# Collaboration in the Washington State Legislature

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## 1 Introduction

Systems of government across the United States and around the world are variable and complex, but in representative democracies legislative processes have some commonalities. Representatives are elected to one or more houses, where they propose, deliberate, and vote on bills to pass into law. Patterns in how and with whom legislators collaborate present the opportunity to understand how key policy decisions are made, and may inform future partnership strategies in legislatures. In addition, the study of these patterns grants outsiders a window into the unseen dynamics of policymaking.

One example is James Fowler's work studying cosponsorship networks in Congress, where the author described "influential" legislators as those at the center of dense clusters of cosponsorship (Fowler 2006). Kessler and Krehbiel noted a pattern in which legislators at ideological extremes were more likely than moderates to be the initial endorsers of legislation, suggesting that policy originates at the extremes and moves to the center. (Kessler and Krehbiel 1996)

Most of this research in the United States has focused on Congress. State legislatures are less-studied, despite the fact that most policy is enacted at the state and local levels, and these are the levels which individuals are most able to influence. As former Speaker of the US House of Representatives Tip O'Neill said "all politics is local". While many of the national findings may be present at the state-level, it seems reasonable that they might not. I suspect that two randomly drawn legislators from the same state have more in common than two randomly drawn national legislators: local geographic, cultural, and economic issues may have a meaningful impact on how they work together.

In this paper, I investigate these patterns in the legislature of my home state of Washington. I apply graph analysis methods to identify "well-connected" legislators, and find that more-connected legislators hold more leadership positions, and that a legislator's rank in connectedness is fairly stable across legislative sessions. I also investigate whether policy originates at ideological extremes in the Washington State Senate, with evidence that contradicts national-level results.

### 1.1 Sponsorship Process

First, let's define terms and methods that are important for understanding the problem space. A piece of legislation is introduced into the legislature proposing some policy. This is often called a "bill", but can technically include many types of motion. Each piece of legislation is proposed by a single legislator, called the *Sponsor*. The Sponsor may recruit other legislators to publicly add their name in support of the bill. These other legislators are called *Cosponsors*.

## 2 Data Sources

### 2.1 Washington State Legislature Data

The Washington State Legislature's Legislative Service Center (or LSC) maintains public APIs for legislative data, including legislation, roll call votes, and committee activities (LSC n.d.). I developed a script to download metadata about all legislation for a given year, and then retrieve a list of sponsors and cosponsors for each item.

## 2.2 Measuring American Legislatures Project

Political Scientists Boris Shor and Nolan McCarty have produced ideology scores for state legislators (Shor and McCarty 2011). The most recent data release includes ideological ideal point estimates for Washington State legislators through 2020 (Shor 2023), as well as legislator party identity. Using legislator names, I manually reviewed and mapped the identifiers in this data set to their LSC ids so that these could be joined for the Washington State Senate.

# 3 Methodology

## 3.1 Measuring Connectedness

Fowler proposes that a well-connected legislator is one who has many strong relationships across the body, that can secure support from a range of other legislators even when there is not broad agreement. The most obvious approach might be to use the total number of cosponsors secured. However, some sponsorships tell us more about the strength of the relationship than others. The number of cosponsors on a given bill varies considerably, and it is not uncommon for bills to gain sponsorshop from half the chamber or more (Fowler 2006). Those bills are broadly popular, and tell us little about the relationship of the Sponsor to individual legislators. A bill with only one cosponsor indicates stronger relationship between the primary sponsor and single cosponsor.

We seek a metric which describes the legislator who is most "well-connected" based on cosponsorship relationships, weighted by the evidence. I use the definition of "Connectedness" described by Fowler (Fowler 2006). I describe this algorithm and illustrate with a simple example. Consider the legislation described in Table 1, with columns "SBx" representing bills:

| | **SB1** | **SB2** | **SB3** | **SB4** | **SB5** | **SB6** | **SB7** |
|---|---|---|---|---|---|---|---|
| **Sponsor** | Leg A | Leg A | Leg B | Leg C | Leg D | Leg C | Leg D |
| **Cosponsors** | Leg B | Leg B | Leg A<br>Leg C<br>Leg D | Leg A<br>Leg D | Leg C | Leg B<br>Leg D | None |

Table 1: An example of legislative sponsorship

To account for the varying weight of cosponsorship, each bill's influence is weighted by the total number of cosponsors. For all legislation $L$, we define a given piece of legislation as $\ell \in L$. Define $c_\ell$ as the total number of cosponsors. Then, $a_{\ell,i,j}$ is an indicator variable that is 1 if legislator $j$ is the primary sponsor of $\ell$, and legislator $i$ is a cosponsor, and zero otherwise. We can then calculate the weighted sum of cosponsorship by legislator $i$ to legislator $j$ across all legislation as follows:

$$w_{i,j} = \sum_{\ell \in L} \frac{a_{\ell,i,j}}{c_\ell}$$

In the Table 1, we can calculate the following weight from Legislator B to A:

$$w_{B,A} = \frac{1}{1} + \frac{1}{1} = 2$$

Note that this is a directed relationship, so the weight of A's support to B is different:

$$w_{A,B} = \frac{1}{3}$$

We can represent this as a directed, weighted graph of support between legislators, as in Figure 1.

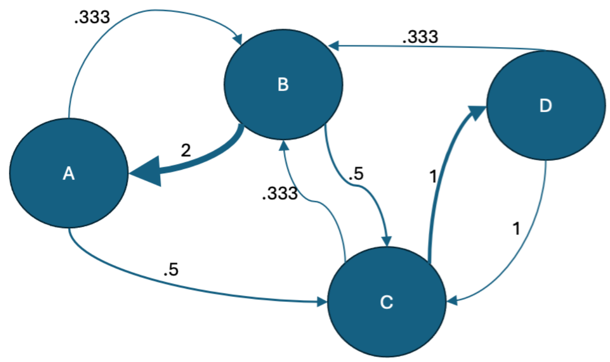


Figure 1: Directed graph of weights between sample legislators

This graph describes the strength of support each legislator has from others in the body. Our goal is to find the legislators who are at the center of the densest network of collaboration. By converting these weights to distances, we can then employ a shortest-path algorithm to find the legislators who are most "central". The distance from legislator $i$ to $j$ is thus defined as the inverse of their weight, so that weaker relationships are "farther":

$$d_{i,j} = \frac{1}{w_{i,j}}$$

These are represented with an adjacency matrix of asymmetric weights. This is visualized for our sample legislature in Figure 2. I then used Dijkstra's algorithm to calculate the distance of the shortest path from each pair of legislators. By converting the weights to distances, strong weights become short distances, as needed to compute shortest paths. Figure 3 shows examples of the shortest path between legislators.

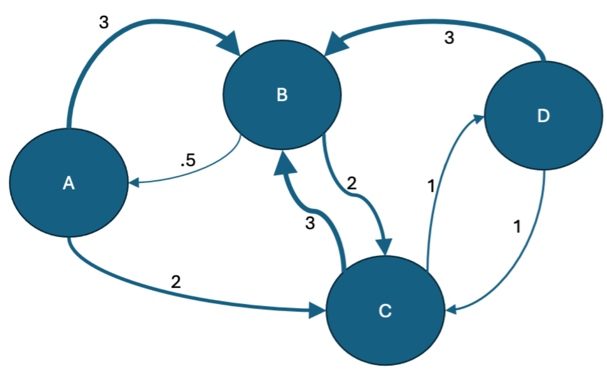


Figure 2: Directed distances between sample legislators

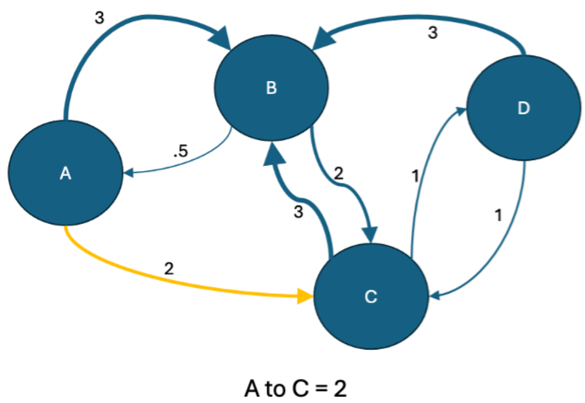


Figure 3: Highlighted shortest paths between sample legislators

As defined by Fowler, Connectedness is the inverse of the average of these distances. The Connectedness for legislator $C_j$ is the inverse of the mean support distance from all other legislators:

$$C_j = \frac{(n-1)}{\sum_{i=0}^{n} d_{i,j}}$$

The connectedness scores for the sample legislators are given in Table 2. You can see that Legislator C has the highest connectedness score. This reflects the fact that they had multiple bills, each with a small number of varied cosponsors. Legislator A also sponsored two bills, but had the same cosponsor on each, indicating a single strong supporter. Contrast these with low connectedness score of Legislator B. Legislator B had only one bill, but it was sponsored by every other legislator. This is certainly a popular bill, and could indicate broad influence, but does not tell us about the strength of individual relationships. This is an important distinction: connectedness is not a measure of legislative power, it is an indicator of the strength of a legislator's social network.

| Leg A | Leg B | Leg C | Leg D |
|---|---|---|---|
| .400 | .333 | .600 | .429 |

Table 2: Connectedness scores of sample legislators

I used the scipy implementation of Dijkstra's algorithm, but implemented the rest of the connectedness algorithm from scratch. However, it's important to note that this algorithm isn't my invention: it was first described for the US Congress by Fowler. (Fowler 2006) To my knowledge, I'm the first to apply these techniques to analyze connectedness in a state legislature.

## 3.2 Testing Policy Origination at Ideological Extremes

Kessler and Krehbiel studied sponsorship activity in the 103rd US House of Representatives, and found that legislators at ideological extremes were more likely to be early cosponsors of bills, with moderate cosponsors coming later. This was most pronounced for representatives at the liberal extreme (highest 25%), but was true for the conservative extreme (lowest 25%) as well. The authors used survival analysis to fit hazard functions for the likelihood of cosponsorship over time (Kessler and Krehbiel 1996). Unfortunately, the LSC services do not provide dates of cosponsorship, only sponsor order, so we cannot employ the same methods as Kessler and Krehbiel.

Instead, I am approaching this as a count-rate analysis. The median number of sponsors for a bill in the Washington Senate from 2015-2018 was approximately 8. I am defining "early sponsorship" as being either the Primary sponsor of a bill, or the first cosponsor. For each senator, I have counted the number of early sponsorships per legislative session, as well as the total number of bills sponsored or cosponsored at any point. The latter is used as an exposure variable for the former, allowing me to analyze the count as a rate.

With a sample standard deviation 27.06 and sample mean 52, the data are overdispersed for Poisson. I fit a Negative Binomial model to predict the rate of early sponsorships based on a senator's ideological extremity using Shor and McCarty's NPAT scores. A senator is coded as an extreme liberal if they fall in the bottom 25% of NPAT scores, while they are coded as an extreme conservative if they fall in the upper 25%. Given that some legislators are present year-over-year, the model was fit with standard errors clustered by legislator.

Finally, because party control of the Senate changed in the 2018, I have included a term for party control as well as interaction terms for the extreme positions under party control. The party in control holds influential committee leadership positions, and is generally more capable of furthering its agenda, so it stands to reason that this may have an impact as well. The results are described in section 5.3.

## 4 Visualization of Cosponsorship Networks

Graphically, there are too many legislators and links in each body to present them all legibly. Figure 4 shows a graph of connections in 2015 Senate. To improve legibility, only the five most well-connected senators are labeled, and only the connections in the top 10% are drawn. Arrow thickness denotes the strength of the support from the source legislator to the destination legislator. Node size represents the legislator's connectiveness score.

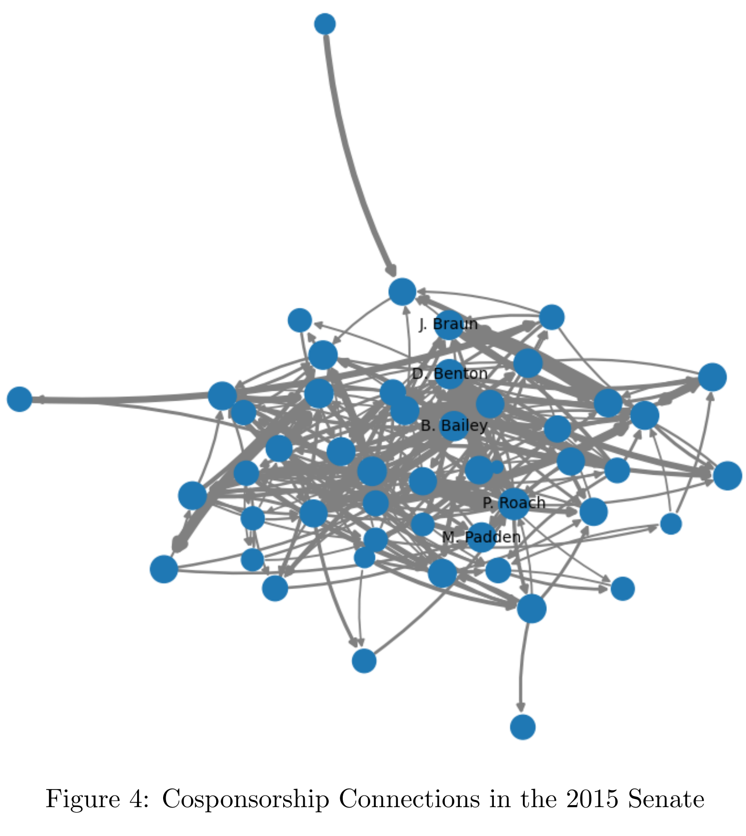


Figure 4: Cosponsorship Connections in the 2015 Senate

The House of Representatives has twice as many members, so its graph (Figure 5) is even more densely packed. We also see a greater variety of node sizes, indicating that there is more variance in connectedness in the House.

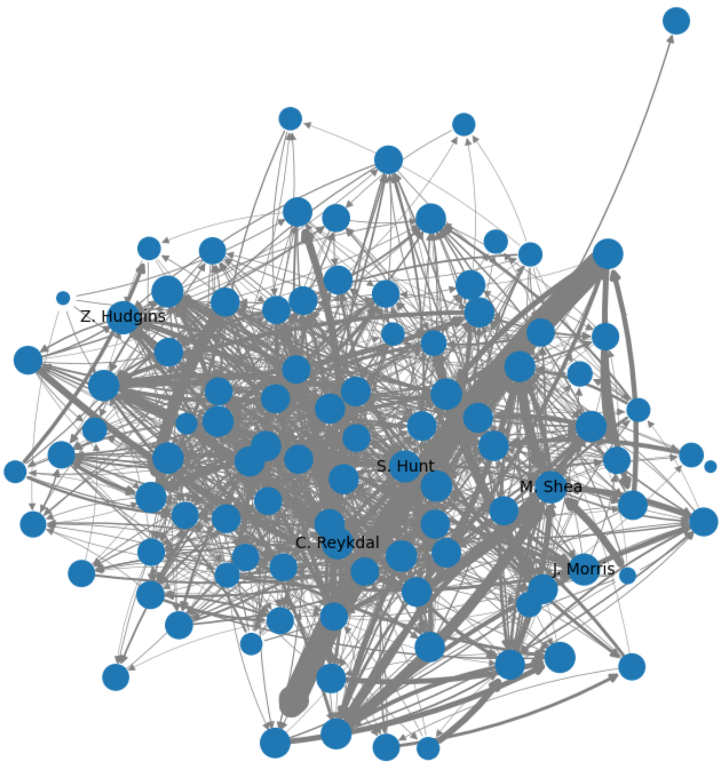


Figure 5: Cosponsorship Connections in the 2015 House

# 5 Evaluation

If connectedness is a good representation of a legislator's strong relationships, a few things should hold:

1. The list of most connected legislators should include legislators in influential positions: committee chairs, ranking members, etc. I evaluate this aspect of the model by manual inspection of the positons of the most and least connected legislators.

2. A legislator's rank in connectedness should be fairly stable from year-to-year, as long as they remain in service. I evaluate this aspect of the model using regression analysis for year-to-year changes in connectedness.

## 5.1 The Most Well-Connected Legislators are In Influential Roles

Ranking the legislators by their connectedness scores, we can see that the most well-connected senators also hold more notable positions (Table 3) compared to the lowest ranked senators (Table 4).

| Rank | Senator | Leadership Positions | # Bills | Connectedness |
|---|---|---|---|---|
| 1 | Pam Roach | President Pro Tempore<br>Chair, Government Operations and Security<br>Vice Chair, Rules | 58 | 1.086 |
| 2 | Mike Padden | Chair, Law & Justice<br>Vice Chair, Senate Accountability & Reform | 35 | 0.959 |
| 3 | Barbara Bailey | Chair, Higher Education | 40 | 0.957 |
| 4 | Don Benton | Chair, Financial Institutions & Insurance<br>Vice Chair, Government Operations and Security<br>Vice Chair, Transportation | 56 | 0.955 |
| 5 | John Braun | Vice Chair, Commerce & Labor<br>Vice Chair, Trade & Economic Development<br>Vice Chair, Ways & Means | 49 | 0.939 |

Table 3: Most-Connected Senators Hold Influential Positions (2015)

| Rank | Senator | Leadership Positions | # Bills | Connectedness |
|---|---|---|---|---|
| 46 | Andy Billig | Deputy Minority Leader | 14 | 0.544 |
| 47 | Kevin Ranker | Capital Budget Chair, Ways & Means | 17 | 0.471 |
| 48 | Mike Hewitt | None in 2015 | 5 | 0.465 |
| 49 | Karen Fraser | None in 2015 | 8 | 0.458 |
| 50 | Dean Takko | Appointed to vacant Senate seat in October 2015 | 1 | 0.167 |

Table 4: Least-Connected Senators Hold Fewer Influential Positions (2015)

We can perform a similar analysis for the House. Note first that connectedness scores are not directly comparable *between* legislative agencies (ie: between the House and Senate); these scores are a function of the size and level of activity of the body. This is why ranking is the preferred method for year-over-year and between-agency comparison. The most well-connected representatives in the House follow a similar pattern (Table 5), but the bottom-ranked representatives present an interesting counterexample (Table 6). Frank Chopp was Speaker of the House and Chair of the Rules committee in 2015, but appears in the bottom-five. Chopp sponsored only five bills, well below the body's average 15.1, and they averaged 97 cosponsors, which is the entire body. All five bills were honorary House Resolutions. For example, HR 4609 "Recognizing the life and work of Dr. Martin Luther King, Jr." This suggests that the Speaker's role in sponsorship is primarily a ceremonial one. This could be due to the heavy procedural and administrative responsibilities of the Speakership, as well as their influence in other ways. Nonetheless, it demonstrates a gap in the connectedness measure as a measure of social capital: these scores focus on one form of influence.

| Rank | Representative | Leadership Positions | # Bills | Connectedness |
|---|---|---|---|---|
| 1 | Zack Hudgins | Chair, General Government and Information Technology | 28 | 0.419 |
| 2 | Matt Shea | Ranking Minority Member, Environment<br>Assistant Ranking Minority Member, Judiciary | 46 | 0.396 |
| 3 | Sam Hunt | Majority Floor Leader<br>Chair, State Government | 30 | 0.390 |
| 4 | Chris Reykdal | Vice Chair, Education | 32 | 0.389 |
| 5 | Jeff Morris | Chair, Technology and Economic Development | 18 | 0.387 |

Table 5: Most Well-Connected Representatives (House, 2015)

| Rank | Representative | Leadership Positions | # Bills | Connectedness |
|---|---|---|---|---|
| 46 | Susan Fagan | None in 2015<br>Resigned in May 2015 | 2 | 0.063 |
| 47 | Frank Chopp | Speaker of the House<br>Chair, Rules | 5 | 0.051 |
| 48 | Mary Dye | None in 2015 | 0 | 0.0 |
| 49 | Dan Kristiansen | None in 2015 | 0 | 0.0 |
| 50 | Patty Kuderer | None in 2015 | 0 | 0.0 |

Table 6: Least-Connected Representatives (House, 2015)

## 5.2 Are Connectedness Rankings Stable?

The next question is whether or not these connectedness ratings are stable year-over-year. Each year, the graph and distances are based on a different set of legislation from the prior year, and not all legislators remain in service. As such, we cannot expect the connectedness scores to be directly comparable year-to-year. However, it is reasonable to assume that, if connectedness measures social capital, the rank-ordering of legislators will be similar year-to-year.

To perform this analysis, I computed connectedness scores for the House of Representatives and Senate for each year 2015-2020. For each year-to-year transition, I compared the rank-ordering of every legislator in year $y$ to their rank ordering in year $y+1$, if they remained in the legislature. Under the hypothesis of stable connectedness, I expect a legislator's rank in $y$ to be strongly predictive of $y+1$.

First, I computed the correlation of each year's ranking with the following year's ranking. The results are presented in Figure 6.

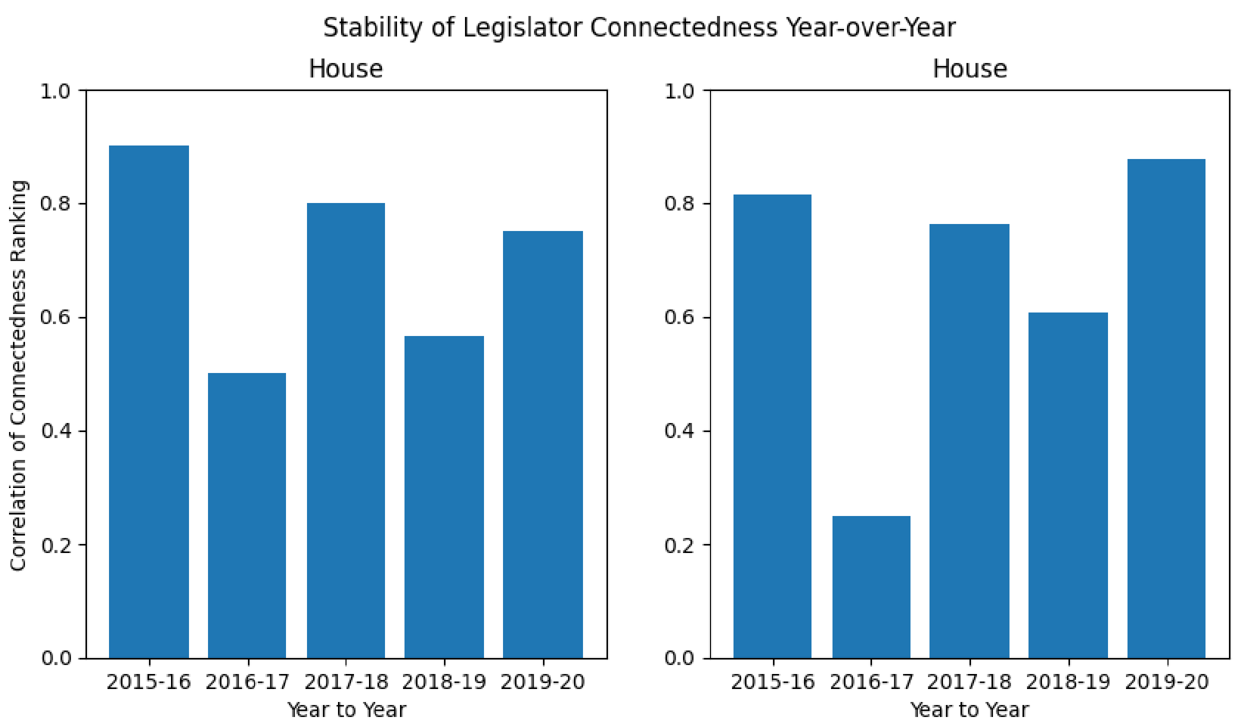


Figure 6: Stability of Connectedness Rankings

Correlation coefficients for year-over-year connectedness in the Senate are moderate to strong, while the House of Representatives shows a major change from 2016 to 2017. In January 2017, there were three

Representatives appointed to vacant seats in the State Senate. Their departures were followed by temporary appointments until the special election in November 2017. This stands out as a plausible explanation for the reduced stability, but a causal study would be required to draw firm conclusions.

While not highly stable, simple correlation suggests connectedness is a fairly stable measure of social capital year-to-year, particularly in the Senate, a body with less turnover year-to-year.

We can conduct a formal hypothesis test using a regression model. Here I attempt to predict a legislator's connectedness rank in year $y+1$ using their rank in year $y$. To allow for differences between the House and Senate, in include an indicator variable for the Senate, as well as an interaction term between year $y$ rank and the Senate indicator. The overall regression is highly significant (F-test $p = 3.56E - 156$) and with $R^2 = .652$ it explains 65.2% of variance. The rest of the regression are shown in Table 7.

| | estimate | std. err | t | $P > \|\|t\|\|$ | [0.025 | 0.975] |
|---|---|---|---|---|---|---|
| **Intercept** | **11.0375** | **1.432** | **7.706** | 0.000 | **8.225** | **13.850** |
| senate | -4.8508 | 2.488 | -1.950 | 0.052 | -9.736 | 0.034 |
| **prior year rank** | **0.7646** | **0.026** | **29.054** | **0.000** | **0.713** | **0.816** |
| rank & senate interaction | -0.0229 | 0.078 | -0.294 | 0.769 | -0.176 | 0.130 |

Table 7: Predicting YoY connectedness ranks

For the hypothesis that prior year's rank is a strong positive predictor, we reject the null hypothesis ($p < 0.0001$), concluding that the year $y$'s connectedness ranking is highly predictive of ranking in year $y+1$.

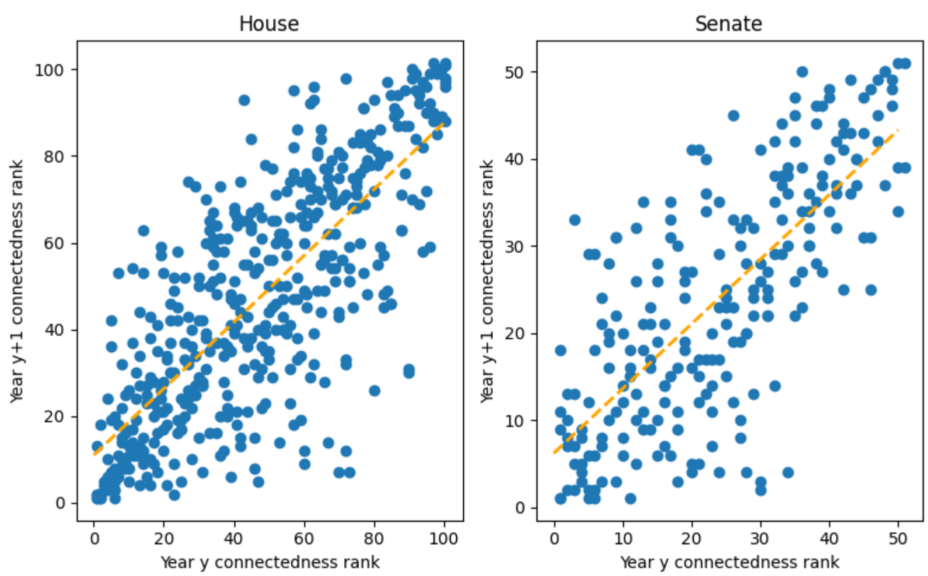


Figure 7: Year-over-year connectedness ranking (2015)

## 5.3 Does Sponsorship Begin at Ideological Extremes?

The Negative Binomial model allows for hypothesis testing of coefficients. The model summary is presented in Table 8. Using $\alpha = 0.05$, we find a significant negative effect on early sponsorship for senators at the liberal extremes ($p < .0001$). This means that senators at the liberal extreme were early cosponsors of fewer bills compared to all other senators. While the interaction term for conservative extremists under conservative control is significant ($p = 0.002 < 0.05$), the main effect for conservative extremism is not, indicating a cross-over interaction. In other words, there is no significant effect due to conservative extremism or controlling party alone, but when taken together extremely conservative legislators were early sponsors on fewer bills.

| | estimate | std. err | z | $P > \|\|z\|\|$ | [0.025 | 0.975] |
|---|---|---|---|---|---|---|
| **Intercept** | −1.0641 | 0.051 | −20.812 | 0.000 | −1.164 | −0.964 |
| **liberal** | −0.3173 | 0.964 | −4.667 | **0.000** | −0.451 | −0.184 |
| conservative | 0.1551 | 0.099 | 1.562 | 0.118 | −0.040 | 0.350 |
| controlling party | 0.0969 | 0.050 | 1.955 | 0.051 | 0.000 | 0.194 |
| liberal with control | -0.1237 | 0.072 | -1.716 | 0.086 | -0.265 | 0.018 |
| **conservative with control** | **-0.2135** | **0.070** | **-3.030** | **0.002** | **-0.352** | **-0.075** |

Table 8: Rate of Early Sponsorship Model Results (2015-2018)

This is interesting because it contradicts the finding for the 103rd US Congress by Kessler and Krehbiel. Their model uses a larger range of ideological positions, but this one incorporates multiple sessions and a change in partisan control. This suggests that there may be meaningful differences in how legislation develops between the more diverse US Congress, and the state legislature.

## 6 Summary of Findings and Areas for Further Reseearch

In this paper, I find that the connectedness measure proposed by Fowler for US Congress (Fowler 2006) identifies state legislators in influential positions. These estimates of connectedness are moderately stable from session-to-session, indicating that they capture durable differences in legislator behavior and networking. However, the connectedness measure is an imperfect measure of overall influence, as it misses leaders that influence the body in other ways, such as the administrative actions of the Speaker of the House. It appears the patterns in connectedness observed at the national level hold for the Washington State Legislature.

I also find that the earlier observation that policy originates at ideological extremes (Kessler and Krehbiel 1996) does not hold for the Washington State Senate from 2015-2018. In fact, I see the opposite effect for legislators at liberal extremes. This suggests a rich area for further research: expanding the methods employed by Kessler and Krehbiel to sessions of Congress beyond the 103rd Hosue of Representatives, and seeking out time-series data on cosponsorship in Washington State to replicate their survival models.

Taken together, these findings reveal that there are similarities and differences between national and local political processes. The methods used to analyze national political behavior are useful starting points for the under-studied state legislatures, but state and local politics produce different patterns in collaboration and policy origination.

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