
- Modularity is not a great metric for measuring polarization

1. 2015, Williams, Hywel TP, James R. McMurray, Tim Kurz, and F. Hugo Lambert. "[Network analysis reveals open forums and echo chambers in social media discussions of climate change.](#)" *Global Environmental Change* 32 (2015): 126-138.

2. 2011, Conover, Michael, Jacob Ratkiewicz, Matthew R. Francisco, Bruno Gonçalves, Filippo Menczer, and Alessandro Flammini. "[Political polarization on twitter.](#)" *ICWSM 133* (2011): 89-96

