

# Mapping the Invocation Structure of Online Political Interaction

Manish Raghavan, Ashton Anderson, and Jon Kleinberg

# Interactions on Twitter

 **Governor Phil Murphy** ✓  
@GovMurphy [Follow](#)

.@realDonaldTrump has attacked American companies regularly and indiscriminately.

But these outbursts do not mask the fact that the President pushed through a massive, unnecessary tax cut for the wealthy – help that could have gone to the middle class.



**Amazon Has Lots of Company as Trump Slams 'Stupid' Businesses**  
Tech firms, military contractors, carmakers, cellphone companies, financial firms, sports leagues and Wall Street giants are all in his Twitter cross hairs.  
nytimes.com

10:35 AM - 5 Apr 2018



**emey @Skoot62** · Apr 5

Replying to @GovMurphy @realDonaldTrump

Here's a list of companies that gave there employees raises and bonuses!!! List of companies that paid bonuses or boosted pay since tax bill passed  
[usat.ly/2miWX7q](http://usat.ly/2miWX7q) via @usatoday



**List of companies that paid bonuses or boosted pay since tax bill pa...**  
Walmart is the latest U.S. company to share their tax cut windfall with employees.  
usatoday.com

Friggeri, Adamic, Eckles, Cheng '14: invoked network structure using Snopes replies

# Invocation Graph on Domains

Could try graph on articles, but in practice too sparse



**Governor Phil Murphy** ✓  
@GovMurphy

Follow

.@realDonaldTrump has attacked American companies regularly and indiscriminately.

But these outbursts do not mask the fact that the President pushed through a massive, unnecessary tax cut for the wealthy – help that could have gone to the middle class.



**Amazon Has Lots of Company as Trump Slams 'Stupid' Businesses**  
Tech firms, military contractors, carmakers, cellphone companies, financial firms, sports leagues, and Wall Street giants are all in his Twitter cross hairs.  
nytimes.com

10:35 AM - 5 Apr 2018



**emey @Skoot62** · Apr 5

Replying to @GovMurphy @realDonaldTrump

Here's a list of companies that gave there employees raises and bonuses!!! List of companies that paid bonuses or boosted pay since tax bill passed  
[usat.ly/2miWX7q](https://usat.ly/2miWX7q) via @usatoday



**List of companies that paid bonuses or boosted pay since tax bill pa...**

Walmart is the latest U.S. company to share their tax cut windfall with employees.

usatoday.com



# Invocation Graph Details



**Key point:** linkage reflects use by readers, not hyperlinks by authors

Fundamentally different type of network

# Invocation Graph Details

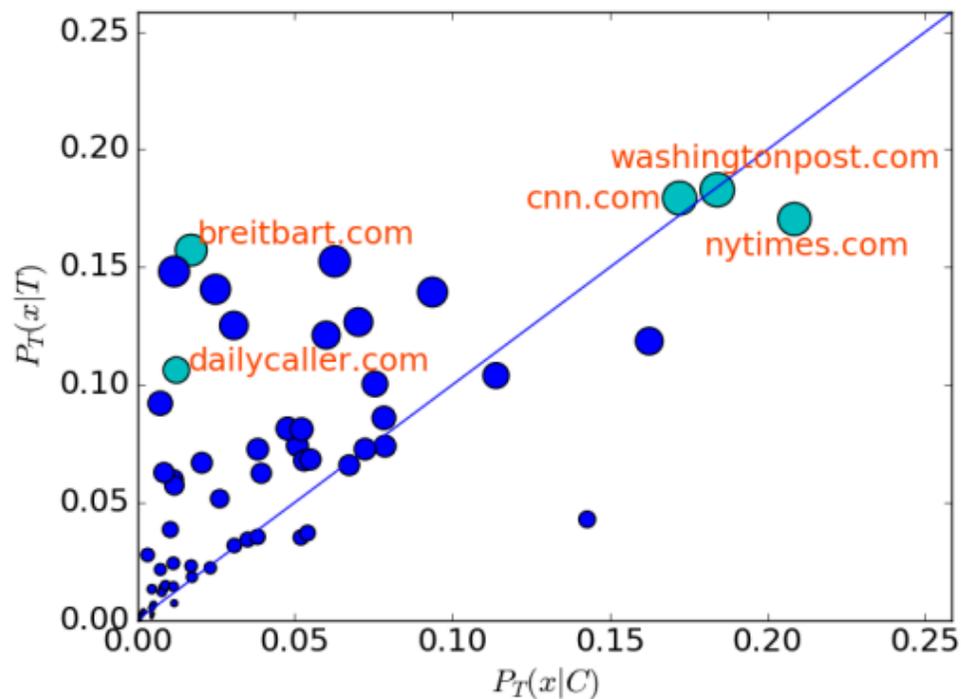


- Blacklist: youtube.com, facebook.com, ...
- Politically relevant: high co-occurrence with Clinton/Trump retweets
- BFS from known political domain following only edges with large weight
- No self-loops

# Basic Questions

- How are edges arranged in a political sense?
- Is linkage symmetric about the political middle?
- How does the structure of the graph evolve over time?

# Political Spectrum



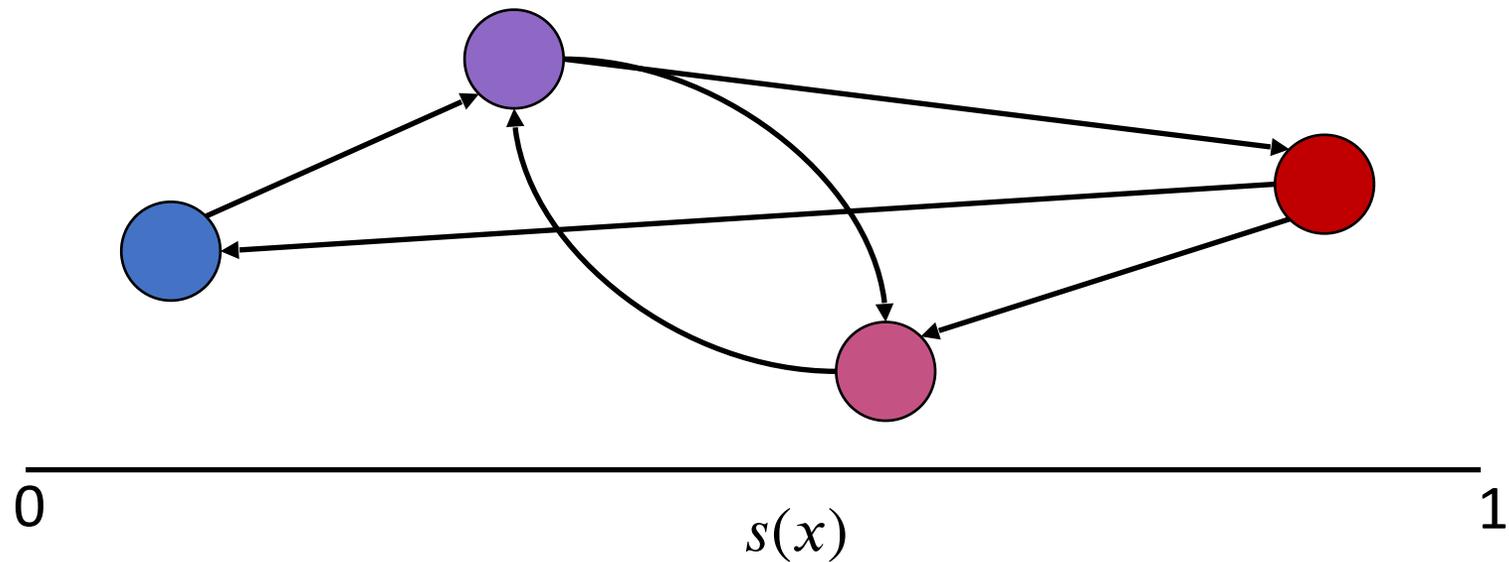
- $P(x | C)$  = probability of tweeting URL from  $x$  given retweet of Clinton on the same day

- ( $P(x | T)$  analogous for Trump)

- $$s(x) = \frac{P(x | T)}{P(x | C) + P(x | T)}$$

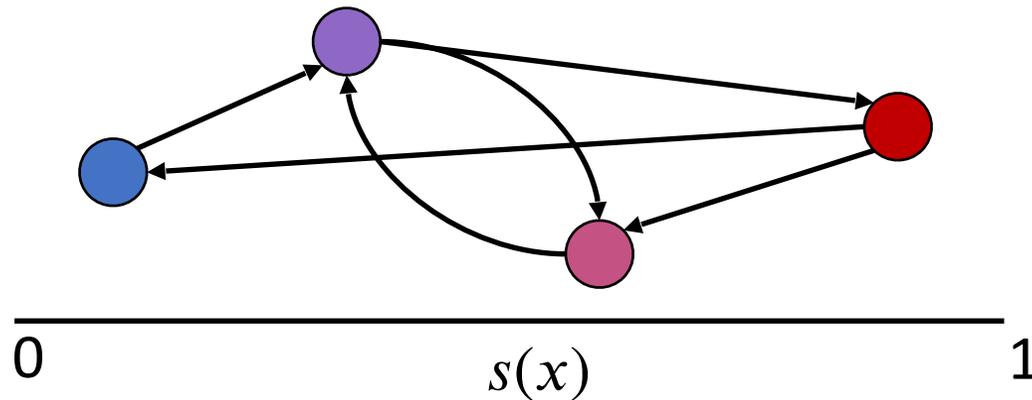
[Benkler, Faris, Roberts, Zuckerman '17]

# Embedding then Invocation Graph on the Political Spectrum

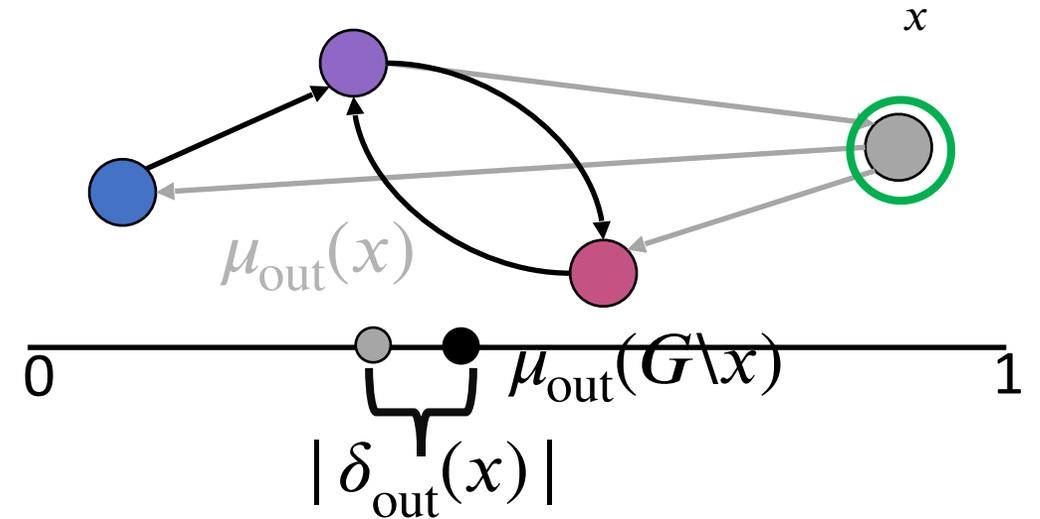
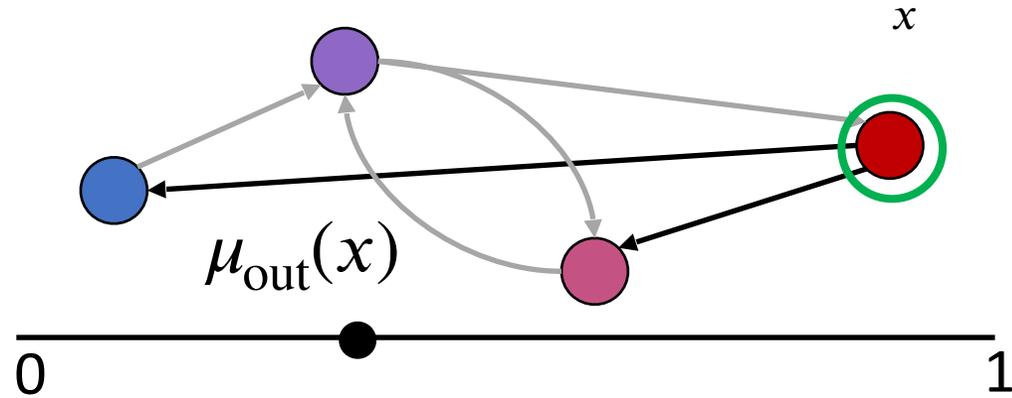


# Concrete Questions

- Does linking pattern from  $x$  correlate with  $x$ 's position on the spectrum?
- Does this change over time?
- What symmetries and asymmetries exist in the graph?
- Where do edges fall on the spectrum?

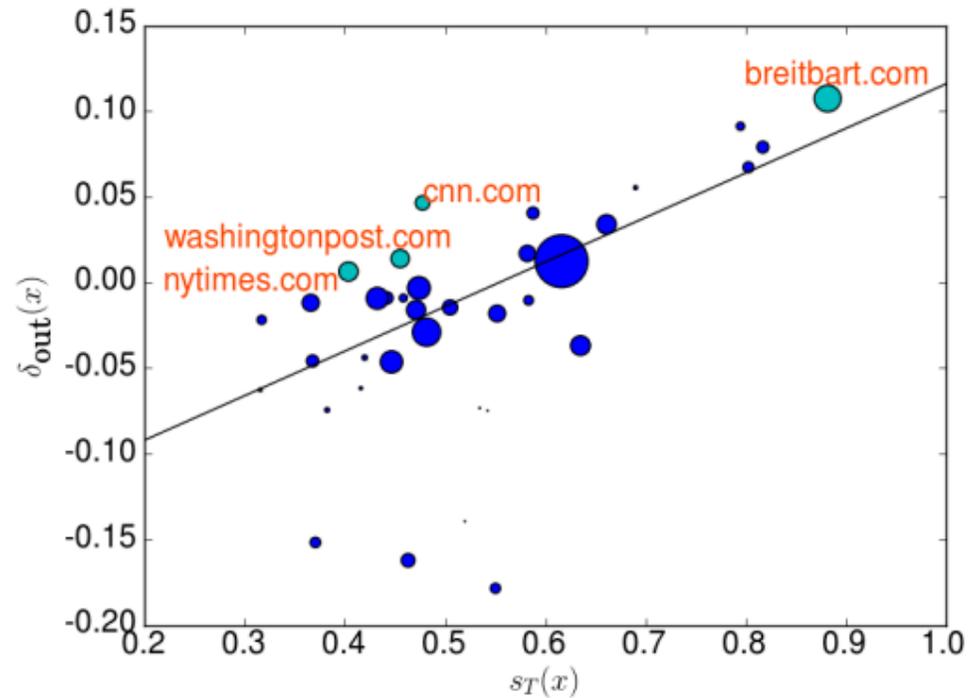


# Linking Pattern

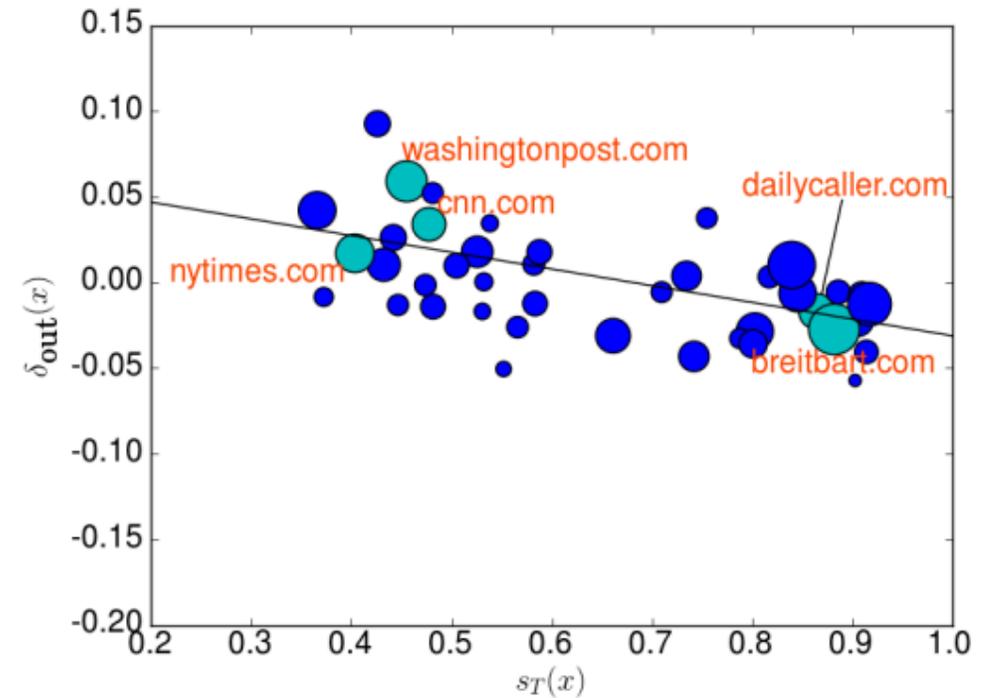


- $\delta_{\text{out}}(x) = \mu_{\text{out}}(x) - \mu_{\text{out}}(G \setminus x)$
- Measures how far  $x$ 's out-links are from average (positive = right, negative = left)
- Correlation with  $s(x)$ 
  - Positive (homophily)? Negative (adversarial)?
  - Change over time?

# Correlation between Linking Pattern and Political Spectrum

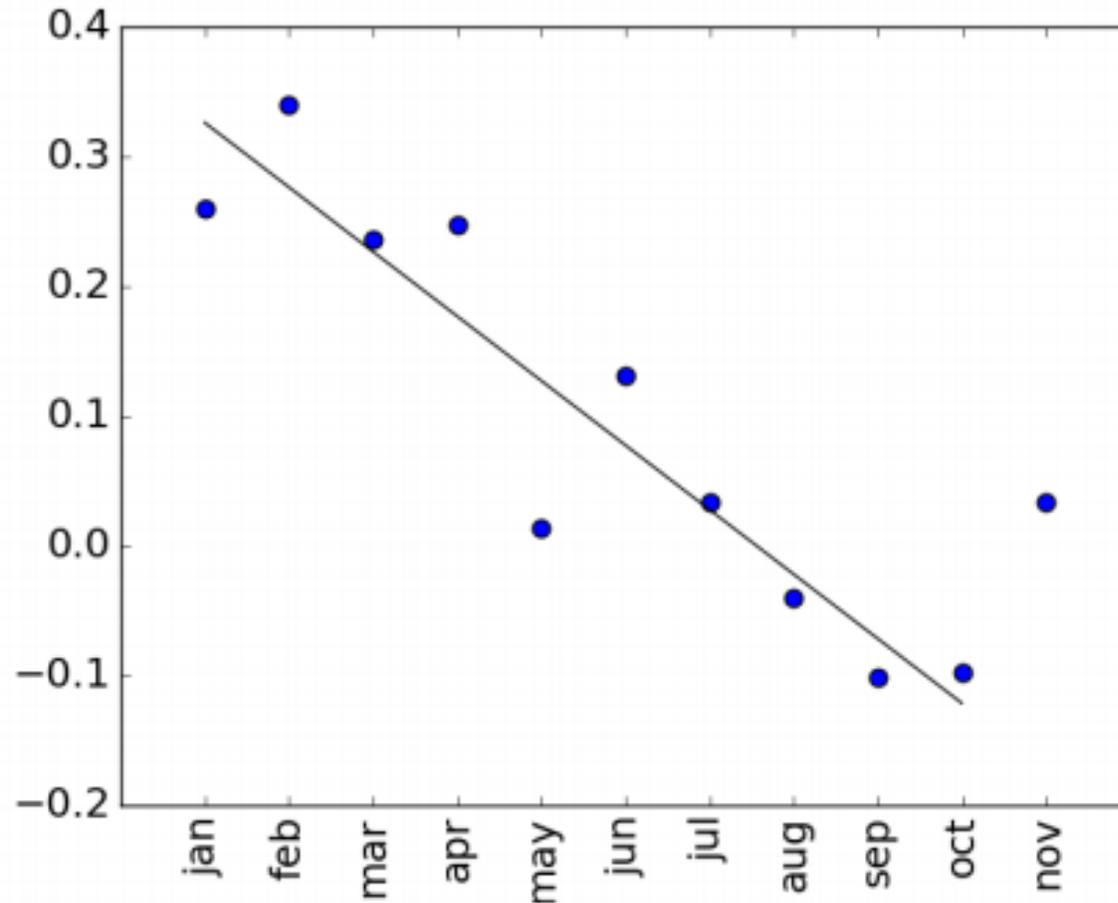


(a) January 2016



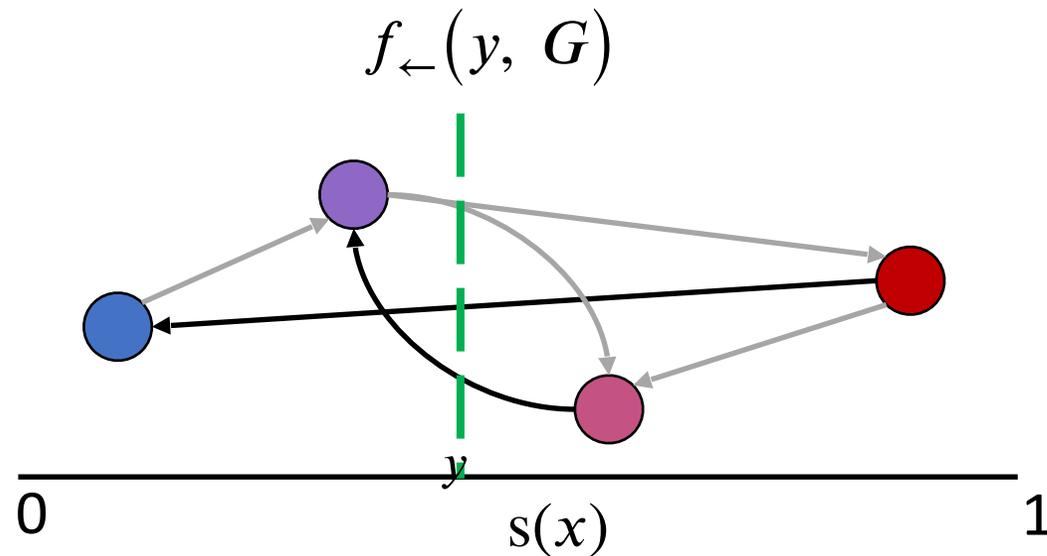
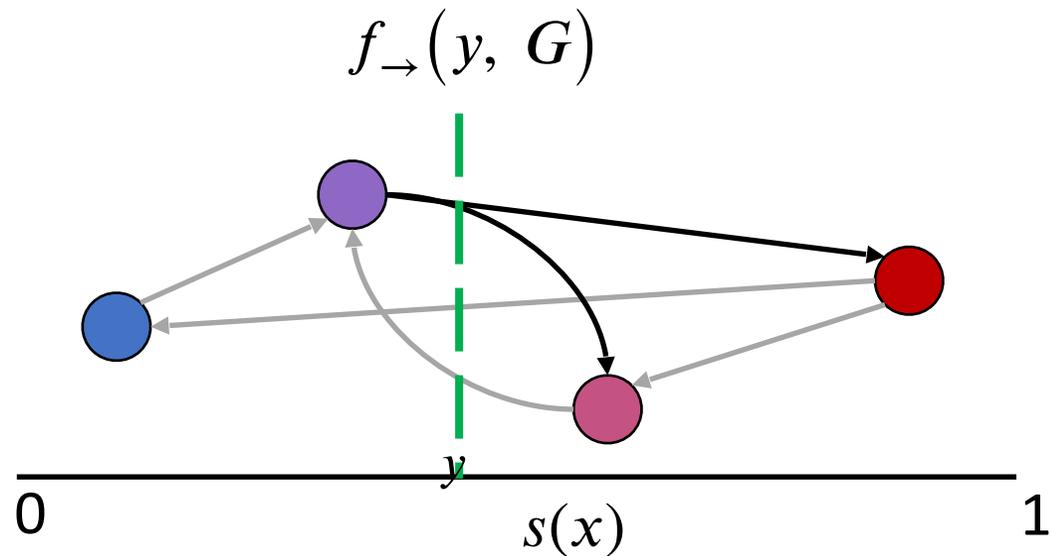
(b) October 2016

# Change in Correlation over 2016



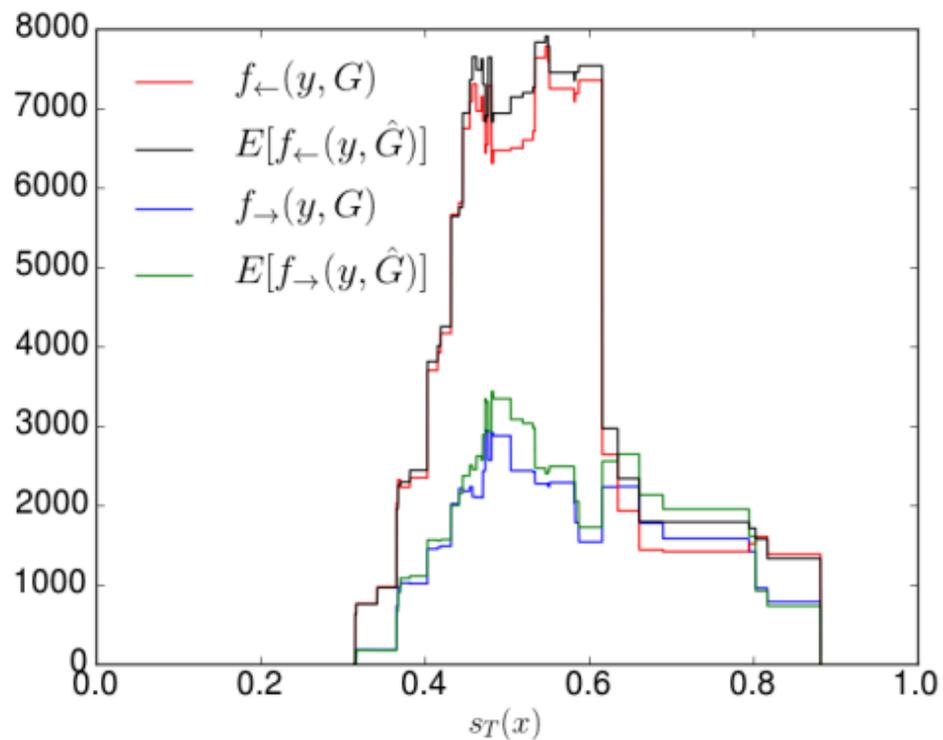
Working against  
homophily

# Edges Crossing over the Spectrum

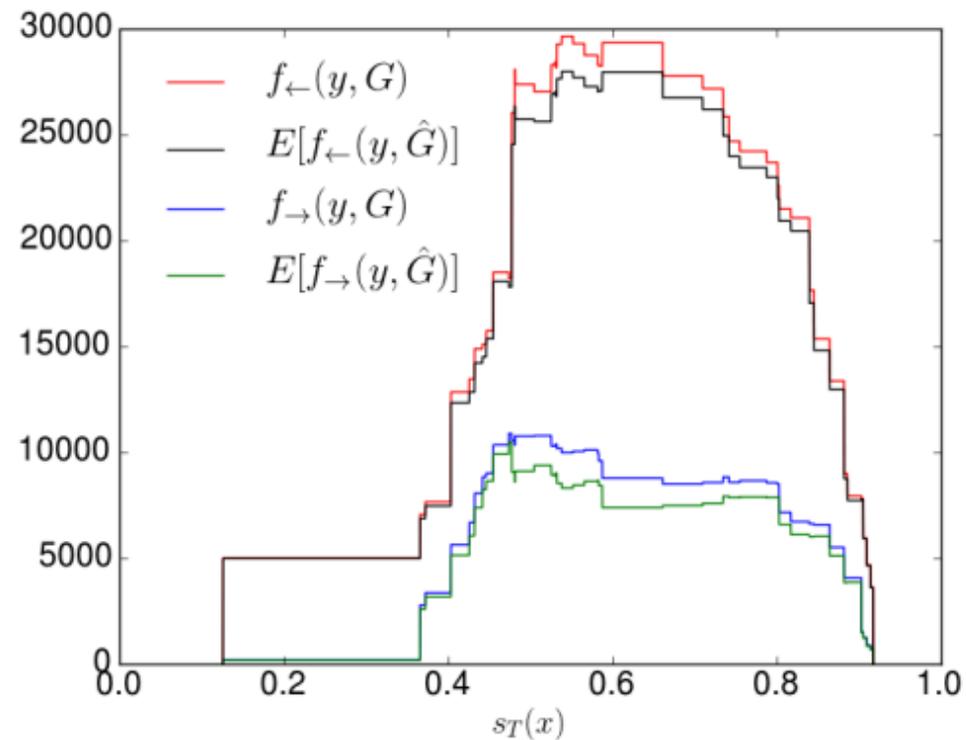


- Baseline comparison: randomly rewired  $\hat{G}$
- $E[f_{\rightarrow}(y, \hat{G})]$  and  $E[f_{\leftarrow}(y, \hat{G})]$

# Edges Crossing over the Spectrum



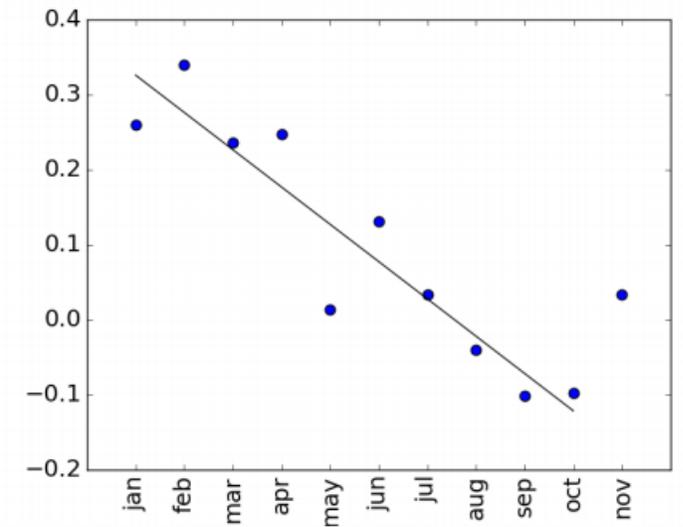
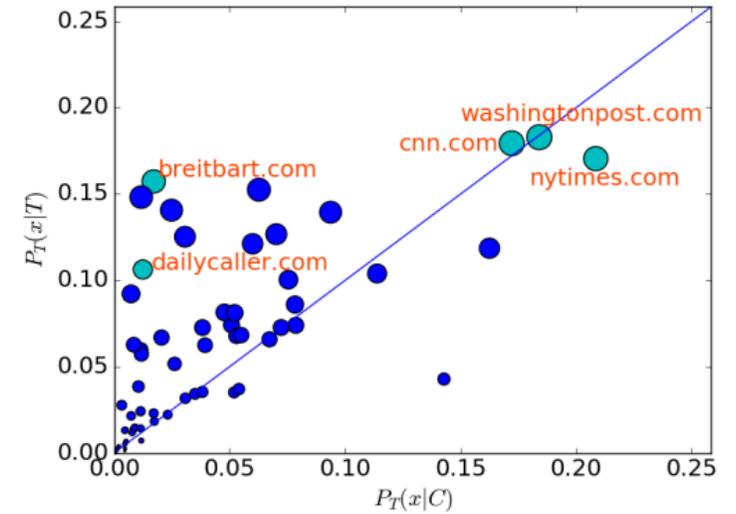
(a) January 2016



(b) October 2016

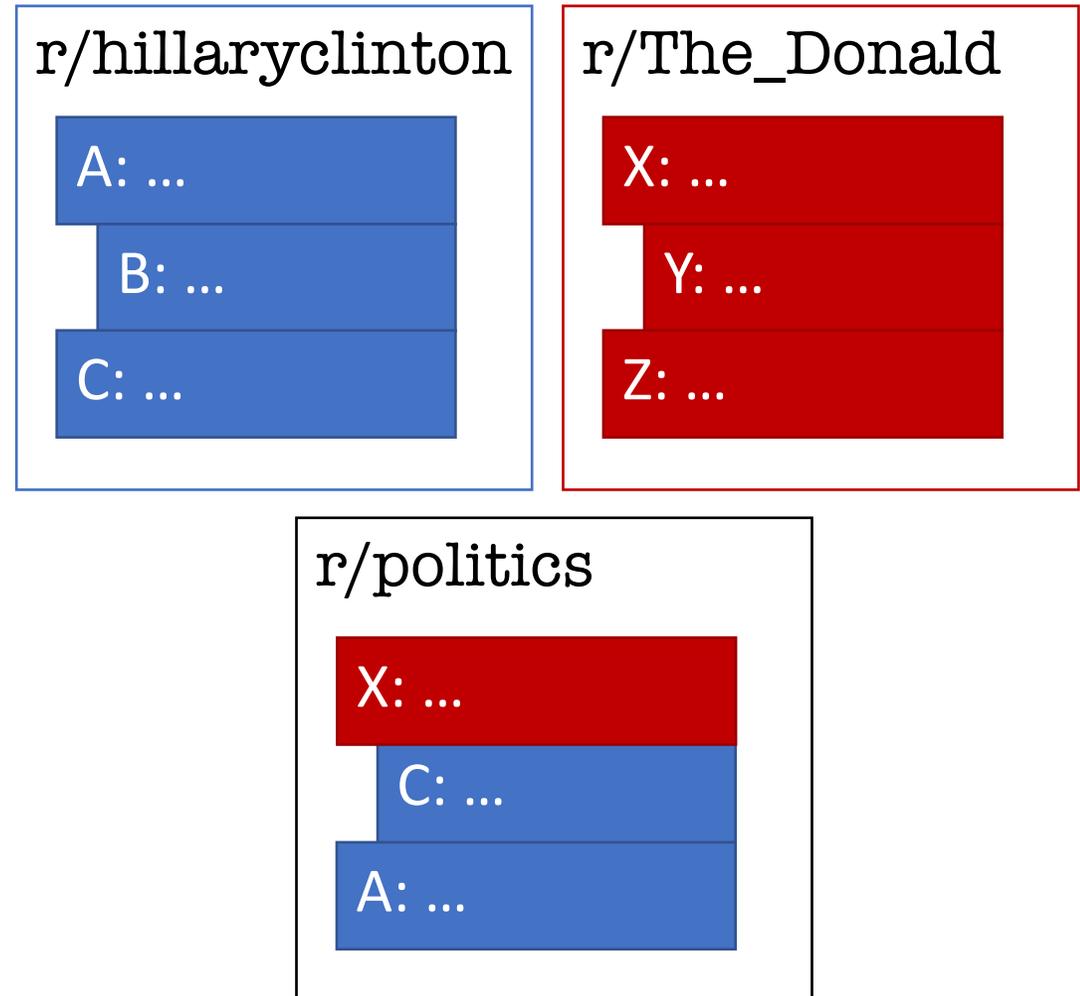
# Analogs in other Domains

- Political spectrum
- Higher rate of cross-ideological interaction leading up to election

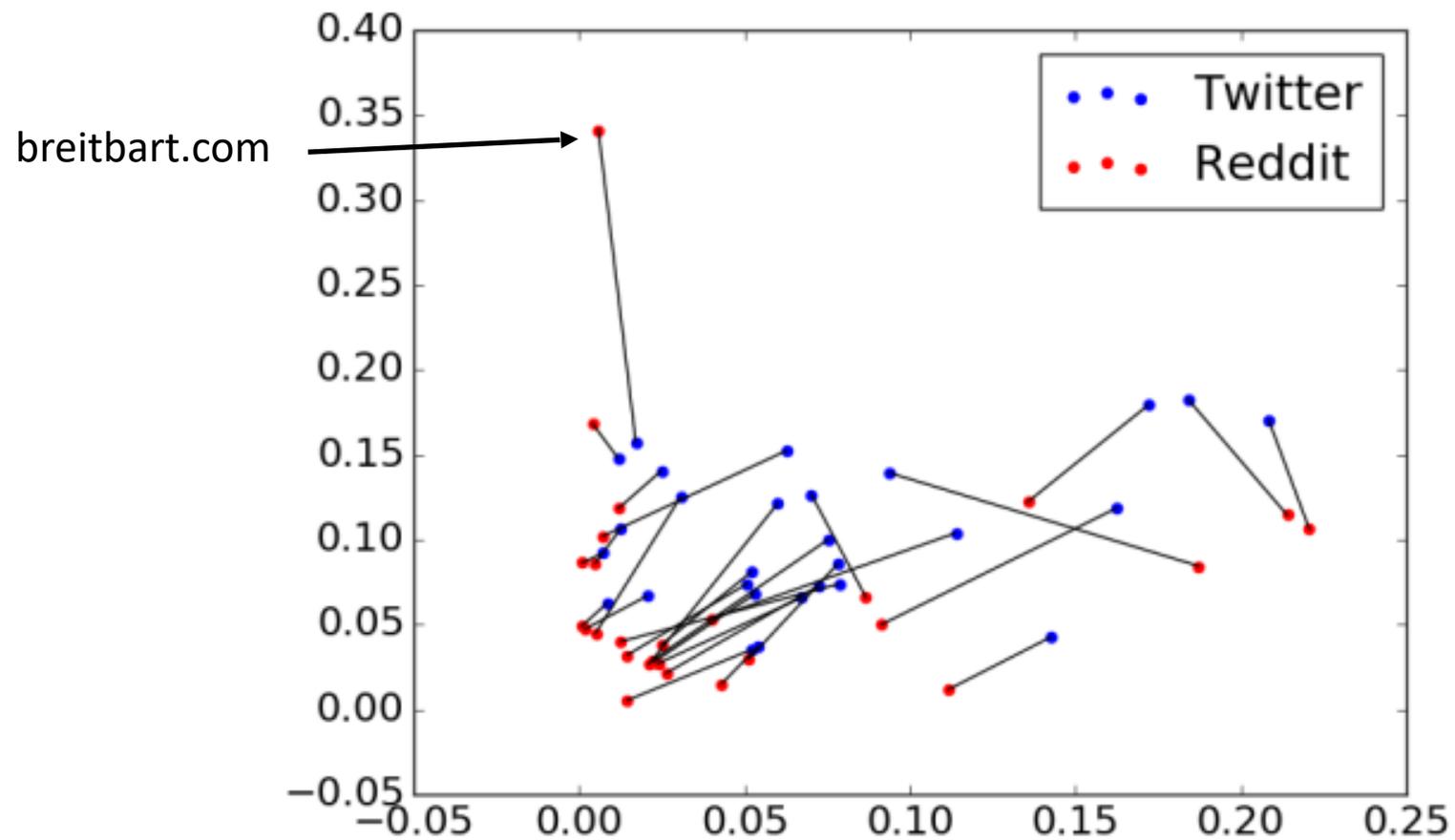


# Adapting to Reddit

- Too sparse – not enough URL → URL replies
- Alternative: user characteristics
  - r/hillaryclinton, r/The\_Donald
  - Sets of active users have small overlap
- Look at interactions in r/politics
- Domain frequencies in each subreddit



# Comparing Spectra



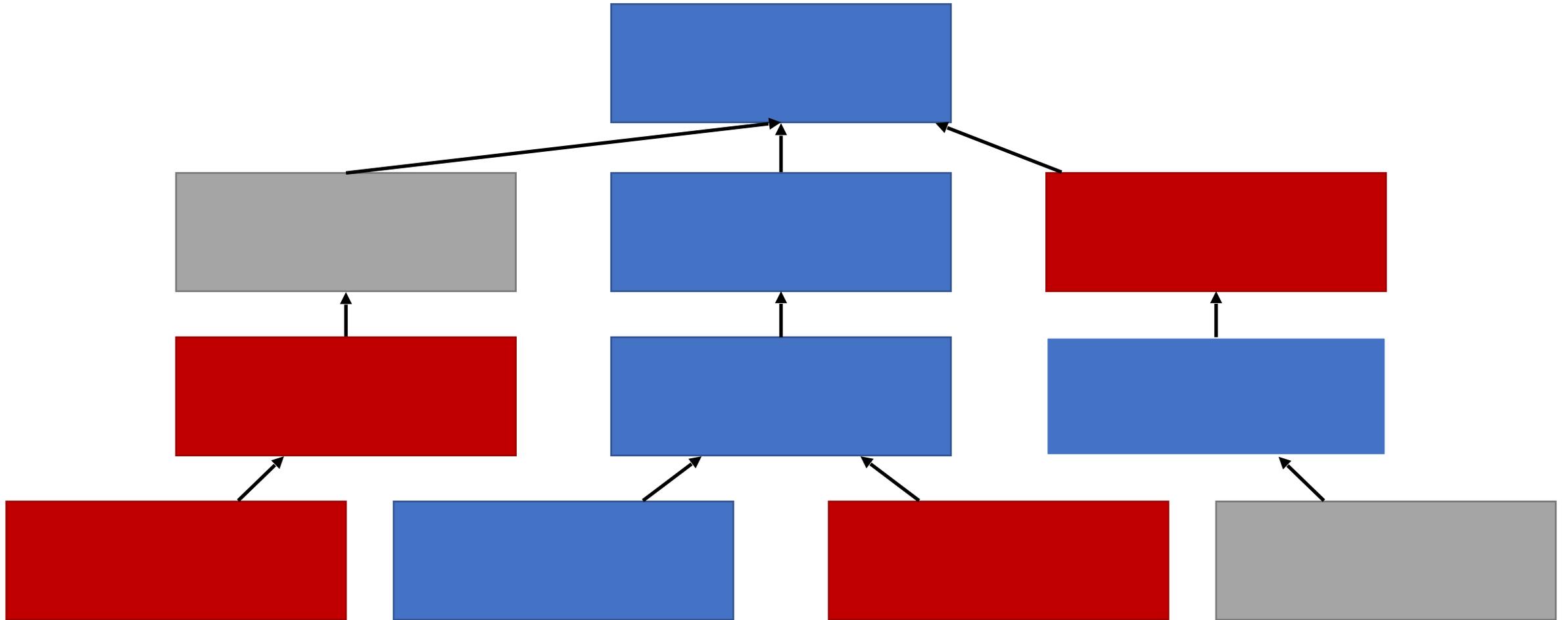
# Comparing Spectra

	Twitter	Reddit
1	donaldjtrump.com	thegatewaypundit.com
2	thegatewaypundit.com	zerohedge.com
3	breitbart.com	breitbart.com
4	dailycaller.com	donaldjtrump.com
5	zerohedge.com	dailycaller.com
6	foxnews.com	dailymail.co.uk
7	nypost.com	foxnews.com
8	dailymail.co.uk	nypost.com
9	thehill.com	bbc.co.uk
10	politico.com	theguardian.com

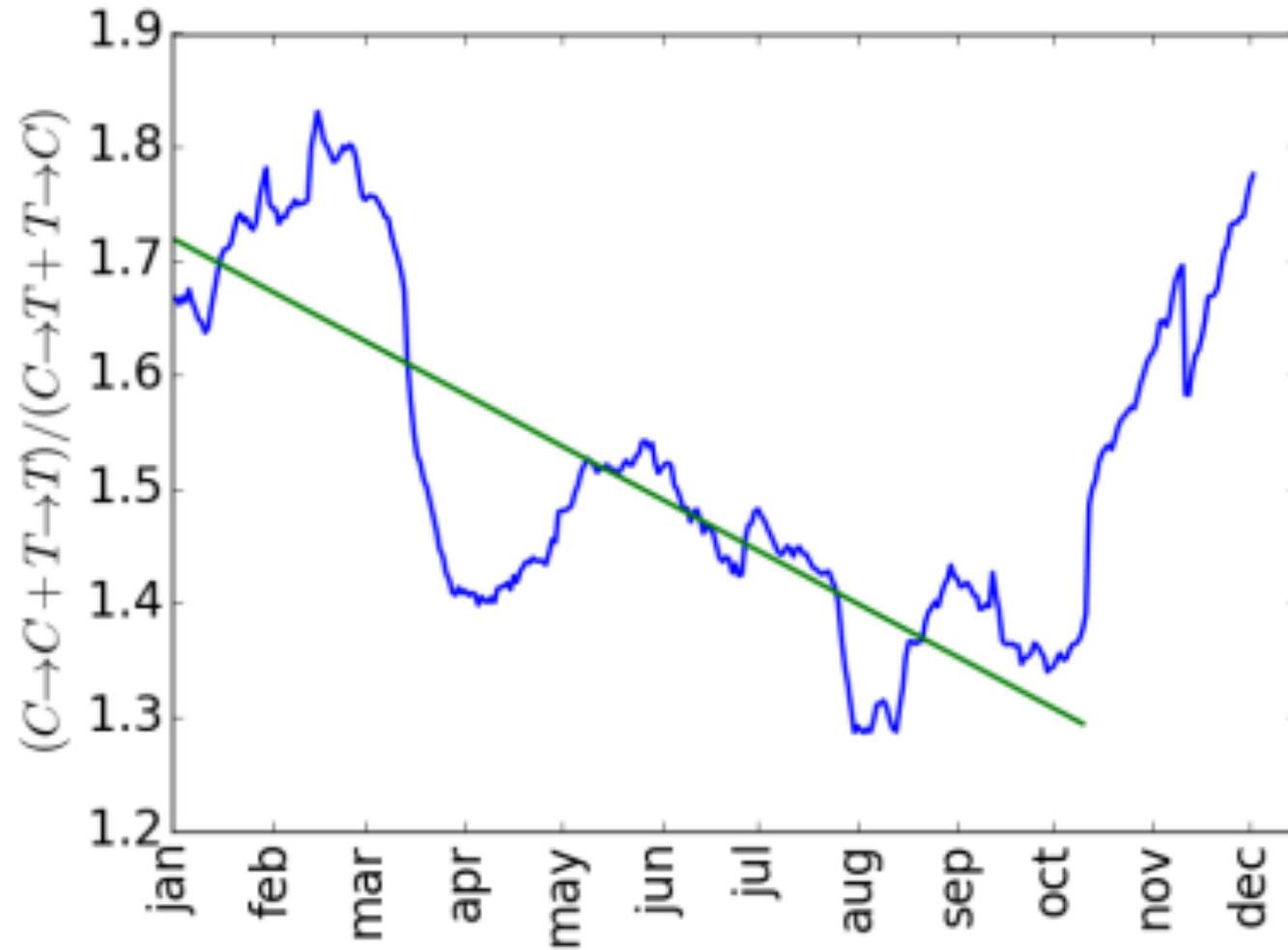
11	cbsnews.com	cbsnews.com
12	nbcnews.com	cnn.com
13	cnn.com	thehill.com
14	washingtonpost.com	nbcnews.com
15	bbc.co.uk	huffingtonpost.com
16	theguardian.com	washingtonpost.com
17	nytimes.com	nytimes.com
18	huffingtonpost.com	politico.com
19	politifact.com	newsweek.com
20	newsweek.com	politifact.com
21	hillaryclinton.com	hillaryclinton.com

Spearman's rank correlation = 0.871  
(max of 10,000 random permutations = .757)

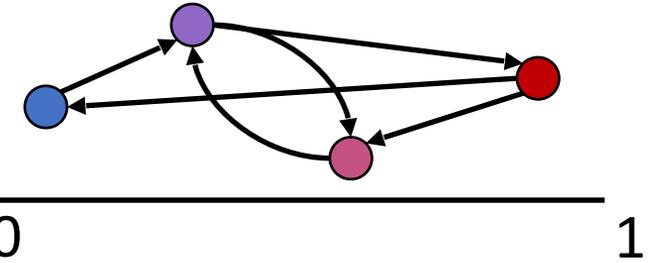
# Cross-Ideological Interactions on Reddit



# Comparing Trends



# Conclusion and Further Directions



- Developed techniques to analyze **invocation graphs**
- Built graph based on **usage**, not hyperlinks
- Uncovered trends leading up to 2016 US election
- Further directions
  - Relationship between invocation graph and polarization
  - Do trends generalize beyond 2016 US election?
  - Curated news feeds

