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### **Legislative Networks**

Nils Ringe, Jennifer Nicoll Victor, and Wendy Tam Cho

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### **Abstract and Keywords**

Legislatures are naturally interactive institutions. Creating laws, engaging in representation and oversight, and serving constituents are social processes. Legislators have many connections with each other, some preexisting or natural and some created while in office. This chapter explores various ways to understand legislative politics through a relational lens. Legislators rely on networks for a variety of functions, including collaboration, information diffusion, policy coordination, coalition building, and voting. Relationships are a fundamental aspect of how legislators, and those who interact with them, function. The chapter examines the history of how networks have been studied in legislatures and describes various challenges this field of study has recently overcome, as well as other challenges yet to be solved in studying legislative politics using networks. It relays the dominant existing applications and methods in this subfield and suggests several fruitful avenues for future research.

Keywords: legislative politics, legislators, roll call voting, cosponsorship, legislative staff, policymaking, information diffusion, parliamentary politics

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## **Introduction**

Studies of lawmaking have been dominated by examinations of individual lawmakers (e.g., their behavior, incentives, characteristics) and research on legislatures (or parliaments) themselves (e.g., the role of a legislature vis-à-vis other institutions of government, policymaking). In this chapter we seek to emphasize the importance of studying legislatures with a relational lens. Legislators are inherently connected in a variety of ways, and studying these connections can help us to better understand legislative behavior and processes.

Social networks in legislatures differ from those in many other contexts in that the participants in the network are selected by an external force: elections. This means that unlike in many other political networks, legislators have not necessarily connected to one another because of some shared characteristic. But over time, many of them develop personal relationships and friendships with one another that may affect their politically relevant behavior. As Baker puts it, “[F]riendships among U.S. Senators are at one and the same time political and personal” (1999, 6).

Legislatures are not mere social clubs, however, but an environment in which formal rules, informal institutions, and social networks interact. In this context, strategic considerations directly counteract the impulse of individuals to associate themselves with those who share their preferences or attributes. How do lawmakers choose to connect themselves to others, given the institutional structures they find themselves in? And how do other features of legislatures, like their size or the number of legislative parties, shape those patterns? Existing institutions directly influence network structures (e.g., because they group subsets of lawmakers in legislative committees or other forums), making social networks partly exogenous, but they also impact with whom individual lawmakers (endogenously) choose to establish social ties. Those different types of social ties in legislative politics are measured in a variety of ways, including cosponsorship of legislation, comembership in various internal institutions, covoting, campaign contributions from the same donors, spatial proximity and shared workspace, as well as direct measures of social ties through interviews or surveys. Legislative scholars have relied on such indicators, both as outcomes to be explained and as variables to explain a variety of political processes and outcomes: the creation and diffusion of information, collaboration between (groups of) lawmakers, policy coordination, coalition building, and voting behavior.

In this chapter we explore the variety of ways legislators are tied to one another and how those ties may affect their legislative behavior. This effort is confined to studies that are explicitly about legislative politics and that employ a social network approach.<sup>1</sup> We start with the early beginnings of studying legislatures as social networks and the various difficulties associated with studying them in this way, noting which challenges scholars have and have not yet overcome. We describe some of the most common applications of networks in legislatures and the most common methods used. Then we examine the ways in which legislative institutions both encourage and limit the creation and maintenance of social networks. The chapter highlights the fact that legislative networks can be conceived of as something to be explained (as a dependent variable), or networks can help us understand common legislative behavior (as independent variables). We also look at some of the most common applications of network methods in legislatures, on

questions such as the exchange of legislative information, roll-call voting, and partisan polarization.

We close by exploring avenues for future research on legislative networks, highlighting in particular how consideration of incentives, institutions, and interdependencies affects network creation and network effects, within legislatures and beyond. Possibilities for new research on legislative networks are also rich, because of the vast amount of data not yet collected, processed, and analyzed. Finally, the great majority of research on networks in legislatures is focused on either the Congress or state legislatures in the United States, with some notable exceptions that are discussed in this chapter. Taking a comparative perspective, however, would greatly enhance our understanding of networks in legislatures and legislative politics in general.

## Early Applications

The idea that relationships and social networks play an important role in legislative politics is not only intuitive, but has also been recognized for a long time. Routh made an early case that “personal contacts between human beings lie at the very heart of all problems of government and society,” and described human relationships as the “basic political prerequisite ... necessary for survival in political life” (1938, 129–130). Following this premise, he observed, recorded, counted, and classified who talked to whom on the floor of the Illinois Senate and found that personal contacts centered on legislative leaders (especially those of the majority Democratic party).

Building on this classic study, other scholars sought to investigate the nature of social relationships between lawmakers. Particularly influential is the work by Samuel Patterson, who made his first mark with his 1959 article on interpersonal contacts between members of the Wisconsin Assembly (Patterson, 1959), investigating friendship ties between lawmakers and the friendship cliques they formed. Apparently the first to have applied sociometric methods to the study of a legislature (Kirkland and Gross, 2014), Patterson identified as the determinants of friendship choices leadership positions, geography, seniority, previous alliances, and seating arrangements on the floor.

Friendship ties, self-identified by legislators from multiple US state assemblies in interviews and surveys, would remain the focus of additional research by Patterson and others. Eulau (1962), for example, considered the relationship between two types of political “authority” in four state legislatures, namely between authority derived from interpersonal sentiments like friendship and respect and from formal sources of authority, like legislative leadership. He found that formal authority correlates positively

with interpersonal relations, but that leaders differ most from rank-and-file legislators in the degree to which they are respected, as opposed to being perceived as close personal friends.

Monsma (1966) also considered different “types” of social ties between lawmakers, in the Michigan House of Representatives. Rather than focusing on differences between ties built on friendship and respect, however, his focus was on the intensity of the relationship, as he distinguished between primary ties (“Who are your closest personal friends?”) and secondary ties (“With whom do you frequently discuss legislation?”). He found this to be a meaningful distinction in explaining the legislature’s social structure, in that secondary relations were more likely to cut across party lines, were more likely to be reciprocated, and tended to be more clustered.

Monsma found relatively few primary relations, or close friendship ties, between lawmakers of opposite parties, a finding that mirrored those of Patterson (1959) and a more extensive study of four state legislatures by Wahlke et al. (1962). This finding connects the research agenda on the social foundations of legislative politics to broader questions in the field, such as the determinants of interparty unity and intraparty competition. As Wahlke and colleagues put it, friendship ties “are more likely to reinforce team spirit and party competition” (1962, 225); indeed, they find a positive relationship between friendship ties and agreement on roll-call votes, above and beyond shared partisanship.

The relationship between social ties and political parties as formal legislative institutions was at the heart of a second strand of inquiry during this period, which focused on social ties established in congressional boardinghouses (or messes) in the first half of the nineteenth century, voting behavior in the US Congress, and the origins of political parties. These considerations were a key component of James Sterling Young’s book, which identified the mess as a crucial determinant of legislative behavior in the Congress and the emerging US political system. Importantly, residents of the same boardinghouse tended to vote alike (Young, 1966). While this last finding would be challenged and qualified by Bogue and Marlaire (1975) after controlling for geographic region, they did not challenge the broader interpretation of boardinghouses as “the basic social units of the Capitol Hill community” (Young, 1966) and as the foundation of important informal group structures in legislative politics.

Such informal groups were the focus of Fiellin (1962), who was particularly interested in informal social groups as communication networks that allow lawmakers to exchange information, advice, and voting cues (see especially Matthews and Stimson, 1975). Such informal groups and networks, Fiellin argued, are not only of value to individual legislators, but also aid the efficiency and effectiveness of the chamber as a whole by, for

example, contributing to successful coalition formation and the negotiation of compromises. While formal institutions like parties and committees satisfy some of the individual and collective needs of legislators, “informal groups supplement and fill in the remaining gaps” (Fiellin, 1962). For example, even the relatively few cross-partisan ties identified in other research have the potential to bridge partisan boundaries, facilitate information exchange and coordination, and mitigate gridlock. As Caldeira and Patterson (1988) later put it, “friendship provides the oil that lubricates the legislative process.”

Patterson and his collaborators remained especially notable contributors to the body of research on legislative networks that predates the surge of the last decade or two. In 1972, Patterson returned to questions raised in his earlier work, namely how spatial proximity and friendship ties affect important outcomes like shared attitudes, party cohesion, and partisan polarization. Both, he argued, matter greatly in that they tend to reinforce partisan loyalties and feelings of intraparty unity. Finally, in the late 1980s and early 1990s, Patterson pursued productive collaborations with Gregory Caldeira and John Clark, using data from the Iowa State Assembly and focusing on the differentiation between friendship and respect made earlier by Eulau (1962). Their articles found friendship and respect to be independent bases of legislative power (Caldeira and Patterson, 1987, 1988; Caldeira, Clark, and Patterson, 1993). While the foundations of friendship are shared partisanship, geography, and age, the bases of respect are less affective; it is driven by education, legislative work, leadership, and experience, and accorded to only a small number of lawmakers. Unlike friendship, respect follows largely from performance, achievement, and formal leadership, and both Democrats and Republicans and freshmen and senior members accord respect based on different criteria.

Even though most of this earlier body of work focused on explaining interpersonal relations rather than examining their impact on legislative processes and outcomes, it previewed many of the major themes that have been picked up in more recent legislative networks research. Important examples are the relationships among formal legislative institutions, lawmakers’ personal attributes, and social networks (Rouff, 1938; Patterson, 1959, 1972; Eulau, 1962; Fiellin, 1962; Wahlke et al., 1962; Young, 1966; Caldeira and Patterson, 1987, 1988; Caldeira, Clark, and Patterson, 1993); communication and information exchange, including voting cues (Fiellin, 1962; Caldeira and Patterson, 1987; Caldeira, Clark, and Patterson, 1993); and the role of spatial proximity and shared workspace (Rustow, 1957; Patterson, 1959, 1972; Caldeira and Patterson, 1987; Caldeira, Clark, and Patterson, 1993). This research also considered the relationship between social networks and floor voting (Fiellin, 1962; Wahlke et al., 1962; Young 1966; Bogue and Marlaire 1975; Patterson 1972) and the how networks may affect internal party cohesion (Wahlke et al., 1962; Young, 1966; Bogue and Marlaire, 1975; Patterson, 1972;

Caldeira and Patterson, 1988), as well as ideological polarization and competition between legislative parties (Wahlke et al., 1962; Patterson, 1972; Caldeira and Patterson, 1988). As such, it provided a strong basis for future theorizing and applications. This work also illustrates some of the difficulties associated with investigating legislative networks, a topic we turn to next.

## Challenges

There are numerous challenges associated with studying social networks in legislative politics, some of which plague all network research, while others are more pronounced in the legislative context than in others. Among the former is the trade-off associated with analyzing one-mode or two-mode (or bipartite) networks. Most legislative network data are collected in two-mode fashion, where some object or actor,  $i$ , is connected with some other object or actor,  $j$  (e.g., sponsors to bills, staff to offices, bills to topics, donors to candidates), but scholars have to make the choice of analyzing the two-mode data themselves or projecting them as one-mode (e.g., number of common cosponsored bills between legislators, number of common staffers between legislators, number of common topics in bills, number of common donors to candidates). The latter can be conceptualized as converting an  $M \times N$  matrix into an  $N \times N$  matrix by multiplying the former by its inverse. The projection can be done by rows or by columns, and depending on the weighting of ties, there may be many different one-mode networks that can be derived from a bipartite network. This conversion has the advantage of offering the researcher a greater number of analytical approaches and tools to work with, because the descriptive and inferential statistics that can be computed from two-mode data are limited. However, two-mode data can be useful for visualization or discovering general properties of a network; more important, converting a two-mode to a one-mode network necessarily discards information and may impose artificial connectivity on a network.

Among the challenges that are more pronounced in the legislative context than in others is the difficulty of measuring social ties directly, as opposed to relying on proxies for interpersonal relationships. Given that much of the data used in the older studies discussed in the previous section measured friendship, respect, or other interpersonal ties directly through self-reporting in interviews or surveys, this statement may seem a bit curious. It has, however, become more difficult to gain direct access to large numbers of lawmakers as legislatures have become increasingly professionalized, and information is guarded more carefully by legislators and their offices than by other types of respondents at a time when it may spread rapidly through online channels and social networks. As a case in point, two of the authors of this article at one time sought to

conduct a survey and interviews to measure ties between legislative offices in the US Congress and received not a single response. They were more successful in another legislative context, the European Parliament (EP) (Ringe, Victor, and Gross, 2013), but even then it was evident that political elites are reluctant to discuss or identify their social networks. The result is that it is difficult, if not impossible, to garner the kind of response rates (of all lawmakers or above 90 percent) that the early studies of US state assemblies feature. Sampling, therefore, becomes a major concern, including the various challenges associated with sampling and network data.

On the upside, legislative networks have an important advantage relative to many other social networks: they have a clearly defined number of members, which has three important advantages. First, there is a finite total population of members to be captured, rather than an indeterminate and often much greater number of potential nodes. Second, it allows for the a priori identification of distinct subnetworks, such as members of particular legislative parties or committees, that can productively be investigated as networks in and of their own; this, in turn, may alleviate some concerns associated with sampling from a larger total population of actors (Ringe, Victor, and Gross, 2013, 613–614). Finally, if investigating a sample of legislators is inevitable, dealing with an identifiable population of all potential nodes gives researchers some leverage in gauging the extent of sampling bias, as it allows them to compare subgroups of legislators not included in the sample to those who are (Ringe, Victor, and Gross, 2013, 614–615).

Yet even if sampling is not a problem, data collection efforts based on self-reporting of ties can be problematic given respondents' cognitive constraints and biases, and the possibility that answers are strategic rather than reflective of actual social relations. The method also suffers from reproducibility and replicability problems, for three reasons. First, the data are likely considered so sensitive that sharing them with other researchers may be inappropriate, thereby making replicability impossible.<sup>2</sup> Second, reproducing data collection across legislatures is exceedingly difficult because of inherent differences in legislative institutions. Finally, reproducing data collection in the same chamber may produce different results, because data collected at different points in time may be inconsistent.

The difficulty of capturing longitudinal networks is quite pronounced when relying on directly measured social ties in legislative politics. Along with the difficulty of collecting such data in the first place, this is one of the reasons that some proxies for social connectedness have been quite popular. Cosponsorship data, which are available across time, are a notable example. Any proxy for interpersonal ties has its own problems, however. The most important challenge is to establish the validity of the measure, or that the proxy reflects the social relationship it intends to capture. Joint membership in a legislative committee, for example, may suggest that two members have a social tie; it is

possible, however, that the two never exchanged a single word or glance. Similarly, while there are good reasons to treat cosponsorship as a social tie (see our discussion below), it may well be endogenous.

Indeed, a final major challenge for legislative network scholars lies in the possibility that the observed ties and networks are endogenous. Put another way, studies of legislative networks are particularly vulnerable to a classic dilemma of network studies: whether an observed commonality between actors is the product of shared characteristics (homophily) or because of some causal peer effect. For example, what we may identify as the impact of friendship, respect, communication, cosponsorship, or collaborative ties may not actually capture the “network effect” of one (or more) actor(s) affecting the behavior of others; rather, the observed tie may reflect those factors that determine network structures in the first place. It may be that lawmakers’ choices about whom to exchange information with are a function of their preferences and strategies, and any outcome associated with communication networks can ultimately be traced back to these determinants of the network structure. Similarly, cohabitation in a boarding house may be associated with like voting, but like voting may simply be reflective of lawmakers with shared preferences, attitudes, and backgrounds choosing to live together. This challenge is an important one, but not often made explicit in research on networks in legislative politics or other context.

## The Social Legislator: What Connects Lawmakers?

Due to data limitations, legislative scholars often have to proxy social ties between legislators by measuring observable behaviors or characteristics. None of those proxies are perfect, but many are reasonable substitutes for social interaction. For example, one study assumes that legislators who simultaneously serve as party or committee leaders are likely to share a social connection (Arnold, Deen, and Patterson, 2000) and shows that those who are tied by leadership roles are more likely to vote the same way. Likewise, serving on the same committees renders legislators liable to exhibit common behavior (Porter et al., 2005, 2007). In a direct study of the relationship between social interaction and legislative voting, Peoples (2008) shows a strong effect arising from shared characteristics, social ties, and spatial proximity on voting behavior (see also Masket, 2008 and Rogowski and Sinclair, 2012).

Alternatively, Ringe and Victor use comembership in legislative organizations, such as caucuses in the US Congress or intergroups in the EP, to indicate connections between

legislators (Victor and Ringe, 2009; Ringe and Victor, 2013). This research shows that legislators gain information and solidify relationships through legislative member organizations (LMOs), and these, in turn, can impact their legislative behavior. Another take on measuring social connection is to examine cases in which legislators attended the same schools. Cohen and Malloy (2014) show that alumni networks among legislators positively affect their legislative roll-call behavior, especially with respect to logrolling and earmarks. In addition, scholars have observed that legislators engage in other common, observable events that can be used to proxy social relationships. For example, Desmarais et al. (2015) show that legislators who participate in joint press events have a positive correlation in their voting behavior.

A particularly popular way to define relationships or links between legislators is via legislative cosponsorship. The development of studies on legislative cosponsorship has occurred in part due to data convenience, since information about the bills sponsored and cosponsored by members of Congress (and also other legislatures) is readily available. Apart from the convenience factor, however, support for using cosponsorship as an indicator for relationships has a strong history in the institutions literature. Campbell (1982), for example, notes that legislators expend considerable effort recruiting cosponsors with personal contacts and “Dear Colleague” letters (see also Craig, 2015). Moreover, legislators frequently refer to these cosponsorships in floor debate, public discussion, letters to constituents, and campaigns. In a hearing of the House Ways and Means Committee, Representative Wally Herger touted both the number of cosponsors as well as the bipartisanship of the cosponsors for the Marriage Penalty Relief Act (Herger, 1967). These examples give credence to the notion that cosponsorship is meaningful and a signal of relationship between legislators, even though the cosponsorship literature is sometimes criticized for overstating the potential network connection provided by common cosponsorship (Kirkland and Gross, 2014).

Beginning with Kessler and Krehbiel (1996), scholars have used cosponsorship as an indication of relationships between legislators. Kessler and Krehbiel show that legislators use cosponsorship as a signaling device to their colleagues, rather than as a low-cost position-taking mechanism. Scholars have also used cosponsorship to document links between legislators defined by expertise and budgetary preferences (Gilligan and Krehbiel, 1987; Krehbiel, 1995). In this way, cosponsorship came to be thought of as signaling strategic behavior between legislative actors, rather than as “cheap talk” that might be considered less significant. A number of follow-up studies on cosponsorship continued this trend without being explicit about the networks formed by cosponsorship (Pellegrini and Grant, 1999; Burkett and Skvoretz, 2001; Koger, 2003; Goodliffe et al., 2005).

The social network literature has capitalized on both data availability and the conceptualization of cosponsorship as a measure of connectedness by demonstrating an empirical link between cosponsorship and other legislative behavior. Fowler (2006a, 2006b) examines basic descriptive features of the social network when cosponsorship is used to define the links, computing connectedness and centrality scores for legislators. Cho and Fowler (2010) use cosponsorship links to understand the small-world properties of various US Congresses and the relationship of that social structure with the ability of Congress to pass important legislation. Indeed, the structure induced by cosponsorship links has garnered significant interest (Fowler, 2006a, 2006b; Gross, 2008; Zhang et al., 2008; Bernhard and Sulkin, 2009; Cho and Fowler, 2010), and cosponsorship has been shown to be a correlate of numerous variables that are of crucial interest and relevance in legislative studies. To offer several examples, Alemán et al. (2009) demonstrate that ideal-point estimates derived from cosponsorship and roll-call vote data, respectively, are strongly associated with each other. Bratton and Rouse (2011) explore the determinants of cosponsorship and how group dynamics affect legislative agenda setting. Kirkland (2011) shows that weak, bridging cosponsorship ties are associated with greater legislative success. Kirkland and Williams (2014) find that collaboration across chambers is important in developing bipartisanship and norms of reciprocity. Kirkland (2012) examines cosponsorship networks in four states that use a combination of single-member and multimember districts and finds that multimember systems generate or strengthen relationships between actors with shared constituencies. In addition, scholars have leveraged the massive amounts of newly available data on voting in a variety of legislatures and parliaments to provide highly useful and stimulating databases and visualizations of such data. A good recent example is from François Briatte, who provides cosponsorship data and visualizations for twenty-seven parliamentary chambers in Europe, providing insights about parliamentary politics (Briatte n.d.).

In addition to offering descriptive statistics about cosponsorship networks and their properties (such as centrality, connectedness, and density), scholars have also been exploring cosponsorship networks via exponential random graph models (ERGMs, also known as  $p^*$  or  $p$ -star models), which allow one to examine the process that might underlie network formation (see chapter by Bruce Desmarais and Skyler Cranmer in this volume). Indeed, cosponsorship has been a defining measure for ERGMs of legislative networks. For example, Kirkland and Williams (2014) examine cross-chamber collaborative networks in the Texas, Maine, Oklahoma, and Colorado legislatures. In addition to legislator characteristics such as partisanship, leadership, and committee membership, they examine the process of reciprocity, out-stars, in-stars, and edges. Their analysis indicates that exogenous characteristics (partisanship, committee membership)

as well as endogenous characteristics (reciprocity both within and between parties) are the basis of tie formations across chambers. In a similar study of state legislatures in Arizona, California, Colorado, Florida, Illinois, Maryland, Michigan, South Carolina, and Texas, with cosponsorship defining ties, Bratton and Rouse (2011) find that while network formation varies somewhat across states, the results generally indicate that ideological distance, district proximity, homophily (race, gender, ideology, district location), and transitivity are important factors leading toward cosponsorship ties and network formation. With data from the policy networks in the Chilean and Argentinian congresses, Alemán and Calvo (2013) again use cosponsorship to define ties and find similar results. They examine edges, triangles, and two-stars and find that partisan, territorial, and committee effects have a significant impact on tie formation.

Cosponsorship will continue to be a staple of legislative network studies, but we see two important routes for advancing this research agenda. First, cosponsorship data have been drawn primarily from US legislatures, with only a few exceptions, such as Calvo and Leiras (2012) and Alemán et al. (2009), who examine cosponsorship networks in the Argentine congress; Alemán and Calvo (2013), who look at both Argentina and Chile; a study of the Chilean cosponsorship networks (Lee, Magallanes, and Porter, 2015); and Parigi and Sartori (2014), who use bill consponsorship in the Italian parliament in the 1970s. There is, accordingly, much to be learned from cases outside the United States. Second, since cosponsorship is not the only way in which ties or edges may be operationalized, we may find that nuances in legislative behavior are illuminated by different data conceptualizations. As data are curated, they would be usefully supplemented with information on other types of legislator ties to offer greater richness in understanding legislative networks in general—even if it may become difficult to cut through the noise and density of such measures to glean insights that cannot be understood with a single measure of social connectedness (Victor, Haptonstahl, and Ringe, 2014).

## Information

Information is an important currency in legislative politics, of course, and it would put lawmakers at a major disadvantage not to maintain any social contacts that provide access to information on the goals, policy positions, and strategies of their colleagues—whether friend or foe. Lawmakers cannot afford to ignore dissonance-producing information by interacting only with political allies with whom they tend to agree, as that would put them at a distinct strategic disadvantage. In other words, while there are important reasons (including strategic ones) to build social ties with trusted colleagues

who pursue the same goals, there are also sound strategic incentives for including political “enemies” in one’s social networks. This makes legislatures a fruitful venue for investigating social networks and the motivations that drive the creation of interpersonal ties and broader network structures (Ringe, Victor, and Gross, 2013).

The value of social networks as venues for the exchange and diffusion of information in legislative politics has long been recognized. Fiellin (1962, 78) discusses informal groups in legislative politics as communication networks that facilitate the provision and dissemination of “trustworthy” information, contribute to the development of legislative strategy, aid negotiation and coalition formation, and provide the basis of voting cues. The informational benefits of interpersonal ties—based on friendship, respect, or trust—are also highlighted by Eulau (1962) and Patterson and his collaborators (Patterson, 1972; Caldeira and Patterson, 1988; Caldeira, Clark, and Patterson, 1993; Arnold, Deen, and Patterson, 2000). Notably, Fiellin implies already in the early 1960s that legislative network structures affect information flow, when he suggests that informal groups facilitate communication across party and committee lines (1962, 82). His observation touches on two important themes that would be picked up in later work: the importance of weak, cross-cutting ties for information exchange and the relationship between social networks and formal legislative institutions.

The concept of weak (Granovetter, 1973), cross-cutting ties that bridge structural holes (Burt, 1995) is a staple of social network research. In the study of legislative politics, Kirkland (2011) demonstrates that weak ties between legislators are most useful in increasing legislative success. Ringe and Victor (2013) show how LMOs—such as caucuses in the US Congress and intergroups in the EP—allow lawmakers to establish social relationships with colleagues with whom they share a common interest in a particular political issue or policy theme. The social networks composed of these relationships, in turn, offer valuable opportunity structures for the efficient exchange of policy-relevant information, because LMO ties cut across party and committee lines and provide lawmakers with access to otherwise unattainable information. Moreover, because LMOs often maintain close relationships with outside actors, such as interest groups or lobbyists, they facilitate the flow of policy-relevant information into the legislature (see also Fiellin, 1962). Another structural characteristic of legislative networks is considered by Cho and Fowler (2010), who identify congressional cosponsorship networks as “small worlds,” where actors are densely interconnected with few intermediaries, which they suggest may affect the efficiency and speed of information flow.

Network structures between legislators or legislative offices are not independent of the broader institutional environment in which they are formed and maintained, however, which underscores the promise of extending the focus of research on legislative networks

beyond the United States. Institutions and networks interact in several ways that have been investigated by legislative scholars. First, attributes of legislatures such as their overall size and the number of parties affect lawmakers' informational needs and, by extension, the social networks they build and maintain. Ringe and Victor (2013), for example, find that LMOs (and the cross-cutting social ties they provide) are more likely to be established in legislatures with a larger total number of members and greater number of parties, since it is in those contexts that legislators have a greater need for both "political intelligence" about the positions of other actors and cross-party coalitions to pass legislation. Looking at collaboration networks, Kirkland (2014b) demonstrates that large legislatures tend to have low-density, highly partisan networks, and that larger legislative committees mitigate these effects. Second, resources available to lawmakers shape their informational needs. An extensive, in-house research service, for example, decreases their dependence on the expertise of their colleagues or actors outside the legislature, such as interest groups, and a large personal staff allows lawmakers to establish policy positions more autonomously (Ringe, 2010; Ringe, Victor, and Gross, 2013). Variation in available resources thus helps shape whom lawmakers choose to establish interpersonal ties with, and thereby a legislature's social structure. Third, legislative rules (and changes thereto) impact network structures directly. For example, Sarbaugh-Thompson et al. (2006) show that term limits create information networks with more prominent hubs able to control the flow of information and entail a decrease in cross-party ties. Also, evidence shows that so-called legislative knowledge networks have distinct network properties that can be leveraged to understand the likelihood of adopting particular policy proposals (Bonvecchi, Calvo, and Stein, 2016).

Legislative rules also affect information flow in the context of voting cues (Matthews and Stimson, 1975; Kingdon, 1981). Masket (2008), for example, investigates the impact of rules that determine seating arrangements in the California Assembly, where lawmakers (often from opposite parties) share desks, on voting behavior. He finds that spatial proximity increases the likelihood that two legislators cast like-votes because, he argues, lawmakers take cues from those closest to them geographically. In contrast, Rogowski and Sinclair (2012) use the US House of Representatives office lottery (whereby new members select their offices in a random order) to investigate the relationship between spatial proximity and legislative behavior; unlike other studies, however, they do not find an effect. Finally, Ringe, Victor, and Gross (2013) consider the possibility that lawmakers purposely establish social ties with political allies for the sake of *positive* cueing and with political enemies for the sake of *negative* cueing. Measuring actual social ties between legislative offices through surveys and interviews of legislative staff in the EP (rather than relying on a proxy measure), they maintain that lawmakers build social ties and exchange information with both political friends and enemies in order to increase the

confidence they have in their own policy positions. Specifically, if a lawmaker expects to agree with a colleague, their actual rate of voting agreement increases as the level of social connectedness goes up, while the rate of voting agreement declines as levels of social connectedness increase if a legislator anticipates that he or she is unlikely to agree with a colleague.

## Legislative Voting and Polarization

The idea of voting cues combines an explicitly relational conceptualization of legislative politics with the outcome most commonly investigated and explained by legislative scholars: roll-call voting. Roll-call votes are not only intrinsically interesting to students of lawmaking institutions because they represent the final outcome of the legislative process; they also have the advantage of being widely and increasingly available for many legislatures.

When legislators cast votes, they express a preference on a proposal. Whether such an expression represents a legislator's "true" policy preference may be a matter of some debate, but by and large, roll-call voting is widely accepted in the academic world and beyond as an indicator of preferences. Beginning with Bogue and Marlaire (1975), scholars interested in examining the social nature of legislative behavior have focused on roll-call agreement, or some aggregation of roll calls (Arnold, Deen, and Patterson, 2000; Masket, 2008; Peoples, 2008, 2010; Rogowski and Sinclair, 2012; Ringe, Victor, and Gross, 2013; Cohen and Malloy, 2014; Craig, 2015).

Studying roll-call voting in the context of social network analysis comes with significant challenges, however. As a dyadic, or network, measure, roll-call voting is typically described as "co-voting" or "agreement scores." These represent mathematical aggregations of individual roll-call votes that provide a descriptive indicator for each pair of legislators, which describes how often they vote the same way. The process of creating such scores is relatively straightforward and familiar to legislative scholars, because of the conceptual and mathematical similarities to NOMINATE scores. NOMINATE scores, developed by Poole and Rosenthal, also aggregate roll-call votes; however, their algorithm takes an inferential step further than agreement scores, because the outcome of NOMINATE provides a numerical measurement of ideology (Poole and Rosenthal, 1991, 2011; Cox and Poole, 2002). By comparison, agreement scores are a nonparametric description of roll-call voting activity, whereas NOMINATE scores map the behavior to a scale that is both comparable across time and venues and allows scholars to infer relative ideological placement in two-dimensional space. NOMINATE scores have been criticized

for methodological reasons (Londregan, 1999) that do not apply to agreement scores, despite the underlying similarities in their creation. This is because agreement scores simply provide descriptive information about behavior, whereas NOMINATE scores draw an inference about the substantive interpretation of that behavior. This difference represents a strength and a weakness of agreement scores, because it means they can be applied without consideration to identification or standard errors; however, they cannot be used to infer ideological placement or some other indicator. On the other hand, there is some question as to whether agreement scores represent a true network. As we have described, these scores are simply a description of a behavior; however, it is a behavior that legislators are more or less compelled to engage in and therefore does not represent a voluntary choice to make a connection with a counterpart. Covoting networks are networks in the sense that they describe a behavior that can be measured as a network because of a shared experience, but does not necessarily represent a tie between legislators in the same way that, say, being from the same state does. However, covoting may be interpreted as a *reflection* of an underlying social process. For example, in a recent application, Ringe and Wilson (2016) conceptualize legislative vote choice as the result of a cueing dynamic that can be captured using (co-)voting data. They show that legislators' centrality in covoting networks can be used as a measure of what they call "signaling influence," in which the most influential legislators are those who influence the votes of the greatest number of colleagues. Notably, this network measure travels easily across legislative arenas, since it is derived from often readily available roll-call vote data.

Voting data can also be used to investigate partisan polarization (Porter et al., 2007; Poole and Rosenthal, 2011), along with committee assignments (Porter et al., 2005, 2007), cosponsorship (Zhang et al., 2008), campaign donations (Koger and Victor, 2009), the aforementioned agreement scores (Andris et al., 2015), and other measures. The literature on political polarization includes a number of controversies and existing puzzles, especially with respect to the sources of polarization. Recently, scholars have begun to apply network-based theories and techniques to this ripe area of research, and that has proved fruitful and enlightening. Kirkland examines ideology and voting agreement in state legislatures to determine that ideological moderates are less likely to support their parties in roll-call votes compared to ideological extremists (Kirkland, 2014a). Moreover, the study shows that states with ideologically heterogeneous populations are more likely to have political parties comprised of ideological extremists. Using networks of campaign donations, Masket and Shor (2011) find that political parties constrained by an institutional unicameral legislature and strict term limits can overcome their limitations by capitalizing on campaign finance networks. In general, the network approach has been useful in describing the robust nature of political parties both within the legislature and outside of it (Masket, 2002; Cohen et al., 2008; Karol, 2009; Koger,

Masket, and Noel, 2009; Waugh et al., 2009; Bawn et al., 2012). Network analysis has also led to hypotheses that the social ties created by some networks may help offset the stagnating effects of polarization (Victor, Haptonstahl, and Ringe, 2014).

## Conclusion

The maxim that politics is inherently relational rings particularly true in the context of legislative decision-making, making legislatures a particularly fruitful venue to study politics from the relational perspective. Yet while the evolution of literature on legislative politics was strongly informed by networks in its early years, it became somewhat disassociated with network analysis during the behavioral and rational choice periods in political science from the 1960s to the late 1990s. Only recently have we seen a resurgence of social network theories, ideas, methods, and insights.

Legislating is a naturally interactive process. For many, the strong assumptions of independence required by many of the most prominent methodological and statistical approaches in the study of legislatures were a convenient untruth, easily accepted. The recent reintroduction of dependency into our understanding of legislative behavior, structures, and outcomes ushers into the social sciences a vast opportunity to capitalize on the best that our prior paradigms have offered. That is, one does not need to divorce rational choice theory in order to adopt a network-based view of the legislature. Game theoretic models have natural dependencies built into them (e.g., extensive form games) and have helped advance our knowledge of legislative interactions (Calvert and Fenno, 1994); therefore, our understanding of the political world can be simultaneously informed by actors' incentives, the constraining institutions in which they operate, and the interdependencies between actors and institutions. It is at this nexus where we expect to see some of the most productive legislative network research being produced in the coming decade.

A second key to future research on legislative networks lies in the collection of data on social ties between lawmakers. Legislators create and maintain a multitude of social connections, and one could imagine plotting a variety of networks on a single legislative body (e.g., networks based on covoting, cosponsorship, cocommittee membership, colegislative member organization membership, common lobbyist contacts, common donors, common leadership roles, etc.), including actual friendships or social connections. Much of these data are freely available, or scrapable, and can be analyzed from a relational perspective. As they are collected and digitized, and as our personal computers have an increasing capacity to store, manage, and analyze them, we may see the creation of vast databases that help reveal network structures and how they affect

legislative processes and outcomes. Even though the availability of data today often exceeds our capacity to process and analyze them statistically, scholars are already showing increasing creativity in capturing and collecting both qualitative and quantitative data that will help us better understand the relational process of lawmaking and its place in politics and government. Among the most exciting of these possibilities in our imagined future awash in data is the potential to better understand global properties of networks. Theoretically, all networks have graph-level properties that can only be observed if all data (nodes and edges) are present, and if the relations capture meaningful properties. When (or if) such networks can be observed, scholars can understand properties such as centrality, density, the presence of brokers, or triangles, each of which carries its own implications about the network. For instance, centrality can be measured on a graph-level network and may provide inferential information about power structures in a network. Networks that exhibit a greater number of triads are known to exhibit greater trust and reciprocity. If we can reliably observe such features in legislative networks, we will expand our understanding of the properties, behaviors, and potential in them.

The third major opportunity for future research on legislative networks lies in extending its theoretical and empirical focus beyond the United States. A comparative perspective offers institutional variation—at both the macro-institutional level of the political system as a whole and at the level of the legislature itself—well beyond what can be found in a single-country case. While social networks surely matter in every legislature, there is bound to be notable and consequential variation in their structures, the roles they play, and their relative importance in shaping legislative processes and outcomes. How does the balance of power between legislature and executive impact network patterns? How do electoral rules affect the networks between legislators once they are in office? Does the internal organization of the legislature structure social networks? Does the strength of parties strengthen or weaken social ties? Are social relations inside legislatures of greater importance when party systems are unconsolidated? How do legislative networks differ between democratic legislatures and those in authoritarian countries? Such questions warrant a comparativist turn in the study of legislative networks, with existing research on the United States poised to serve as a major reference point.

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### Notes:

(<sup>1</sup>) For example, we disregard research that focuses on legislative elections without connecting them to politics inside the legislature and studies that broadly conceptualize legislative politics as relational without, however, investigating social *networks*.

(<sup>2</sup>) In the aforementioned EP study by Ringe, Victor, and Gross (2013), for example, all respondents were assured complete anonymity, and the small sample of (actual and potential) respondents prevented the release of data even if proper names had been replaced by general attributes such as party affiliation and nationality.

#### **Nils Ringe**

Associate Professor of Political Science, University of Wisconsin, Madison

#### **Jennifer Nicoll Victor**

Jennifer Nicoll Victor, Associate Professor of Political Science, Schar School of Policy and Government, George Mason University

#### **Wendy Tam Cho**

Wendy Tam Cho, Professor of Political Science and Statistics and Senior Research Scientist at the National Center for Supercomputing Applications, University of Illinois at Urbana-Champaign.

