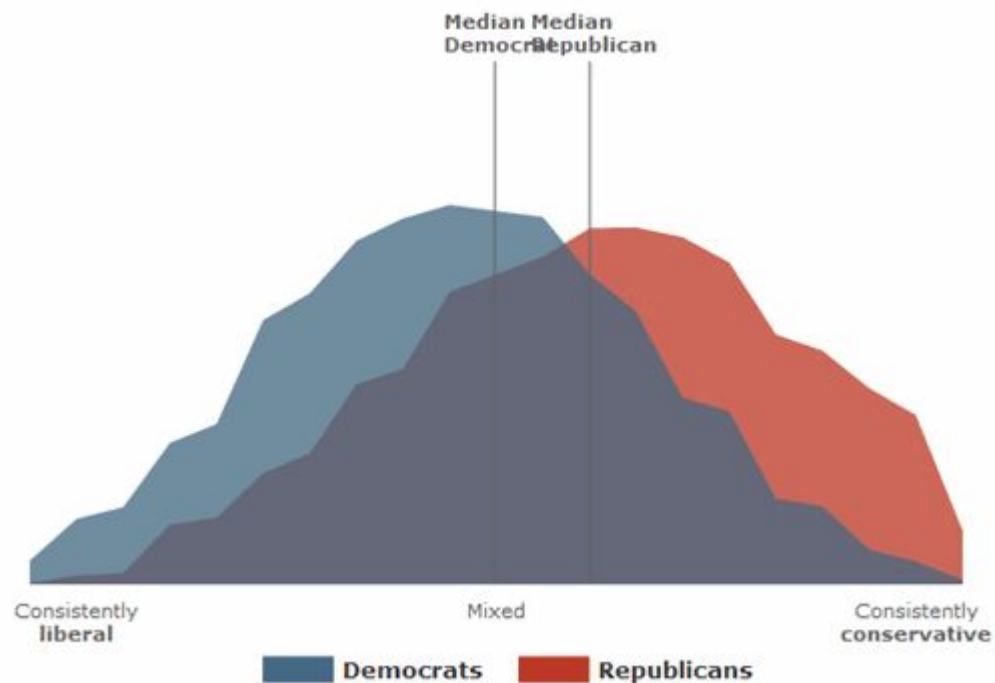# Networks

Lenka Sefcakova, Antonia George, Nicole Poynarova

Political Polarization of the American Public, 1994-2014
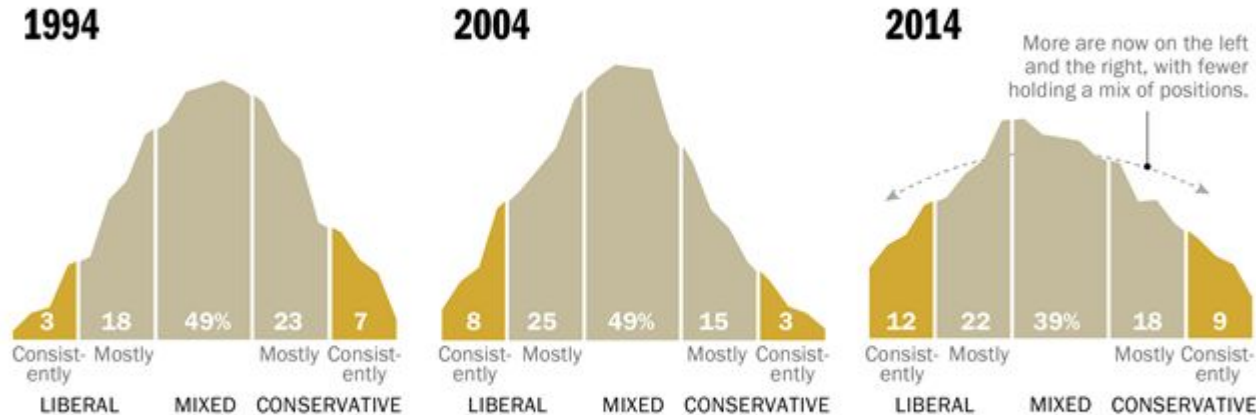

Median
Democrat

Median
Republican

Consistently
liberal

Mixed

Consistently
conservative

Democrats   Republicans

© Pew Research Center

Motivation - *how is polarization measured?*

Growing Minority Holds Consistent Ideological Views

On a 10-item scale of political values, % who are...

1994

3	18	49%	23	7

Consist-ently LIBERAL | Mostly | MIXED | Mostly | Consist-ently CONSERVATIVE

2004

8	25	49%	15	3

Consist-ently LIBERAL | Mostly | MIXED | Mostly | Consist-ently CONSERVATIVE

2014

More are now on the left and the right, with fewer holding a mix of positions.

12	22	39%	18	9

Consist-ently LIBERAL | Mostly | MIXED | Mostly | Consist-ently CONSERVATIVE

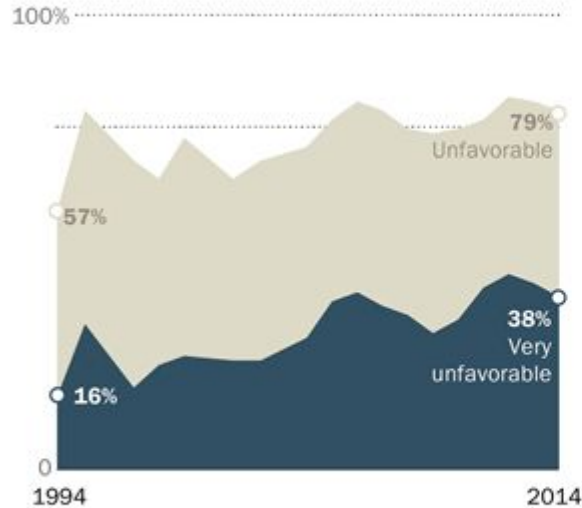Source: 2014 Political Polarization in the American Public
Notes: Ideological consistency based on a scale of 10 political values questions. (See Appendix A for details on how the scale is constructed and how scores are grouped.)
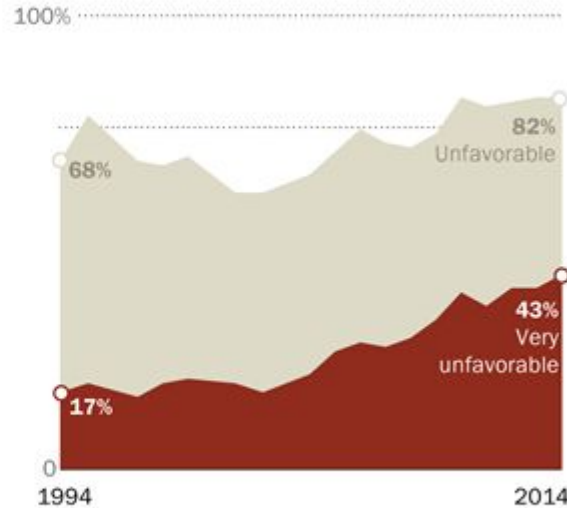
PEW RESEARCH CENTER

Based on survey data measuring the political views and opinions of respondents

Motivation - *how is polarization measured?*

A Rising Tide of Mutual Antipathy

Democratic *attitudes* about the **Republican Party**

100%

57%

79%
Unfavorable

16%

38%
Very unfavorable

1994   2014

Republican *attitudes* about the **Democratic Party**

100%

68%

82%
Unfavorable

17%

43%
Very unfavorable

1994   2014

Source: 2014 Political Polarization in the American Public
Note: Republicans include Republican-leaning independents; Democrats include Democratic-leaning independents.

PEW RESEARCH CENTER

Based on survey data measuring respondents' attitude about the opposing party

Motivation - *how is polarization measured?*

Can be based on:

- Political views and opinions
- Views of opposing parties
- Voting patterns of constituents
- Ideological sorting
- Media consumption habits
- Social networks or interactions
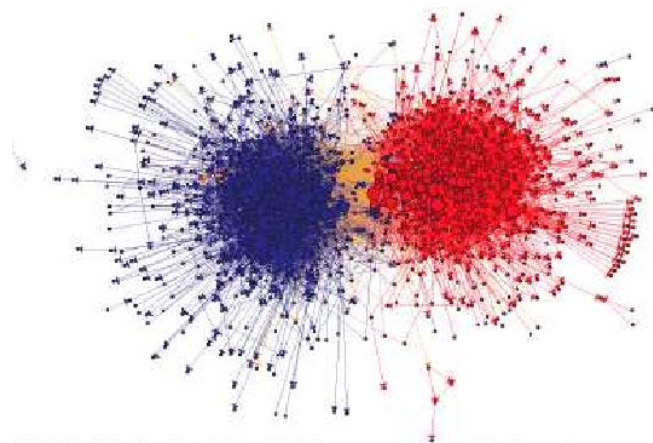
2004 U.S. Political Blogosphere [Adamic et al. 2005]

We will focus on:

- **U.S. Congressional bill co-sponsorships and roll-call votes**

- Political polarization can take both weak and strong forms, defined by intergroup relations.
- Positive and negative political ties can be inferred from patterns of bill co-sponsorship.
- Both chambers of the US Congress have grown more polarized since the 1970s.
- Trends in congressional polarization are unrelated to which party holds the majority
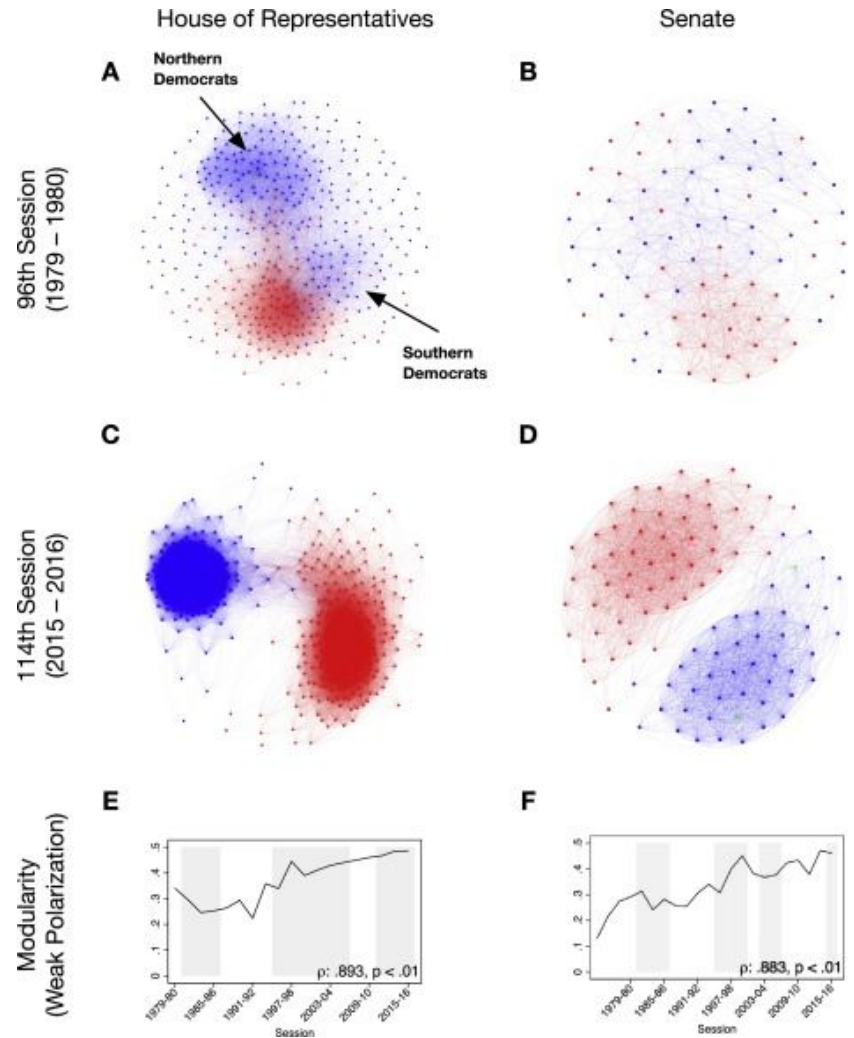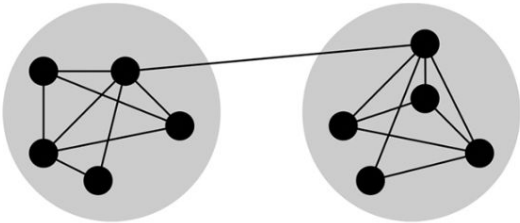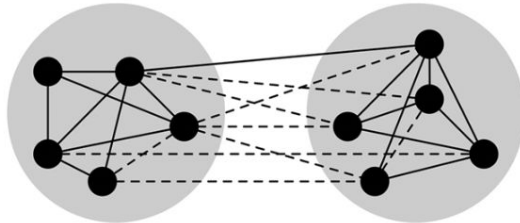
Co-sponsorship Network (used in paper)

- Created two temporal networks of bill co-sponsorship tendencies among US congresspeople for each year from 1973 to 2016
  - Represents the 93rd- 114th congress
- Each node is a US congressperson
  - House of Representatives networks each have 435 nodes
  - Senate networks each have 100 nodes
- Each edge is the co-authorship tendency indicating whether or not they have the tendency to cosponsor or not
  - Average edges per network is 1,784,112
- Edges represent positive, neutral, or negative link
  - Created using stochastic degree sequence model (SDSM) - construction of empirical edge weight distributions from random bipartite networks with stochastic marginals (Neal 2014)
  - This is useful for seeing whether *weak* or *strong* polarization is present
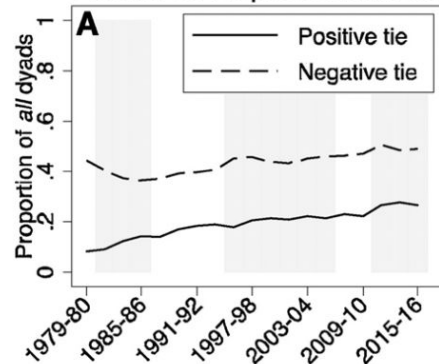
Weak vs Strong Polarization
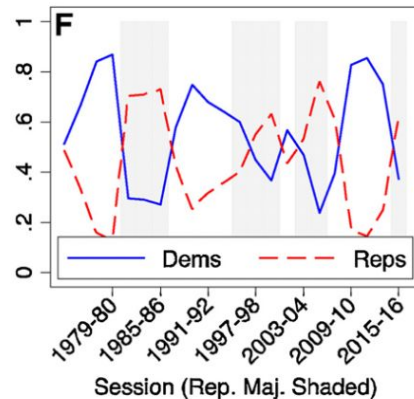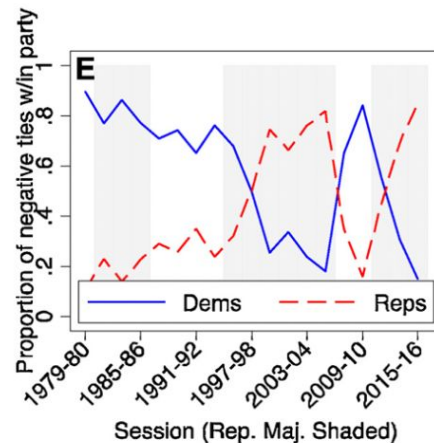
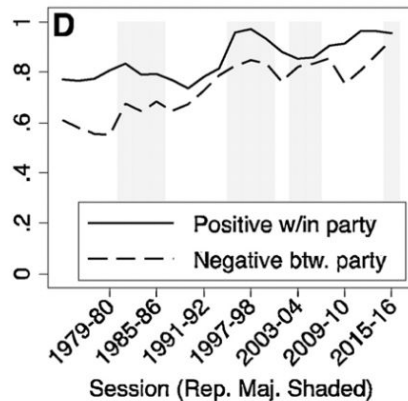Intergroup relations and types of polarization.

Type of polarization	Weak	Strong
Intergroup relations analog	In-group favoritism *without* out-group derogation	In-group favoritism *with* out-group derogation
Network Definition	Groups are distinguishable by the presence of (implicitly positive) relations within groups, and by the absence of (implicitly positive) relations between groups.	Groups are distinguishable by the presence of positive relations within groups, and by the presence of negative relations between groups.
Measurement	Modularity in a non-signed graph	Triangle index in a signed graph
Example Network Relations ——— Positive - - - - - Negative		

House of Representatives — **Senate**

A. Proportion of *all* dyads — Positive tie / Negative tie (1979-80 to 2015-16, Session Rep. Maj. Shaded)

B. Proportion of *all* dyads — Positive tie / Negative tie (1979-80 to 2015-16, Session Rep. Maj. Shaded)

C. Proportion of *specified sign* dyads — Positive w/in party / Negative btw. party

D. Proportion of *specified sign* dyads — Positive w/in party / Negative btw. party

E. Proportion of negative ties w/in party — Dems / Reps (Session Rep. Maj. Shaded)

F. Proportion of negative ties w/in party — Dems / Reps (Session Rep. Maj. Shaded)

Co-sponsorship Network - Incidentally

- How we will get the 2016-2023 data:
  - [incidentally: Generates Incidence Matrices and Bipartite Graphs](#)
- Data:
  - Nodes: Congress representatives and Bills
  - Edge: If a representative sponsored/co-sponsored said bill
  - Metadata on both congress members and bills
  - Available for all sessions up to date
- Task: Reformulate data as described in paper and reproduce results
  - Using stochastic degree sequence model (SDSM) to construct empirical edge weights (Neal 2014)

US Congress Roll-Call Votes Network

- Build a graph using data from voteview.com
  - Scattered data across different files
- Append the information onto findings from the previous section
  - Not a network dataset
  - Different ID system
  - Further preprocessing required
- Increased Network complexity with size
- Deeper information on voting patterns of legislators and their connection per each bill

What will we do?

Goal: To identify and examine polarization based on the network structure of US Congressional party cooperation

- Replicate results of the paper by Z. Neal (2020) by using additional data from 2016-2023 to see how the polarization trends have developed in the recent years
- Incorporate further data on roll call votes to see whether patterns of polarization are similar to the co-sponsorship networks

References

- [A sign of the times? Weak and strong polarization in the U.S. Congress, 1973–2016 - ScienceDirect (Z. Neal 2020)](#)
- [Political Polarization in the American Public | Pew Research Center](#)
- [Neal, Z.P., 2014. The backbone of bipartite projections: inferring relationships from co- authorship, co-sponsorship, co-attendance and other co-behaviors. Soc. Netw. 39, 84–97.](#)
- [incidentally: Generates Incidence Matrices and Bipartite Graphs](#)
- [voteview.com](#)