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Measuring legislative collaboration: The Senate press events network

Bruce A. Desmarais[a,*], Vincent G. Moscardelli[b], Brian F. Schaffner[a], Michael S. Kowal[a]

[a] Department of Political Science, University of Massachusetts Amherst, United States
[b] Department of Political Science, University of Connecticut, United States

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ABSTRACT

Scholarship regarding the causes and consequences of legislative collaboration has drawn several insights through the application of network analysis. Previously used measures of legislative relationships may be heavily driven by non-relational factors such as ideological or policy-area preferences. We introduce participation in joint press events held by U.S. Senators as records of collaboration and the networks they comprise. This measure captures intentional relationships between legislators along the full timeline of collaboration. We show that there is substantial community structure underlying press event networks that goes beyond political party affiliation, and that press event collaboration predicts overlap in roll call voting.

1. Introduction

Notions of complex interdependence among legislators pervade theories of congressional decision-making (e.g., vote trading, Carsey and Rundquist, 1999; bargaining, Baron and Ferejohn, 1989; information exchange, Groseclose, 1994; and coalition-building, Lee, 2000; Madonna, 2011). Though such theories offer predictions regarding roll call voting, roll calls provide a limited view of the interactions between legislators. Legislative networks, on the other hand, offer a direct means of assessing patterns of interactions and interdependence. Congressional scholars have begun to focus on the study of legislative networks, in which the fundamental unit of analysis is the relationship between two legislators, however that relationship is defined. The network framework offers the opportunity to (1) formulate and test theory about legislative interactions, and (2) observe the effects of legislative interactions on important legislative outcomes, such as roll-call votes or the passage of legislation. In order to study interactions among legislators, the essential measurement step is to define an interaction that is meaningful to the legislative process. Cosponsorship of legislation has served as the most commonly studied operationalization of congressional networks (Fowler, 2006a,b; Zhang et al., 2007; Cranmer and Desmarais, 2011; Desmarais and Cranmer, 2012). Others include networks that have been constructed using co-membership on congressional committees (Porter et al., 2005) and co-membership in congressional caucuses (Ringe and Victor, 2013).

The existing research on congressional networks offers insights into the causes and consequences of overlap in legislative decisionmaking (e.g., cosponsorship) and overlap in organizational membership (e.g., committees and caucuses). These domains constitute an important piece of the puzzle in understanding legislative collaboration, but the relational component of previously studied congressional networks might be overshadowed by individual preferences (in the case of cosponsorship) or institutional constraints (in the case of shared committee membership). We introduce an alternative measure of collaboration in Congress that complements extant measures – joint press events in the U.S. Senate. Senators commonly hold individual press events to express their policy positions, claim credit for distributive benefits, and promote their initiatives. When Senators join collaborators in their publicity activities, they activate relational benefits. Senators have an incentive to organize collaborative press events because events that include multiple senators tend to receive more news coverage than events that include just a single member (Sellers and Schaffner, 2007). At the same time, the physical spaces in which such events take place generally preclude very large numbers of senators from appearing at a single event and, in any event, there are undoubtedly diminishing returns to adding additional senators to any given press event. Most importantly, press events are quite costly to organize and participate in, as compared to voting or cosponsoring legislation. When multiple senators hold a press event together, such an event is the result of non-trivial coordination by the senators and their staffs. Thus, co-participation in press

* Corresponding author. Tel.: +1 413 545 1992.
E-mail addresses: desmarais@polsci.umass.edu (B.A. Desmarais), vin.moscardelli@uconn.edu (V.G. Moscardelli), schaffne@polsci.umass.edu (B.F. Schaffner), mkowal@polsci.umass.edu (M.S. Kowal).

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events provides us with an indication of which senators have close working relationships with each other.

In this paper, we use data on joint press events from the 97th to 105th congresses to study the structure of collaboration in the Senate. We first introduce the press events network and describe how this network differs from the most extensively studied congressional network – the cosponsorship network. After demonstrating the value of the press events network for measuring meaningful collaborative relationships between senators, we consider whether press event collaboration predicts agreement in roll call voting, adjusting for other determinants of legislative choice. Our findings indicate that the structure of the press event network departs considerably from that of the cosponsorship network, most notably in the extent to which and the point at which the network begins to reflect the partisan polarization that now characterizes the chamber. Considering the relationship between roll call agreement and press event collaboration, we find that senators who hold press events together also vote together. Linking these two findings, we conclude with a discussion of the implications of this new network for our understanding of polarization in the United States Senate.

2. Networking legislators

In this section we consider the alternative approaches to operationalizing legislative networks and discuss, from a theoretical perspective, what we offer through the use of joint press events to operationalize connections. In measuring legislative networks, scholars are usually interested in understanding the dynamics of legislative collaboration. As Kirkland and Gross (2014, p. 101) note in their study of cosponsorship networks in the U.S. Congress, "the construct we are attempting to capture is collaboration." In describing the relational benefits of caucuses, which they use to operationalize legislative networks, Victor et al. (2013, p. 4) indicate, "caucuses offer an opportunity for MCs to collaborate on issues for which they share policy priority." To measure collaborative relationships, scholars have looked to co-support of legislation and co-membership in policy-focused legislative organizations. We argue that the use of joint press events complements extant measures due to the costly and intentional nature of the relationships formed through joint press events, the lack of institutional constraints on co-participation in them, and the incentives members have to limit the number of participating senators.

Cosponsorship is the relational process that has received the most attention in legislative networks scholarship. At the aggregate/chamber level, Tam et al. (2010) show that the structure of cosponsorship networks in the U.S. House and Senate varied significantly over the last quarter of the 20th century and that when the two chambers behave like a 'small world' – consisting of several tightly overlapping communities – Congress passes a higher number of important laws. Cosponsorship network structure relates to legislative outcomes at the individual legislator level as well: legislators receiving a strong degree of support from their colleagues through cosponsorship, as measured through centrality and other measures of connections in the cosponsorship network, exhibit a high degree of success at various stages in the legislative process (Fowler, 2006a; Kirkland, 2011). Scholars have also looked to legislative sub-organizations as a means through which to establish connections among legislators. Porter et al. (2005) and Porter et al. (2007) look at co-committee membership networks. Studying the House in the 101st – 108th congresses, Porter et al. (2007) show that the committee assignment network is significantly more hierarchical in Republican controlled congresses. Considering yet another legislative sub-organization, Ringe and Victor (2013) show that the memberships of legislative caucuses bridge across party and committee organizations – supplementing the formal organizational structure where it fails to provide the substantive and political information members crave.

For all their strengths, the major shortcoming of extant measures of legislative networks is that overlap between legislators may be driven by correlated preferences (e.g., for legislation or policy areas) and/or institutional forces (e.g., the committee assignment process) and may not be indicative of active collaboration between or among legislators. To understand why this distinction is important, we outline the motivations for senators to intentionally build collaborative relationships.

2.1. Collaboration on discrete policy proposals

Collaboration can occur as two or more senators work together over time to develop expertise and to build support for a discrete policy proposal (or proposals). This process of complementary specialization and integrated coalition-building serves as a primary motivation for legislators to seek out collaborators. The end result of legislators' partnerships can be seen in prominent examples of eponymous legislation attributed in name to dyads or triads of senators – McCain–Feingold, Nunn–Lugar, Gramm–Rudman–Hollings to name a few. Consider the following description by Senator Richard Lugar (R-IN) of how his collaboration with Georgia Democrat Sam Nunn on the Nunn–Lugar Cooperative Threat Reduction (CRT) Program (the program responsible for securing and dismantling nuclear weapons in former Soviet republics that became law in 1992) came to be.[1]

> Well, it started in 1986 when Sam and I were invited to be a part of a delegation to go to Geneva, Switzerland. It was the hope for a beginning of arms control talks with the Soviet Union, which did not pan out in that period of time. . .. But we both found that we had an intense interest in the subject. And so, as a result, in subsequent years, Sam and I were both in Europe, [and we] banded together to visit often with delegations of Russians that we had met in Geneva or a derivative of that in Geneva. So we could begin to see the unraveling of the Soviet Union and the dangers that were clearly there that were not being met by arms control, which was very helpful (Lugar, 2011).

In this case, a conversation on a trip to Europe activated relational benefits that ultimately proved instrumental in the passage of important legislation six years later.

2.2. Other benefits of collaboration

But collaborative relationships need not be so instrumentally focused on discrete policy proposals to be beneficial. A second mechanism through which being central in a network of collaborators might yield legislative benefits would be if better-connected legislators are simply better situated to mobilize their many friends quickly when opportunities to pass laws emerge. Given how quickly policy windows can open and close, senators with a broad network of personal relationships might have a head start in building coalitions. In his obituary of Edward Kennedy (D-MA), CQ's Seth Stern described Kennedy's ongoing efforts to build personal relationships with colleagues.

> Kennedy. . . always made. . . efforts to connect with his colleagues – and their aides – long before he wanted to work with them on a bill. He carefully courted them with gifts and

[1] The fact that Nunn and Lugar were not members of the same party, did not hail from the same state or region, and never shared a committee assignment during their long careers in the Senate may illustrate the limitations of co-membership and/or constituency-based networks as indicators of collaboration.

> gestures large and small, much like an Irish ward boss back in Boston would curry favors with voters. . .. 'Whenever any of us encountered great difficulties, he was always the first to call,' [Utah Republican Senator Orrin] Hatch noted in a tribute from the Senate floor in 2008 (Stern, 2009).[2]

Finally, senators who are well-connected in a collaborative network would seem to make attractive coalition partners due to the informational and experiential advantages they have over less well-connected senators. Well-connected legislators might develop, over many meaningful interactions with their colleagues, a better understanding of what is acceptable to and/or important to their colleagues, and this strategic information would prove to be a valuable commodity during the coalition building process. While predating network analytic treatments of Congress by decades, Matthews (1960) was arguably the first scholar to document the informational advantages held by members who were central in the Senate's social network:

> Still another factor encouraging the reporter's reliance upon a relatively few news sources in the Senate is the chamber's internal patterns of influence. "I don't talk about this for obvious diplomatic reasons," one reporter for a nationally known paper said, "but there's not too much use in talking to more than five or six senators. After you've talked to them, you know what's going on." Another top news reporter elaborated on the point. "Take_or_, for example, they have big hearts but no real influence. Much of the time they don't have a good idea about what is going on, or what will happen in the future. I could ask_how many votes a bill will get on final passage and he probably would tell me. But it wouldn't be as good an estimate as that of a more influential senator. _is just not a member of 'the club' " (201).

Thus, senators who have developed close, ongoing working relationships with many of their colleagues will benefit not only from the legislative proposals around which those relationships may have been formed, but they will also be better situated to form legislative coalitions when new issues arise and to navigate the process through which ideas eventually become law.

2.3. Joint press events as records of collaboration

While cosponsorship and joint membership in legislative organizations may be valid and reliable indicators of the types of collaborative partnerships in which we are interested, we suspect that they are also rather noisy ones given the number of cosponsors on major bills and the individual policy, electoral, and institutional power motivations that influence committee assignments (Fenno, 1973, pp. 1–14) and caucus membership (Hammond, 1998, pp. 64–79). In contrast, there are several reasons to believe that press events paint a richer portrait of the most meaningful collaborative social relationships in the United States Senate.

The first is that joint press events are costly to organize, promote, and in which to participate. In the contemporary Senate, being added as a cosponsor is a low-cost activity, often handled by a simple phone call or Email exchange. But joint press events are costly and require extended planning and coordination of several offices at both the member and staff level. Second, joint press events are, for both logistical and strategic reasons, characterized by a limited number of senators (Sellers and Schaffner, 2007). During the two decades of press event data we have available, only 2.9% of the events included more than four senators and just 0.65% included at least 8.[3] Third, unlike cosponsorship, committee assignments, or caucus memberships, press events can be held at any point in the legislative process, from promoting a policy problem to publicizing the successful passage of legislation. And fourth, the decision to hold a joint press event ultimately rests with the individual senator, which means they are subject to very few formal constraints. Unlike the more stable, institutionalized interactions captured by co-party, -committee, and/or -caucus membership, press event interactions are potentially more fluid and idiosyncratic. Thus, connections created through and reflected in co-participation in press events are quite different from those made through the activities that constitute extant legislative networks. Collaboration in press events simultaneously offers a glimpse at (1) every stage in the legislative process, (2) a comparatively fluid and less institutionalized legislative relationship, and (3) co-participation in a process that is both relatively costly and still free of majoritarian incentives. Thus, we believe that collaborative press events provide us with a useful indicator of which senators (and senators' staffs) have active, working, collaborative relationships with each other. Moreover, as a measure of the number of collaborative relationships one has with one's colleagues, we believe the press events network has several advantages given the measures currently available in the literature.

To illustrate the function of legislative collaboration that underpins joint press events, we discuss the press conference Edward Kennedy and Orrin Hatch held on March 13, 1997 to announce their proposal for the Children's Health Insurance Program (CHIP). Kennedy, a Catholic liberal Democrat from Massachusetts, and Hatch, a Mormon conservative Republican from Utah, developed a working relationship through their service on the Judiciary and Labor and Human Resources committees that eventually developed into a close friendship (Hatch, 2009).[4] These two very different personalities came together in helping to secure the passage of CHIP during the 105th Congress (1997–1998). The issue gained prominence when President Clinton proposed it in his 1997 State of the Union Address. Kennedy had introduced virtually identical legislation (along with Massachusetts colleague John Kerry) in the 104th congress. But anticipating serious Republican opposition, Kennedy made a deliberate effort to secure bipartisan support in the 105th. He reached out to Orrin Hatch, with whom he had worked successfully in the past, for leadership in developing and promoting CHIP. Edwin Chen of *The Los Angeles Times* describes the events that followed.

> When approached, Hatch was blunt. Yes, he too wanted more children to have medical insurance, but "it ain't going to be a Kennedy–Kerry bill," Hatch said he told Kennedy. . . "That bill's nothing but a big bureaucracy and creates a big entitlement program," Hatch said. Kennedy didn't bat an eye. "We'll work with you," he told Hatch. Kerry graciously bowed out. Thus began countless bargaining sessions between Kennedy and Hatch and their staffs. . .. During their negotiations, Hatch insisted $20 billion be offered to states as block grants, with the states free to set their own eligibility standards. But he acceded to Kennedy's demand that states must follow certain federal guidelines. "I wish we didn't have to have strings – and just make everything

[2] Kirkland (2011) explains why Orrin Hatch, a well-connected Republican, would have been a particularly valuable connection for Kennedy when compared to other Democrats or to socially isolated Republicans like Elizabeth Dole (889–90).

[3] Regardless of whether one conceptualizes cosponsorship as an example of position taking ((Mayhew, 1974), pp. 63–64), legislative signaling ((Kessler and Krehbiel, 1996); (Wilson and Young, 1997)), or entrepreneurial coalition building (Wawro, 2000), it remains true that bill sponsors have incentives to maximize the number of cosponsors they can attract. Joint press events are free of this majoritarian incentive.

[4] Due to the politically charged nature of the issues in its jurisdiction, the latter committee has undergone several name changes since the 1970s. For virtually the entire period studied here, however, it was referred to as the Labor and Human Resources Committee. Since 1999, it has been referred to as the Health, Education, Labor, and Pensions (HELP) Committee.

absolute block grants," Hatch said. "But that's not real." (Chen, 1997)

Despite Hatch's input, the basic outlines of the Hatch–Kennedy plan – the expansion of Medicaid and the controversial decision to fund the program through an increase in excise taxes on cigarettes – still closely resembled those of the Kennedy–Kerry bill from the previous congress. So to keep his own side interested, Hatch won a concession from Kennedy to set aside $10 billion of the $30 billion in revenue generated by the new tax for deficit reduction (Tobacco Institute, 1997). "When was the last time you saw Ted Kennedy favoring a bill that had block grants, with states setting the standards, and had a deficit-reduction component?" Hatch asked (quoted in Chen, 1997). At the press conference announcing the legislation (which was covered extensively by the national media), Hatch noted the apparently odd political alliance between the two, saying, "Some refer to us as the legislative odd couple of the U.S. Senate. I like to think of us as the dynamic duo" (Davidson, 1997). Hatch expressed hope that "many of my Republican colleagues in the Senate will join me in this bipartisan effort," but given the large increase in cigarette taxes, which angered conservative Republicans and tobacco state Democrats in both chambers, it is not surprising that the bill underwent several changes before ultimately being included in the Balanced Budget Act of 1997 (P.L. 105-33). But the program that was enacted – a major expansion of Medicaid funded by block grants to the states paid for by an increase in tobacco taxes – clearly reflected the collaborative efforts of Kennedy and Hatch. This event is one of the many joint press events documented in the dataset we describe below.

While our data end in 1998, it is important to note that events such as the one described in the previous paragraph are not relics of a bygone era, as evidenced by the following, more recent, example. In both the 112th (2011–2012) and 113th (2013–2014) congresses, Mike Enzi (R-WY), Lamar Alexander (R-TN), and Dick Durbin (D-IL) introduced the Marketplace Fairness Act, which would allow states to collect sales and use taxes on purchases from online retailers with no physical presence within the state. The collaboration on this topic involved a sophisticated, multi-staged press strategy that spanned at least two congresses; in fact, for Durbin and Enzi, the collaboration dated back more than a decade. At a joint press event just outside the Senate chamber on November 9, 2011 (the day they introduced the bill), Durbin explicitly referenced his ongoing collaboration with Enzi on this issue: "I can remember this battle what, 10 years back Mike [looks at Enzi]... when we first fought it. Remember that?" Durbin then appealed directly to the public (something only possible at such an event), enlisting their help in encouraging colleagues to support the bill by cosponsoring it:

> So I hope we can get it done. I know that Senator Harry Reid supports it. It's great to have the majority leader in the Senate on our team, but we've got to do a lot of work before we're ready to bring it up on the floor. We need more cosponsors, and I encourage all the retailers and all the folks in small business: reach out to all those colleagues of ours on both sides of the aisle who give great speeches about how much they love small business and tell them to prove it. Come and sign up on the marketplace fairness bill (Durbin, 2011).

Alexander's participation in the press conference reflected his key substantive contribution to the legislation Enzi and Durbin had been working on for years. As Enzi pointed out during testimony before the Senate Commerce Committee the following August,

> My original versions – and I've had a number of different versions of this bill – were considerably more complicated until Senator Alexander suggested to Senator Durbin and I *(sic)*, who had been working on the previous versions, that this should be... considerably simpler, and it is.... I want to publicly commend Senators Durbin and Alexander for taking a leadership role in this and looking for some of the flaws that were in the bill and helping us to eliminate them (Hearing, 2012).

The November 9 press event was organized to draw attention to a specific piece of legislation and to appeal for support among colleagues (directly and indirectly through constituent action) for that legislation. The Marketplace Fairness Act of 2013 passed the Senate on May 6, 2013 after attracting 29 cosponsors. Thus, while nearly one-third of the Senate ultimately co-sponsored this legislation, the press events announcing the introduction of these bills were organized and attended by a bipartisan group of three senators, two of whom had been working on this topic for the better part of a decade and one of whom had contributed a major substantive reframing of the underlying issue.

3. The press events network

In this paper, we conduct a network analysis of press events held in the Senate from 1981 to 1998. These events include any gathering on the Senate side of the Capitol where broadcast (radio or television) news media were present, including press conferences, stakeouts, committee hearings, studio interviews and photo opportunities. Records on these events were provided by the Senate Radio and Television Gallery (SRTG). Since the late 1970s, the SRTG has recorded information on each press event held in the Senate, including the type of event, the senators involved, and the subject of the event (Sellers and Schaffner, 2007). A daily listing of all press events can be viewed here: http://www.radiotv.senate.gov/?page_id=29. While the full dataset includes information on over 20,000 press events held during this time period, we limit our analysis to 4131 press events at which more than one Senator appeared, which we refer to as joint press events.

As is the convention in network analyses of Congress (Fowler, 2006a; Zhang et al., 2007), we aggregate events over the two year period of a congress to construct a single network for each congress, from the 97th to 105th. In a given network, two senators share an undirected weighted tie, given by the number of press events at which they both appeared during the respective congress. The degree distribution of a network is the distribution of the number of ties in which each node (i.e., senator) is involved. To provide a sense of the connectivity of the networks, we depict the degree distributions for the networks in which a tie indicates that two senators appeared together at at least one press event in the respective congress. We see in Fig. 1 that, over the period under study, on average, each senator co-appeared at press events with approximately 20 other senators. The outlier congresses include the 98th and the 102nd, in which the average was closer to 10, and the 103rd and 104th in which the average senator co-appeared at press events with approximately 30 others.

One additional important descriptive aspect of the joint press events that we draw upon in constructing the networks is the typical subject matter of the events. In particular, we should confirm that the events, by-and-large, address topics central to legislative collaboration. After all, legislators hold press events to discuss issues tangential to collaborative legislating, including extreme weather events, prominent electoral contests, and federal grants won in their districts. During the period under study, the SRTG recorded brief (on average, three words) summaries of the topics of the press events. In our data, there are textual descriptions of approximately 3800 events. Though in-depth text analysis is not feasible given the brevity of the descriptions, simple word frequencies provide assurance that issues central to legislative collaboration dominate the agendas of the collaborative press events

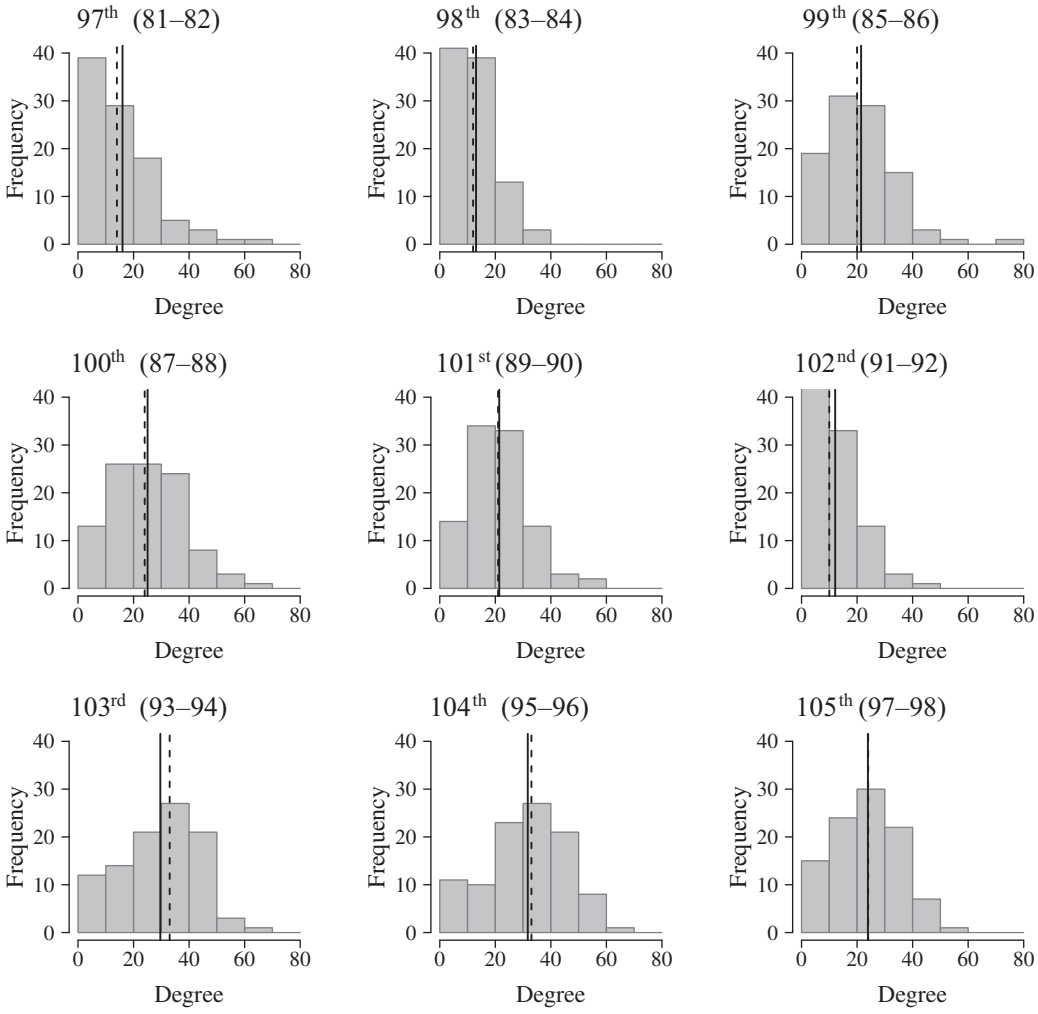

Fig. 1. Degree distributions of the Senate PE network. The plots are histograms of the number of unique senators with whom each senator held press events in the respective congress. The mean (solid) and median (dashed) degree are given by the vertical black lines.

that we use to construct the press event network. Fig. 2 depicts the top 25 terms used in the descriptions of the joint press event agendas.[5] Only one of the top ten words, "nomination", would indicate topics arguably tangential to legislating. The overwhelming majority of the top terms are closely tied to legislating, with several of the words – bill, act, amendment, legislation, resolution – synonymous with legislation.[6]

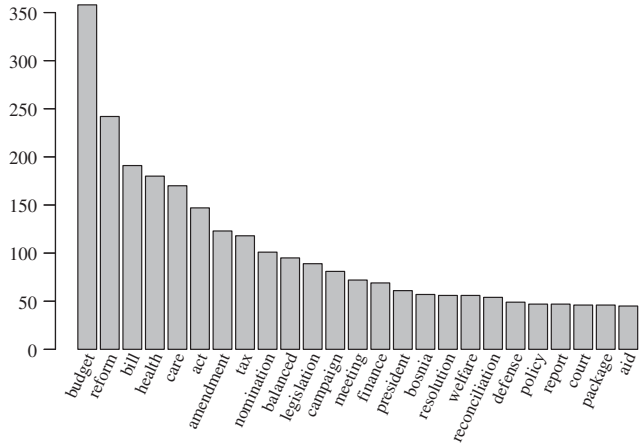

Fig. 2. Top 25 terms used in short descriptions of joint press event agendas. *y*-axis gives the number of press event descriptions in which the term is used.

3.1. Community structure and partisanship in press event collaboration

Congressional scholars have documented the growing partisanship in roll call voting during the past several decades (Poole and Rosenthal, 1984; McCarty et al., 2009). While this polarization has been particularly noteworthy in the House, similar patterns are apparent in the Senate as well (Lee, 2009; Theriault and Rohde, 2011; Bonica, 2014). Data provided by Poole and Rosenthal (2007) indicate that while fewer than 50% of the roll call votes in the Senate were party-line votes in the 1970s, over 60% of votes in recent congresses have pitted a majority of one party against a majority of the other party. In addition, individual senators have been more unified with their parties on those votes in recent congresses. In the mid-1970s, the average senator voted with his or

[5] We use the R package `tm` (Feinerer et al., 2008) to assess the word frequencies across the press event descriptions.

[6] Though we are limited in the current study by the brevity of the textual descriptions, in future work it would be fruitful to gather longer textual descriptions of the agendas such that the press event networks can be parsed and modeled on the basis of agenda topics.

her party about 75% of the time; in recent years, party unity scores in the Senate have hovered around 90%.

While roll call voting in the Senate has become increasingly partisan, there is less systematic documentation of the extent to which partisanship has affected interactions among members of Congress. Zhang et al. (2007) examine polarization in cosponsorship through a creative application of standard community detection methods (Girvan and Newman, 2002). In many contexts, it is useful to identify groups of individuals in networks, whereby within-group interactions are much more common than across-group interactions. These groups are commonly referred to as communities, and their identification is the goal of community detection in networks. We refer to an assignment of nodes into groups as a *community structure*. The most commonly used measure of the quality of a community structure is referred to as *modularity*. The modularity of a community structure for a given network is a measure of the degree to which the number of ties, or tie weights, within communities exceed the expected tie weights if the nodes in the networks randomly formed ties with nodes throughout the network, preserving the node degrees. Specifically, modularity (Porter et al., 2009) is

$$Q = \sum_i (e_{ij} - b_i^2),$$

where e_{ij} is the proportion of ties with one node in community i and one node in community j, and, defining the tie between nodes h and k to have two tie ends (h and k), b_i is the proportion of tie-ends that are captured in community i.

Zhang et al. (2007) study the relationship between party polarization and community structure in the cosponsorship network using modularity. They define a tie in the cosponsorship network as the number of pieces of legislation over the period of a congress on which two legislators were both cosponsors or sponsor and cosponsor. They compare two community structures for each congress; (1) the unconstrained, modularity maximizing partition of legislators into communities, and (2) the community structure defined by making each political party its own community. This accomplishes two ends. First, the modularity of the party community structure serves as a measure of party polarization within the cosponsorship network. Second, the difference between the modularity of the unconstrained community structure and the modularity of the party community structure serves as a measure of group structure within the cosponsorship network that is not explained by party membership. Two findings emerge from their analysis of community structure in cosponsorship, and we replicate their results for the Senate in panel (b) of Fig. 3. First, there is a dramatic spike in the modularity of the cosponsorship network starting in the 103rd Congress and topping-out in the 104th Congress, which corresponds with the "Republican Revolution." Second, over the period under study, the modularity of the party community structure (the gray line) is nearly as high as the modularity of the unconstrained community structure, suggesting that the group structure underlying the cosponsorship network is effectively explained through partisanship.

To what extent do press events capture a different type of network? We examine the community and partisan dynamics of modularity in the Senate press event network. The analysis is given in panel (a) of Fig. 3. First, with respect to the modularity of the party community structure in the Senate press event network, we see a similar spike in modularity that peaks in the 104th Congress. However, this upward trend begins in the 101st Congress – two congresses earlier than the spike in cosponsorship. Second, only in the most polarized congresses is the modularity of the party community structure close to that of the unconstrained community structure, suggesting there is much more driving the group

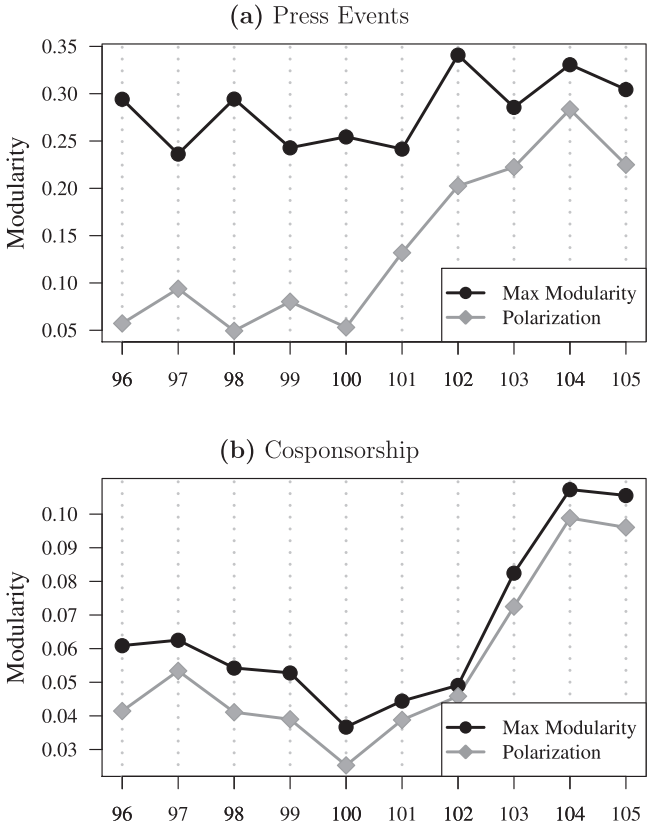

Fig. 3. Modularity in the Senate press events and cosponsorship networks. These plots depict the modularity of the networks in both the community structure identified with the community detection algorithm (black) and with communities defined by political party affiliation (gray).

structure underlying press event collaboration than just partisanship.

Though Fig. 3 shows the difference in modularity of the two community structures, the presentation does not fully depict the community structure in the press events or cosponsorship networks.[7] Fig. 4 illustrates the number, size and party composition of the unconstrained (i.e., maximum modularity) community structures in both the press events and cosponsorship networks. There are many more communities in the press events network than in the cosponsorship network. Also, at least up to the 103rd Congress, there are substantial bipartisan communities in the press events network, whereas, only in the 96th Congress is there a bipartisan community in the Senate cosponsorship network.

The exploratory analyses depicted in Figs. 3 and 4 provide evidence that, excepting the later congresses in our series, there is structure in the press events network beyond partisan homophily. Though it is beyond the scope of the current research to develop a complete statistical model of the network, as an additional exploratory step, we examine whether the other traditional power centers in Congress – committees – provide a basis for co-community membership. Fig. 5 provides estimates of the associations between senator co-community membership and co-partisanship (panel a), as well as senator co-community membership and senator co-committee membership (panel b). In the 97th–101st and 105th co-community membership is 4–8% more prevalent among pairs of senators that share a committee assignment than among pairs of senators who do not share a committee

[7] We present the communities for each congress in the online Supporting information.

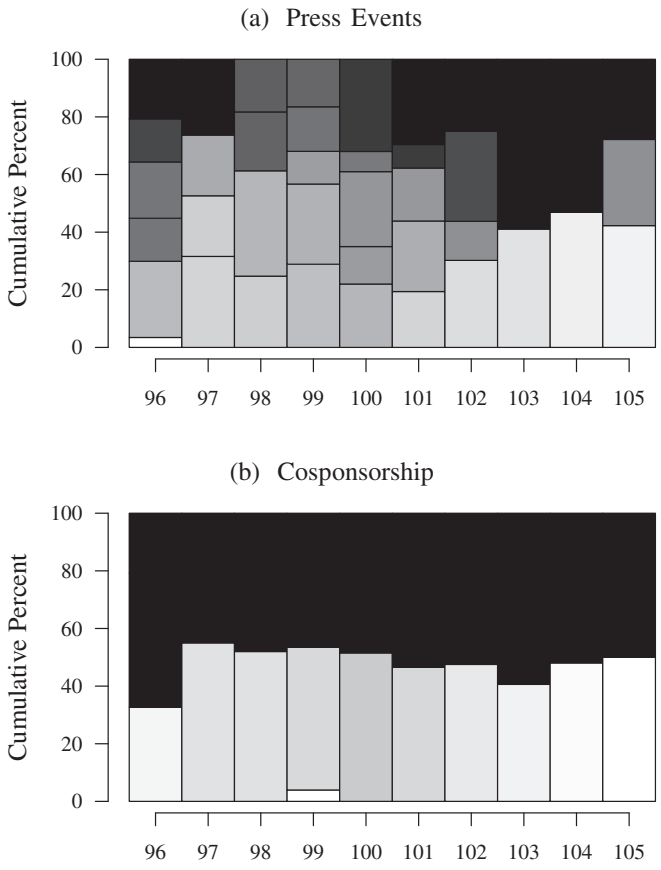

Fig. 4. Community structure in the Senate press events and cosponsorship networks. These plots depict the communities discovered with the community detection algorithms. In each congress (i.e., vertical slice), a block represents a community. The size of each block is proportional to the number of senators in the community. The color of each block represents the partisan composition of the community.

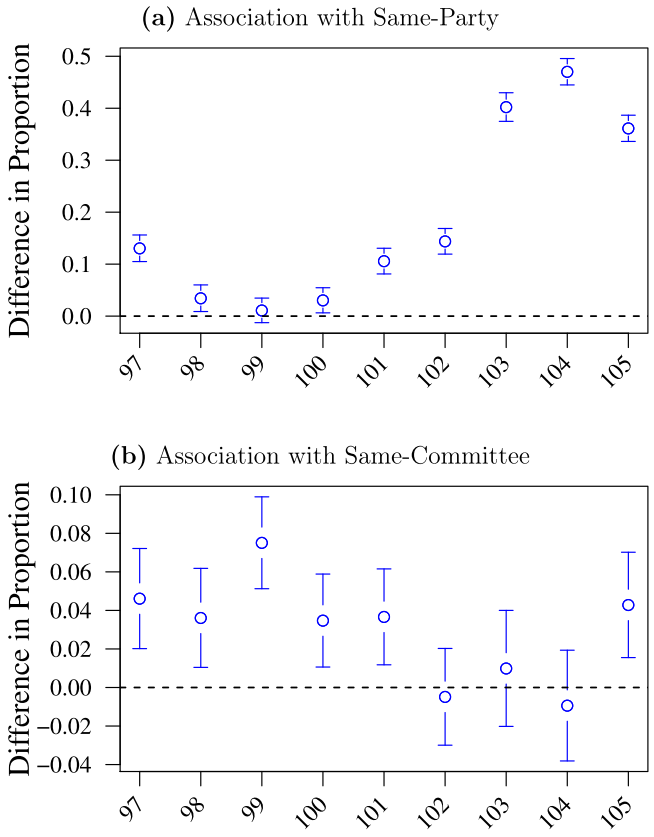

Fig. 5. Difference in proportions of dyads with the same community label by those in and not in the same party (a) and those sharing and not sharing a committee assignment. Circles are located at the point estimates, and bars span 95% confidence intervals.

assignment. These differences are all statistically significant at the 0.05 level. The difference based on co-partisanship is more volatile, ranging from close to or barely distinguishable from zero difference in a number of the early congresses, to almost 50% in the 103rd–105th congresses. Moreover, the prevalence of party and committee-based homophily appear to be negatively associated, with the strongest periods of committee-based homophily aligning with the weakest periods of partisan homophily and *vice versa*. Though we leave it to future research to build a complete explanatory model of press event collaboration, the results presented in Fig. 5 indicate that the two major power centers in Congress serve as a basis for co-community membership in the press events network, and suggest that there are interesting dynamics between partisan and committee-based homophily. For current purposes, however, we simply note that the growth in the partisan structure of collaboration at the expense of collaboration conditioned by co-committee membership is consistent with an institutional transformation characterized by the shifting of power and influence away from committee-based policy specialists to floor-based policy generalists (Sinclair, 1989), and later to party messaging organs such as the Democratic Policy and Communications Center (Lee, 2009; Ritchie, 1997).

4. The network correlates of roll call voting

Thus far we have demonstrated that (1) joint press events address topics central to the process of legislative collaboration, (2) the structure of the press event network is distinct from that of the most commonly studied congressional network – cosponsorship, and (3) press event ties are correlated with the two most substantial organizational forces in Congress – parties and committees. In this section we consider whether press event ties contribute to our ability to predict meaningful legislative behavior. Roll call voting constitutes what is arguably the most consequential and, as a result, most thoroughly studied behavior in the U.S. Congress and countless other legislatures. Scholars rely upon roll call votes to evaluate the ideological positions of legislators (Poole and Rosenthal, 1985, 1997), to assess the strength of political parties (Snyder and Groseclose, 2000, 2001; Aldrich and Rohde, 2001), and to evaluate the importance (Krehbiel and Rivers, 1988) and composition (Snyder, 1992) of committees. In this section we test whether network connections between senators, in the press events and cosponsorship networks in particular, predict similarity in senators' roll call votes. We present analyses on two different time-scales and with two related, but slightly different dependent variables – one at the level of the two-year congress predicting vote correlation and one at the monthly level predicting the co-voting rate. The two analyses represent two ends of the tradeoff between aggregating and accurately assessing voting overlap in the dependent variable (i.e., the congress-level analysis) and unpacking the PE→co-voting dynamics (the monthly analysis).

5. Congress-level analysis

Networks constitute relational data. As such, the most natural approach to evaluating whether networks predict voting is to infer the relationships between networks and voting similarity (e.g., it is not possible to directly relate the press event or cosponsorship network to the ideological predispositions of legislators, as

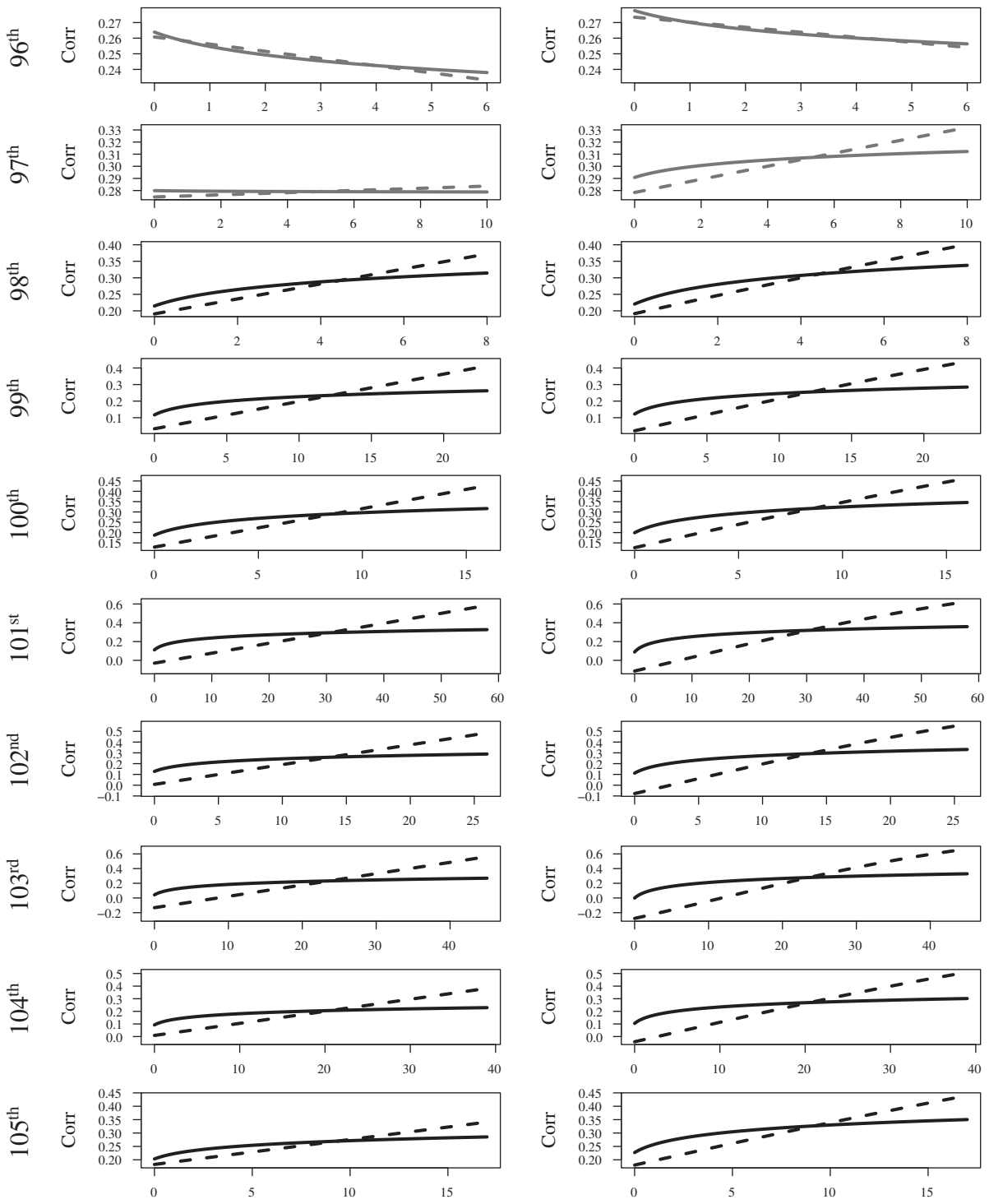

Fig. 6. Effect of senate press event ties on vote correlation. *x*-axis gives tie strength. Left column gives estimates with $[-1, 1]$ dependent variable, and right column gives estimates with $[-\infty, \infty]$ (logistic transformed) DV. Solid line is the log-transformed independent variable, and the dashed line is the linear transformed independent variable. Gray lines indicate non-significant relationships at the 0.05 level (one-tailed).

measured through roll call votes). For the congress-level analysis, we operationalize the similarity between two senators' roll call voting records as the the Pearson product-moment correlation coefficient between their roll call votes in a congress, with roll call votes coded 1 for Yea, Paired Yea, and Announced Yea; 0 for Announced Nay, Paired Nay, and Nay; and missing otherwise, based on Poole and Rosenthal's roll call vote data. Pearson's correlation coefficient is an established measure of association for binary variables, and is sometimes referred to as the *mean square contingency coefficient* (Pearson and Heron, 1913; Weida, 1927; Goodman and Kruskal, 1959). Our objective in the empirical analysis that follows is to test whether ties between senators in the press events network predict higher correlation between senators' roll call votes, adjusting for other factors that predict the correlation between roll call votes.

We use linear regression, estimated by ordinary least squares, to characterize the effects of the press event network and control variables on the correlation between senators' votes. The

unit of observation is the dyad-congress (i.e., an observation for each pair of senators in each two-year congress). We estimate a separate model for each congress from the 96th to 105th. Due to the relational structure of the dependent variable, and the resulting marked departure from the assumption of independent and identically distributed errors, specialized hypothesis testing methodology is required for statistical inference regarding the regression coefficients. Quadratic assignment procedure (QAP) (Krackardt and David, 1987) is a method of statistical inference that builds upon Mantel's (1967) permutation procedure and computes the statistical significance of parameter estimates when the dependent variable is itself a relational matrix (e.g., distance, correlation, network adjacency matrices). QAP is a form of non-parametric permutation testing in which row and column shuffles of the dependent and independent variables are used to simulate the null condition, which results in a simulated null distribution of regression coefficients. It has been used in a variety of studies to evaluate the statistical significance of correlation matrix structure (Cheverud et al., 1989; Nemeschkal, 1999; Romney et al., 2000).[8] We use the double semi-partialing algorithm for QAP proposed by Dekker et al. (2007). We run our models with two separate specifications of the dependent variable – one on the natural, −1 to 1 scale for the correlation, and one in which the dependent variable is specified as $\ln[((1+\rho)/2)/(1-(1+\rho)/2)]$, which transforms $[-1, 1]$ to $[-\infty, \infty]$ via the logistic function.

In the models we estimate, the main independent variable of interest is the measure of press event ties between senators, which we operationalize in two ways: first as the number of press events that both senators in a dyad attended during the two-year period of a congress, and in a second round of models as the natural logarithm of one plus the number of press events co-attended.[9] The log is taken to mitigate the influence of large outliers. We adjust for other potential predictors of the correlation between senators' votes, including an indicator of whether the senators in the dyad are both in the same political party, an indicator of whether the senators represent the same state, and the natural logarithm of the number of bills introduced during the congress on which both senators were cosponsors (plus one). These controls adjust for the influence of shared constituency, the effect of party organization and the effect of the most commonly studied form of congressional network – cosponsorship.

The results of the analysis are reported in Fig. 6 and Table 1.[10] Fig. 6 presents the effects of press event ties, over all 10 congresses, and the two independent and dependent variable specifications. Across specifications, there is a statistically significant positive relationship between press event ties and roll call vote correlation in the eight most recent congresses. The relationships we find are also quite substantively significant. The *x*-axis ranges of the plots in Fig. 6 span the range of co-attended press events in our data for the respective congress. We see that moving from the low point to the high point of this range corresponds to a move from a non-existent (i.e., <0.20) vote correlation to a moderate or strong correlation of 0.35–0.60. The magnitude and significance of the effects of press events provide a clear indication that joint press event activity offers predictive insights into roll call voting in the Senate above and beyond extant measures of legislative collaboration.[11]

Table 1
Control variable coefficients for regression models predicting the roll call vote correlation between senators. Dependent variable is the correlation coefficient on the $[-1, 1]$ scale. Coefficients reported are from the model in which the log of press events co-attended is included as the main independent variable. * indicates statistical significance at the 0.05 level (one-tailed) according to QAP with 1000 permutations.

Congress	Cosponsorship	Same party	Same state
96	0.1013*	0.2899*	0.1043*
97	0.0821*	0.4051*	0.1354*
98	0.0804*	0.3198*	0.1313*
99	0.0788*	0.3878*	0.1499*
100	0.0831*	0.4142*	0.0978*
101	0.0838*	0.3953*	0.0803*
102	0.0352*	0.5096*	0.1201*
103	0.1068*	0.614*	0.0722*
104	0.0915*	0.7861*	0.0521*
105	0.1752*	0.6429*	0.0095

The effects of the control variables are reported in Table 1. They relate to roll call vote correlation largely as expected. The votes of senators who cosponsor together, represent the same state, and are in the same party, vote similarly. There is some temporal heterogeneity in the results with respect to the effects of the controls. The same-state indicator exhibits a downward trend in the size and significance of its effect on co-voting. The magnitude of the same-party effect increases considerably over the time period under study, more than doubling from 96th to 105th.

5.1. Monthly analysis

The previous analysis established that, at the congress level, press event collaboration is robustly correlated with roll call vote correlation, adjusting for other factors that predict vote correlation. This, however, omits an important part of the legislative collaboration story. That is, if press events are actually "upstream" from more formal expressions of legislative collaboration, such as co-voting, then joint press events now should predict overlap in votes in the future. In the following analysis we model the monthly co-voting rate between senators. The unit of analysis is the senator-dyad-month. It represents a dynamic extension of the co-voting model presented in Table 1. For each dyad in the Senate in a given month, we model the proportion of votes on which the two senators in the dyad vote the same. This constitutes the dependent variable. As independent variables, we include three lags of the co-voting rate, three lags of the natural log of the number of joint press events, a same-party indicator, a same-state indicator, and both Congress and month fixed effects.[12] Due to the dyadic structure of the data, to construct confidence intervals for the coefficients, we use the temporal bootstrap proposed by Desmarais and Cranmer (2012).[13] The coefficients are estimated by ordinary least squares.

The results from the dynamic model are reported in Table 2. We find that joint press events have a statistically significantly positive effect on senator co-voting rates up to two lags out. Due to the substantial autocorrelation in co-voting, the press events coefficients are not directly interpretable. The impulse-response function, which accounts for the direct effects of the lagged covariates as

[8] Our co-voting analysis is quite similar in structure to that of Ringe et al. (2013). We depart from their approach in the way we conduct hypothesis tests (i.e., using QAP rather than parametric hierarchical modeling.)

[9] In all we estimate 40 models, four for each congress; with each combination of the count and log-transformed events co-attended and the $[-1, 1]$ and $[-\infty, \infty]$ scale dependent variable.

[10] We use 1000 iterations in the QAP.

[11] These findings are robust to including the ideological distance between legislators in the dyad as a control variable. We omit this variable due to endogeneity concerns, as it is measured – in the form of DW-nominate scores (Poole and Rosenthal, 1997) – using roll call votes.

[12] We do not include co-sponsorship, as we do not have data on the month of the cosponsorship activity. However, we are not concerned about omitted variable bias due to the several lags of the dependent variable included in the model.

[13] In this approach, time points (i.e., months) are re-sampled such that within-time dyads in the co-voting network are not assumed to be independent observations. Desmarais and Cranmer (2012) show that this approach provides confidence intervals with much better, and asymptotically correct, coverage probabilities, when compared with confidence intervals that assume independence among dyads.

Table 2
Dynamic model of senator dyad co-voting rate. OLS coefficients with temporal bootstrap confidence intervals reported. Sample includes 822,497 total observations spanning 214 months over the 96th–105th Congress.

	Estimate	2.5%-tile	97.5%-tile
Intercept	0.1697	0.0562	0.3622
Co-voting ($t-1$)	0.3164	0.2646	0.3660
Co-voting ($t-2$)	0.2074	0.1717	0.2491
Co-voting ($t-3$)	0.1293	0.0947	0.1726
Joint PE ($t-1$)	0.0376	0.0259	0.0472
Joint PE ($t-2$)	0.0223	0.0111	0.0335
Joint PE ($t-3$)	0.0081	−0.0028	0.0204
Same party	0.0650	0.0472	0.0826
Same state	0.0188	0.0142	0.0226

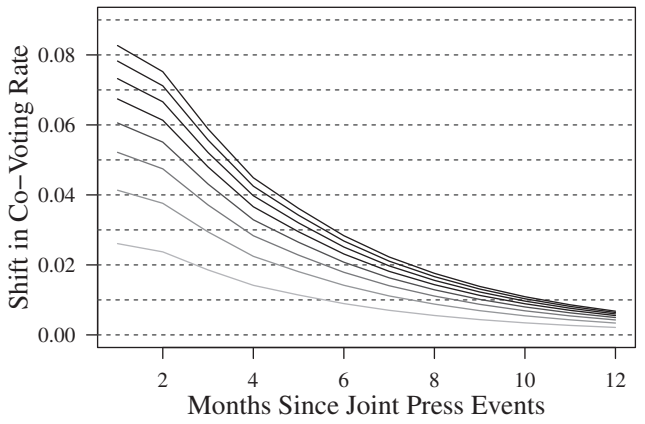

Fig. 7. Impulse-response functions. The different lines correspond to the number of joint press events, with darker and higher lines corresponding to larger numbers. The lines correspond to 1–8 joint events in a month, which spans the range of what we observe in our sample.

well as indirect carry-over effects from autocorrelation (Box et al., 2013), is more substantively informative. The impulse response function for joint press events is depicted in Fig. 7. Depending upon the number of joint press events held, joint press event activity is predicted to raise the co-voting rate by 3–8 percentage points in the month following the joint events, and persist in shifting the co-voting rate by more than 1% for 6–10 months. This time interval aligns quite well with the anecdote of Edward Kennedy and Orrin Hatch's efforts on the Children's Health Insurance Program that we discussed above. The press conference announcing the senators' proposal for CHIP was held on March 13, 1997. It was passed into law, as an amendment to the Balanced Budget Act, in June 1997. [14]

6. Conclusion

Legislation is often the end product of a lengthy collaborative effort, much of which precedes the introduction of a bill. In the context of network analysis, many scholars have recognized the value of studying directly the relational component of legislative processes. In this paper, we introduce the network of U.S. Senators defined by collaboration in press events, and we present a theoretical argument that outlines the strengths of joint press events as indicators of legislative collaboration. Unlike previously studied congressional networks, the press events network is relatively exclusive, and senators have incentives to limit, rather than maximize, the number of colleagues with whom they collaborate at any one event. Furthermore, in contrast with bill cosponsorship, press events are relatively costly to participate in because they require extended planning and coordination at both the member and staff level. Finally, unlike the routinized interactions associated with committee or caucus memberships, joint press events constitute a more fluid and less institutionalized legislative relationship. As a result, we argue that they reflect a particularly meaningful form of collaboration among colleagues.

Empirically, we demonstrate that the structure of the joint press event network introduced here is distinct and more subtle than that of previously operationalized congressional networks, which we argue are rather noisy indicators of the underlying concept – meaningful collaboration – in which we are interested. We find that, unlike cosponsorship, the community structure of the press event network cannot be explained through partisanship alone. Yet, we see the buildup in party polarization that preceded the "Republican Revolution" a full two congresses earlier in the press events network than in the cosponsorship network. Perhaps most significantly, we find that, controlling for other factors, press event ties are strong positive predictors of a highly consequential form of legislative behavior – roll call voting. Senators who collaborate in press events vote similarly – a relationship that emerges in all but the two earliest congresses in our data. And our dynamic analysis reveals that within congresses, joint press event activity raises the co-voting rate by 3–8 percentage points in the month following the event, an effect that persists for 6–10 months. This dynamic result supports our interpretation of joint press events as "upstream" indicators of legislative collaboration.

Taken together, our findings point to the value of incorporating joint press events – and/or other indicators of legislative collaboration that share similar properties – into future studies of polarization in Congress. Political scientists have relied on roll call voting records to document growing polarization, and efforts to understand the mechanisms driving polarization in the Senate have emphasized the relative contributions of membership replacement and behavioral change (Theriault, 2008; Theriault and Rohde, 2011; Bonica, 2014), as well as the changing strategies of legislative leaders (Lee, 2009; Sinclair, 1995). Yet the two mechanisms that have received the most attention from scholars – replacement and adaptation – have a bit of a "black box" element to them in that we know little about their impact on the sorts of sustained, meaningful collaborative efforts that characterize the contemporary lawmaking process. The joint press events network, however, sheds new light on precisely these sorts of collaborative relationships. Press events involve inter-office planning and coordination that often occur long before legislation is even introduced, much less voted on. As such, it is not surprising that polarization in this network turns out to be a leading indicator of polarization in the cosponsorship network. Absent meaningful bipartisan collaboration "upstream" in the legislative process, there is little reason to expect bipartisan support for legislation at points farther "downstream" (e.g., cosponsorship and eventually, voting). Thus, analyses of collaborative relationships may hold the key to determining whether the collapse of bipartisan collaboration led to polarization or polarization led to the collapse of bipartisan collaboration.

Finally, since much of the coordination and planning of joint press events falls to the legislative staff, we believe analyses of the staff network could be a natural future direction for the study of legislative networks. In their discussion of members of Congress as "enterprises," Salibury and Shepsle describe "'alumni networks' composed of people who once worked for a member and now work elsewhere on the Hill, but continue to carry the more or less clearly acknowledged blessing of their erstwhile principal" (Salisbury and Shepsle, 1981, pp. 561–562). However, while network analyses of staff mobility between and among offices, committees, and chambers (and ultimately to executive branch, think tanks, or

[14] As with the congress-level analysis, we re-ran these models with the ideological distance between legislators. We still find statistically significant effects of joint press events out to two lags, and the impulse response functions are very similar.

lobbying shops) are at least feasible given existing data and disclosure requirements, collecting data on social connections among legislative staff across offices, committees, and chambers would prove much more difficult. In fact, in their attempt to measure actual social connections among staff members, Ringe et al. (2013) achieved just a 47% response rate among staff of a single committee of the European Parliament despite extensive efforts to maximize the number of respondents from that rather narrowly defined population. The subterranean nature of many professional staff-level interactions on the Hill, combined with likely low response rates to surveys attempting to document informal, social ties among staffers, would no doubt prove to be a substantial, perhaps insurmountable, hurdle to such a study. But the insights to be gained from such an endeavor would certainly be substantial.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.socnet.2014.07.006.

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