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Centrality in Politics: How Networks Confer Power

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Abstract

A traditional view of power in politics is that it comes from the possession of important resources. The

relative possession of resources is thought to provide actors such as people, organizations, and states with

means of coercion or influence over others. This traditional view is highly limiting, since power also

comes from ties (patterns of association) that link together actors in networks. These ties, whether

material (like trade flows) or social (like friendship), determine an actor's ability to have access to, make

connections between, or quickly spread resources to, other actors. An actor's relative position in a

network formed by these ties thus provides another important source of influence over others. In this

article, we introduce three classes of network centrality positions (degree, betweenness, and closeness),

explain the advantages of each, and demonstrate that network notions of power that derive from centrality

can significantly inform the study of politics.

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[1] The authors share equal responsibility for this paper and their names appear in alphabetical

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INTRODUCTION

A traditional view of power in politics is that it comes from the possession of important resources. The relative possession of resources is thought to provide actors such as people, organizations, and states with means of coercion or influence over others. This traditional view is highly limiting, since power also comes from ties (patterns of association) that link together actors in networks. These ties, whether material (like trade flows) or immaterial (like friendship), determine an actor's ability to have access to, make connections between, or quickly spread resources to, other actors. An actor's relative position in a network formed by these ties provides another important source of influence over others.

Power thus comes not only from the relative acquisition of important resources but also from an actor's relative position in networks due to enduring sets of ties to other actors (Hafner-Burton, Kahler, and Montgomery 2009). These ties determine an actor's importance (or centrality) in networks independent of the individual possession of resources. Different centrality positions confer actors with different forms and degrees of power in a network. In this article, we introduce three classes of network centrality positions (degree, betweenness, and closeness), explain the advantages of each, and demonstrate that network notions of power that derive from centrality can significantly inform the study of politics. Although our examples are from international politics, the principles of network power through centrality span across field boundaries.[2]

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[2] For example, in American Politics, centrality has been found to be important in the US Congress (Fowler 2006a, 2006b, Heaney and Rojas 2007) and Supreme Court (Fowler and Jeon 2008, Fowler, et al. 2007).

ADVANTAGES OF NETWORK CENTRALITY

Some actors are more central in networks than others: they are involved in many relationships with other actors. Network centrality creates political advantages from three classes of relationships. The first class of political advantage, degree centrality, comes from possessing a large number of strong ties (close relationships) to other actors in a network. This pattern of ties gives an actor direct *access* to other important actors. The second class of political advantage, betweenness centrality, comes from linking together individuals, groups, or even entire networks of actors that have few other ties between them. Being in this position gives those actors the ability to *broker* relationships between parties that lack other connections. The third class of political advantage, closeness centrality, comes from being proximate to (only a short number of ties away from) any other actor in the network. If an actor is able to minimize the number of steps required to reach all other actors, that actor can potentially acquire and transfer resources more *efficiently* than other actors in the network. To illustrate, Figure 1 depicts three sample networks, each of which demonstrates a different class of centrality.

Access by degree centrality

--Insert Figure 1 and Table 1 about here--

In network A, State 1 has more ties than any other state in the network. State 1 thus has a higher *degree centrality* than any other state. In networks, resources (whether ideational or material) are transferred through ties, linkages between actors whose magnitude is proportional to the frequency, duration, and intensity of interaction. State 1 is thus less apt to be dependent on other states for resources than State 2 because their density of ties to other states provides them with multiple ways to give out or take in resources. If State 4 does not provide a resource, State 2 or 5 might, while State 2 is left in the lurch if State 1 refuses to provide it.

In the real-world network of preferential trade agreements (PTAs), for example, France had a degree centrality several times that of Poland in 2004. This is because France belonged to PTAs with many more states than Poland did, and thus had potential *access* to more states in the trade network. This

access provided more opportunities for France than Poland to exchange resources that flow through the trade network, including imports, exports, investment, and information. Access, in turn, gave France more political power than Poland in this network by allowing them to better amass and control trade resources. Advantages such as access help explain why states with high degree centrality in the PTA network are much more likely to use their PTA access to coerce others by imposing economic sanctions—they have more opportunities to coerce others and they have more avenues for taking in resources if any single trade relationship becomes contentious (Hafner-Burton and Montgomery 2008; 2009).

Brokerage by betweenness centrality

In network B, Organization 1 is the only one with connections to Organization 2. To exchange resources with Organization 2, Organization 3 must go through Organization 1. Organization 1 thus has higher *betweenness centrality* and is consequently possesses brokerage power. Other organizations that want to transfer resources to or from Organizations 2, 3, 4 or 5 must do so through Organization 1, which can allow, withhold, or distort incoming and outgoing resources.

In the real-world network of human rights non-governmental organizations (NGOs), Amnesty International (AI) is a broker. Although AI and Human Rights Watch (HRW) are both important in the network of NGOs, AI has a betweenness score five times that of HRW, and so has more ability to *broker* coalitions or the exchange of resources between other less-connected NGOs (Brewington, Davis, and Murdie 2009). This brokerage capacity, in turn, gives AI more power in this network than HRW, by allowing them to better control the flow of important resources, such as information, money and members, to and from other NGOs. These political advantages help explain why NGOs like AI that have substantial brokerage capacity dominate agenda setting and are more effective at "naming and shaming," shaping global governance, or arranging for disaster relief than other NGOs.[3]

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[3] Brewington, Davis and Murdie 2009, Carpenter 2007a, 2007b, 2009, 2010, Lake and Wong 2009, Moore, Eng and Daniel 2003.

Efficiency by closeness centrality

In network C, Person 1 is more proximate to more people than Person 3. Person 1 thus has higher

closeness centrality. They are more able to quickly spread and receive resources than Person 3 because

their proximity to other people allows them to reach more people more quickly. This capacity for greater

efficiency, in turn, gives them power in the network. More than any other person, they can collect and

disseminate information or other resources to and from a wider audience. They also have a first mover

advantage because they can give out resources, such as information or money, more quickly and to more

people in the network than any other actor.

In the September 11th hijackers' network, Mohammed Atta had the highest closeness score of any

of the other 18 hijackers—or, for that matter, anyone in their extended network (Krebs 2002). This

position gave Atta the ability to obtain and spread instructions, material resources, and information more

efficiently to the rest of the hijackers in the network than any other hijacker. Capturing him would have

significantly impaired the efficiency of the remainder of the network, contrary to the popular idea that

terrorist networks are amorphous and highly resistant to attack. Atta was a powerful actor in his network.

NETWORK CENTRALITY

These political advantages—access, brokerage and efficiency—created by high network

centrality—degree, betweenness and closeness—can translate into three "faces" of political power.[4] In the

first, an actor has various capabilities to coerce another actor to do something they would otherwise not

do (Dahl 1957). In the second, an actor has capacities to prevent grievances from being aired through

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[4] For an extended discussion of why, see Hanneman and Riddle 2005, Chapter 10. For an early

discussion of power exerted through networks in world politics, see Stoll and Ward 1989, Ward and

House 1988. For a general discussion and history of power through relations in sociology, see Cook and

Yamagishi 1992, Emerson 1962. On social capital and networks, see Borgatti 2006, Borgatti, Jones and

Everett 1998.

setting or shaping agendas and deciding who sits at the political decision making table (Bachrach and Baratz 1962). In the third, an actor can manipulate the desires, interests, and identities of another actor (Lukes 1974).

For the first face of power, central network positions provide an actor, such as a state, various capacities to coerce another actor to do something they would otherwise not do. In the same way that a materially powerful state can use or threaten military force to intimidate another state into taking certain actions, forcing governments to withdraw from captured territories, a centrally powerful state can pressure another state into doing what they want by withholding, controlling, or using valuable network resources, such as aid, trade, or information.[5] The denser an actor's network ties to other actors (the more degree central they are), the more potential access and therefore power they have to manipulate the flow of resources to others. If they are in a brokerage position (due to high betweenness centrality) between two parties, the actor can withhold valuable resources coming in from other actors, shutting actors in one group out from the benefits of the other group, such as membership in certain organizations, intelligence information, or trade. If they can quickly put out resources into or receive resources from the network (due to high closeness centrality), they can also hurt other actors, spreading unfavorable information throughout the network to give them a bad reputation or isolate them, receiving information about the target's vulnerabilities quickly, or sending weapons and intelligence to the target's enemies. Bad network reputations and threats of isolation are weapons; they may operate in much the same way as threats of force or economic coercion, imposing costs that would otherwise not be there on target actors and that compel them to do things they otherwise would not do.[6]

[5] Network centrality can also be used to reward as well as punish, of course; access can be used to redirect resources to a favored target, brokerage is crucially important in bridging differences through negotiation, and efficiency can be used to quickly supply assistance.

[6] For example, in terrorist networks, the main leaders tend to have high degree, closeness, and betweenness centrality, and thus get to decide who does what and when, where, and how to strike, while

The same logic applies to the second face, agenda setting power. Actors with centrally located network positions can leverage their centrality to prevent other actors from participating in certain political decisions or decide what gets put on negotiation agendas. For example, in legislative bodies, the ability of a representative to shape who gets to speak and who is silenced is affected by that representative's capacity to mobilize support for their positions, in terms of their direct access to other decision makers in the network (degree centrality), their ability to broker agreements between decision makers or parties (betweenness centrality), and the speed with which they can exchange information with other groups (closeness centrality). All three of these are associated with legislators' ability to pass amendments.[7] The representative's density of ties with others in the network assists in this mobilization and can boost their ability to set agendas by mobilizing the most support for their issues from other actors, by keeping some actors out of the discussion or by shaping the agenda first.

The ability to define interests and identities is the third face of power; in a network, this is a function of how many other actors are receiving this information. The more ties an actor has to a broad audience in the network (degree centrality), the more conduits it has to manipulate the interests or identities of other actors in the network. Brokers (betweenness centrality) are in a special position to control information to and from other actors that rely on them, while actors that can efficiently spread norms (closeness centrality) can more quickly shape others' identities and interests. Actors exercise this form of power in networks through manipulating identity by speaking multivocally; that is, using language that can be interpreted by different parts of a network in a different fashion. Having direct and efficient access to many different coalitions while remaining in a brokerage position can allow for consolidation of rule in domestic or international politics.[8]

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suicide bombers are generally marginal actors with low scores on all three measures. See, for example, Pedahzur and Perliger 2006.

[7] For an empirical example of this in Congress, see Fowler 2006a.

[8] On multivocality and the manipulation of identity and interests in networks, the classic study is

Network Analysis as an Approach

Our proposition is that holding a central position in a network gives an actor more potential power to coerce others, set agendas, and manipulate interests and identifies than holding an isolated position–whether that position was arrived at deliberately or not. Network analysis offers practical tools to measure these potential power sources and their distribution in any system of actors. It concerns relationships defined by ties among nodes (or actors). Nodes can be individuals such as people or corporate actors such as organizations and states. Ties can be conduits for the exchange of material resources (for example, weapons, money, drugs or disease) or non-material resources (for example, information, beliefs, and norms). Network analysis examines the associations among nodes in addition to the attributes of particular nodes because relationships are not properties of actors but of systems of actors (Scott 2000). While this study is necessarily limited in scope to the effects of powerful network positions, network analysis can also analyze the creation and growth of networks through processes of selection and contagion. We make no assumptions about which processes dominate network creation.[9]

Like rational choice approaches, network analysis is not a unified set of theories about behavior but rather a framework for analysis based on a set of assumptions and tools that can be applied to an assortment of behaviors. It is grounded in three principles: nodes and their behaviors are mutually dependent, not autonomous; ties between nodes are channels for the transmission of resources; and persistent patterns of association among nodes create structures that can define, enable, or restrict the behavior of nodes. The underlying difference between network analysis and standard ways of analyzing behavioral processes is accordingly the use of concepts and indicators that identify associations among units rather than solely focusing on the attributes of the units (Wasserman and Faust 1994, p. 4).

Padgett and Ansell 1993; on an international scale, see also Goddard 2009.

[9] See Hafner-Burton, Kahler and Montgomery 2009. Recent agent-based statistical models combine allow for a variety of mechanisms for tie creation Snijders, van de Bunt and Steglich 2009.

Networks are defined as any set or sets of ties between any set or sets of nodes; no assumptions are of necessity made about the homogeneity or other characteristics of the nodes or ties. Consequently, network analysis can be used to analyze any kind of ties, including market or hierarchical transactions. Beyond these basic principles, network analysis enables calculation of structural properties, such as centrality of nodes, groups, or the entire network.[10]

Network Approaches versus Traditional Approaches

A network approach complements traditional approaches to power politics but also differs on crucial points. First, most traditional approaches derive power from an actor's possession of resources relative to other actors. Power is thus measured by asking how much of a resource two actors have relative to each other or how much of a resource an actor has relative to the distribution of that resource across multiple other actors. For example, in international relations, structural realists argue that power in the international system is an emergent property of the distribution of capabilities among all states: "Power is estimated by comparing the capabilities of a number of units" (Waltz 1979, p. 98). A network approach derives power from an actor's ability to transfer and receive resources in a network, which is determined by the ties between actors. This allows power to be measured in a network by looking at the distribution of ties to determine which nodes have the greatest access to other nodes, are in the most advantageous positions to broker compromises, or can efficiently route resources through the system. Like traditional approaches, these measures must be combined with domain-specific theory to determine the relevant related variables. For example, if a less-socialized country is hypothesized to be more war-

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[10] For a good overview of network analysis, see Scott 2000; the most comprehensive, if slightly dated, technical overview is Wasserman and Faust 1994. For recent additions to Wasserman and Faust, see Carrington, Scott and Wasserman 2005. For a much more concise and up-to-date reference, see Knoke and Yang 2008. A useful online textbook is Hanneman and Riddle 2005. For an historical overview of the development of the field, see Freeman 2004.

prone, then in a given dyad, the minimum of those two countries' centrality measures in a socialization network would be the relevant measure.

Second, most of the traditional approaches focus on the material sources of power—usually on force or economic capabilities. A network approach, by contrast, derives power from actor ties, which are channels for the transfer of any kind of capability or valuable resource, including material capital, such as weapons or bananas, and non-material capital, such as information or norms. The approach is neutral as to which types of capital acquisition and transfer "matter" most in politics; here, we develop tools to analyze all types of exchange relationships but say nothing *a priori* about which capital types will be most influential. We argue only that power can be derived from resource conduits. It is not a senator's wealth that determines whether they sponsor a bill or offer an amendment, but rather their ties of friendship and favor through working together on previous bills that determines whether they work together on future legislation. Our approach can thus inform theories that focus on material or non-material sources of power, including information and norms.

Third, most standard approaches assume that any form of power other than those resulting from force or purchasing capabilities is a derivative of these possessions. In other words, wealth and brute force determine an actor's centrality. Our approach does not make – and allows for a test of – this assumption. Power derived from centrality is not of necessity a derivative of individual ownership of resources. Sometimes, one form of power follows from the other. For example, a state with a powerful economic market may also be highly central to some information networks in international relations. A charismatic and wealthy insurgent leader may be able to create more ties and thus be more central than those lacking such characteristics. Other times, there is a tradeoff between forms of power. A state may be militarily powerful because it possesses nuclear weapons but be centrally weak in an important network because its possession of this weapon has left it marginalized, with few positive relationships to other states or with diplomatic relationships managed only through a third party broker, which lessens its capacity for global political influence. An insurgent may be charismatic and wealthy but lack centrality in a social network that values different attributes, such as religion, ethnicity, or class. Often ties are created not as a result of

attributes but due to previously existing ties or networks of a different nature, just as smuggling networks can be used for more than one product. As an empirical matter, standard power measures in many cases will explain little of the variation in measures of network access, brokerage and efficiency.

CENTRALITY IN NETWORK SYSTEMS

The centrality of a node in a network can take various forms. We discuss measures for each family of centrality measures—degree, betweenness and closeness. We begin with the simplest form of each measure, show how they can be measured, then discuss more complex and nuanced variations. In all three measures, we deal with undirected (symmetrical) cases, in which the value of the tie from actor i to actor j is the same as the tie from actor j to actor i. In most cases, these measures can be generalized to the directed, asymmetrical case as well.[11]

Degree Centrality

Degree central actors are those actors in a network that have the most ties to other actors. An actor's degree centrality can be measured by simply totaling up the number of direct connections they have. For example, in Figure 1A, State 1 has the highest degree centrality in the network. If x_{ij} is the strength of the tie between actors i and j, then the degree centrality of actor i is:[12]

$$C_D(n_i) = \sum_j x_{ij}$$

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[11] Networks can be either directed – where resources can only be transferred through a tie in one direction – or undirected – where resources can flow both ways. In this article we consider centrality in undirected networks because they are the most general. Some of the concepts we discuss in this section, such as eigenvector centrality, are not appropriate for directed networks.

[12] Wasserman and Faust 1994, p. 178

High degree centrality gives this state more access to other actors in this network, and thus more potential power. State 1 is a central conduit for gathering or spreading information or other resources. They are less dependent than other actors in this network because they have more choices. In this network, State 1 has higher degree centrality than State 2 and thus is more powerful than 2, who is more peripheral in the network.

Degree centrality only measures the number and strength of direct connections to an actor. Yet better access often results from being connected to other actors who are also well-connected; being connected to many poorly-connected actors will give an actor access to those particular actors, but will not give that actor much influence in the overall network.

In Figure 1, State 1 has a degree centrality of .75. But degree centrality counts being connected to State 2, an isolate, and State 4, who is connected to State 3 as well, identically for the purposes of calculating State 1's centrality. A variant on degree centrality, eigenvector centrality, derives an actor's centrality from how many connections they have in the network and how many connections those actors have to others. The eigenvector centrality of a node x is proportional to the sum of the eigenvector centralities of all of the nodes it is connected to. If λ is the largest eigenvalue of the valued adjacency matrix x_{ij}, then the eigenvector centrality of actor i is:[13]

$$C_E(n_i) = \frac{1}{\lambda} \sum_j x_{ij} C_E(n_j)$$

Betweenness Centrality

Another way to measure actor centrality is betweenness—an actor is central if their position in the network lies on the shortest (geodesic) path between many other actors. This measure assumes that actors prefer to make connections by choosing one of the shortest pathways, and that they are equally

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[13] Bonacich 1987, p. 1172. This can be generalized to cases where being connected to weakly connected actors is a source of power as well.

likely to choose any of the shortest pathways. If g is the number of nodes, g_{jk} is the number of geodesics linking actors j and k, and $g_{jk}(n_i)$ is the number of geodesics that contain node i, then the betweenness centrality for node i is simply:[14]

$$C_B(n_i) = \sum_{j<k} g_{jk}(n_i)/g_{jk}$$

This can be standardized to the range (0,1) by dividing it by the theoretical maximum, which is the number of pairs of actors, excluding node n_i, in the graph:

$$C'_B(n_i) = \frac{\sum_{j<k} g_{jk}(n_i)/g_{jk}}{[(g-1)(g-2)/2]}$$

For example, in Figure 1, Organization 1 has a betweenness centrality of 1, while the other nodes have betweenness centralities of 0: Organization 1 is the sole broker. Other organizations must go through them if they want to make connections in the network.

The basic betweenness centrality measure assumes that actors that fall on one of the shortest pathways between other actors have a network advantage because others depend on them to broker information or resources. However, actors in a network might prefer some short pathways to others or might select a longer pathway if brokers are unwilling or exploitative. Some pathways may also have more capacity to transfer resources than others. The flow approach derives an actor's betweenness centrality from the capacity of every pathway that connects each actor to other actors. The maximum flow m_{jk} between two actors j and k is the minimum of (1) the direct flow out of j and into k and (2) the capacity of each path between the intermediate actors, where the capacity of a series of ties is equal to the

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[14] Wasserman and Faust 1994, p. 190

strength of the weakest tie. If $m_{jk}(n_i)$ is the maximum flow between j and k that passes through node i,

then where $j<k$ and $i \neq j \neq k$, then the flow betweenness of node i is:[15]

$$C_F(n_i) = \sum_{j}^{g} \sum_{k}^{g} m_{jk}(n_i)$$

This is standardized to the range (0,1) by dividing it by the total flow between all actors where

actor i is neither a origin nor a destination:

$$C'_F(n_i) = \frac{\sum_{j}^{g} \sum_{k}^{g} m_{jk}(n_i)}{\sum_{j}^{g} \sum_{k}^{g} m_{jk}}$$

Closeness Centrality

Distances between actors might affect relationships. Degree centrality only considers the number

of relationships an actor has to others, while Closeness centrality considers the distance between actors.

For example, in Figure 1, Person 1 has the highest closeness centrality because they have the shortest

mean pathway to the other actors. Person 3, by contrast, has the lowest closeness centrality because the

pathways to other actors have longer geodesic distances. If $d(n_i,n_j)$ is the number of links in the geodesic

linking actors i and j, then the closeness of actor i is:[16]

$$C_C(n_i) = \left[\sum_{i \neq j}^{g} d(n_i,n_j) \right]^{-1}$$

This can be normalized by multiplying it by the number of nodes in the graph other than node i:

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[15] Freeman, Borgatti and White 1991, p. 148

[16] Wasserman and Faust 1994, pp. 184-5

$$C'_C(n_i) = (g-1)\left[\sum_{i \neq j}^{g} d(n_i, n_j)\right]^{-1}$$

If the speed of exchange varies by geodesic distances, then high closeness centrality gives Person 1 the ability to communicate or transfer resources more efficiently than other actors in the network. This ability can translate into power. Person 1 can send a message to Person 4 faster than any other actor can. Person 1 can receive information from Person 2 more quickly than Person 4 or 5. And they can transfer resources more quickly. Person 1 thus has a structural advantage in the network because they can reach more people more quickly than any other actor.

Closeness centrality only considers geodesics, not the number of paths, nor does it weight the paths by how likely resources are to travel along particular paths. Information centrality is based on the quality of information from each path between two nodes; the longer the path and the lower the capacity, the less reliable that particular path is likely to be. To calculate information centrality, first a matrix A is created. If x_{ij} is the strength of a tie between actor i and actor j, then

$$a_{ii} = 1 + \sum_{i \neq j} x_{ij}; a_{ij} = 1 - x_{ij}$$

The matrix A is then inverted ($B = A^{-1}$); the information centrality of node i is then:[17]

$$C_I(n_i) = \frac{1}{b_{ii} + \left(\sum_{j=1}^{n} b_{jj} - 2\sum_{j=1}^{n} b_{ij}\right)/n}$$

This can be normalized by dividing it by the total information centrality of all nodes:

$$C'_I(n_i) = \frac{C_I(n_i)}{\sum_i C_I(n_i)}$$

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[17] Stephenson and Zelen 1989, p. 12

APPLICATIONS TO POLITICS

Political scientists can use these and related measures of network centrality to test theories about how networks create and affect politics, whether through coercion, agenda setting and interest or identity changes inside a network. In this section, we highlight three examples where a network centrality approach informs existing exemplary research by offering new insights into politics. In each of these applications, we use the original methodology and add or substitute the appropriate network measure. Ideally, network models include the dynamics of the network itself, treating the evolution of the network as endogenous; however, this is beyond the scope of this paper, and in order to produce results that are as directly comparable as possible to the original results, we limit ourselves to replication and extension.[18] Additionally, many networks suffer from missing data. While the networks we use here are either not sampled (in the case of most of our networks) or missing values have been imputed to deal with missing data (in the case of the trade network), centrality measures are sensitive to missing data, and proper procedures must be followed in order to maintain validity.[19] Finally, while most of our analyses here use binary connections (whether an alliance exists or not, whether a state belongs to an international organization or a preferential trade agreement, and whether two states have any trade), these measures are generalizable to valued flows as well.

Degree Centrality and Access

It is a long-standing controversy whether or not joint memberships in international organizations (IOs) reduce violence between states. On one side of the controversy are scholars that argue IOs stave off wars between members. They allow states to communicate information and facilitate bargaining, provide states with mechanisms to make credible commitments and resolve disputes, and expand states'

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[18] For an introduction to models that include full network dynamics, see Snijders, van de Bunt and Steglich 2009.

[19] Costenbader and Valente 2003

understandings of identity and self-interest.[20] On the other side of the controversy are scholars that see IOs either as epiphenomenal or as exacerbating conflicts between members by increasing competition over resources and aggravating longstanding differences.[21]

In a seminal article, Jon Pevehouse and Bruce Russett (2006) propose a theory about IOs composed mainly of democracies. They argue that densely democratic IOs are far more likely to bring about peaceful relations between members than are IOs with a smaller proportion of democracies. Their theory is that these particular organizations reduce the likelihood of conflict in three possible ways: allowing states to make credible commitments that can prevent conflict by monitoring members' behavior and preventing autocratic backsliding; providing dispute settlement and mediation mechanisms to prevent or resolve conflicts before they escalate; or socializing members to trust each other and find peaceful alternatives to deal with potential conflicts.

To test their theory, Pevehouse and Russett measure IOs from 1885 to 2000, counting joint dyadic membership in IOs whose members' average level of democracy is equal to or greater than 7 on the Polity scale (a commonly used scale to measure democracy). Their statistical results show that the more joint memberships in IOs composed of democracies, the less likely it is that the states in the dyad will engage in fatal militarized international disputes. From these results, the authors conclude that densely democratic IOs help quell violent conflict between member states in ways that other IOs do not. Pevehouse and Russett use this measure of democratic IOs as a proxy for all three causal mechanisms and acknowledge that their statistical results cannot explain how democratic IOs help keep the peace or identify which causal process is operating.

[20] Dorussen and Ward 2008, Keohane and Martin 1995, Martin and Simmons 1998, Oneal, Russett and Berbaum 2003, Oneal and Russett 1999, Russett and Oneal 2001, Russett, Oneal and Davis 1998

[21] Boehmer, Gartzke and Nordstrom 2004, Hafner-Burton and Montgomery 2006, Mearsheimer 1994, Ward, Siverson and Cao 2007

A network approach can help to unpack the causal power processes at work. We concentrate here on socialization, a form of interest or identity manipulation. According to their theory, IOs can act as norm entrepreneurs, socializing member states by defining interests and building trust and a sense of mutual identity—here, the actor of socialization is the IO.[22] States might also be susceptible to socialization in all of the democratic IOs that they belong to, not just the ones that they specifically share with a given state. Consequently, a centrality approach can provide an alternative measure of the extent to which a state has been (or could be) socialized by IOs to democratic norms.

We cannot measure socialization directly, but we can measure the probability that any particular state (or other actor) is more or less subject to socialization in a network. Socialization requires direct access: it is a process whereby an actor imparts a personal identity to another actor and teaches them norms, values, behaviors, and social skills appropriate to their social position.[23] Here, we assume that effect is proportional to the access that other influential actors have on that actor. In networks, the direct access that actors have to each other is measured by degree centrality. We consequently use degree centrality to measure socialization (or the probability of being socialized) in this network.

We create two measures. To gauge the potential for socialization of states by IOs (what some scholars refer to as the power of IOs), we create the variable *Democratic IO Socialization* equal to the total number of incoming ties from democratic IOs for each state (i.e., the number of democratic IOs they belong to). It is also possible that states as well as (or instead of) the IOs are the actors of socialization— that they socialize each other through interactions in IOs, independent of the character of the IOs themselves. In this case, states that are more influential themselves should be more likely to successfully socialize others; since this access is amplified by the extent that individual states are, in turn, themselves influential, the best measure to use for potential state socialization through IOs (rather than by IOs) is eigenvector centrality. We measure this second potential socialization effect—by democratic states

[22] Also see Greenhill 2010

[23] Definition from: http://dictionary.reference.com/browse/socialization

through IOs—as the eigenvector centrality of the IO democracy network.[24] A tie in this network between two states is calculated as the number of shared IOs both states belong to, multiplied by .5 if one state is a democracy (has a Polity score equal to or greater than 7) and by 1 if both states are democracies. This results in the variable *Democratic State Socialization*. In both cases, we hypothesize that a weak-link mechanism operates: the extent to which either socialization mechanism could dampen down conflict depends on the less-socialized member of a dyad.

Figure 2 illustrates the distribution of the values of these two variables relating socialization, IOs, and conflict—potential for democratic IOs to socialize states and potential for democratic states to socialize other states through IOs. The number of incoming ties for each state indicates the number of democratic IOs each state belonged to in 1950 (e.g., Switzerland has 3, while Turkey has 2). The node size is proportional to the eigenvector centrality of each state in the network the same year. Some states are potentially open to socialization by multiple democratic IOs, but have a low eigenvector centrality (such as Pakistan and Sri Lanka), whereas others are prominent in the network but possess few democratic IO ties (e.g., Norway). Are Pevehouse and Russett's findings evidence of socialization at play, or some other mechanism? We can use these centrality measures to unpack the socialization mechanisms in their argument and test whether it is simply the IOs themselves, ties made between democratic states through IOs, or both that may change the interests of members and dampen conflict.

--Insert Figure 2 about here--

Table 2 shows our findings. Model 1 of Table 2 replicates Pevehouse and Russett (2006) (their Model 1 on page 984); the dependent variable is the onset of a militarized dispute between two states in which at least one fatality occurs.[25] Model 2 substitutes the degree centrality of states in the IO network for the number of joint democratic IOs, demonstrating that states with greater total number of incoming

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[24] Note that the eigenvector centrality of one mode (here, states) in a two-mode network (states and IOs) can be calculated by calculating both simultaneously. See Bonacich, Holdren and Johnston 2004

[25] Following them, we use a logit model and lag the dependent variable by one year.

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ties from democratic IOs are less likely to engage in militarized disputes. Model 3 substitutes the eigenvector centrality of states in the network, demonstrating that states with greater eigenvector centrality are also less likely to engage in disputes. Model 4 is a simultaneous test of Pevehouse and Russett's dispute resolution and monitoring mechanisms (using their measure of Joint Democratic IOs) and potential state socialization though IOs, while Model 5 tests both socialization pathways simultaneously, finding that both are still significant, if slightly diminished. Due to the high correlation between the number of joint democratic IOs and democratic IO socialization (0.8172), a direct test of which of these two causal pathways dominates is not possible.

--Insert Table 2 about here--

All three effects—IO dispute resolution and monitoring, potential IO socialization, and potential state socialization through IOs—are statistically significant. Since the first two cannot be run together in a single model, we used the models where each was tested separately to determine substantive significance. In each case, we compared the base rate of fatal MIDs to the rate when the variable of concern was raised from the median to the 95% level.[26] Joint democratic IOs decreased the probability of a fatal militarized dispute by 14% in Model 1, minimum IO socialization decreased it by 24% in Model 2, and minimum state socialization through IOs decreased it by 45% in Model 3.

Degree and eigenvector centrality measures shed new light on Pevehouse and Russett's theoretical model, providing a way to measure the socialization mechanism as distinct from the credible commitment or dispute settlement mechanisms. The authors' original results hold up: the relationship between democratic IOs and conflict is negative and statistically significant. However, the new results also show that the relationships between conflict and minimum degree centrality of states in the democratic IO network, as well as minimum eigenvector centrality of states in the democracy network,

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[26] We chose the 95% level due to the asymmetrical distribution of democratic IOs. At median, the number is 0; at 95%, 3 (e.g., Switzerland in Figure 3); at maximum, 47.

are negative. In other words, both democratic states and democratic IOs may be shaping the interests of other states in the network in ways through access power that reduce conflict.

The measures we have developed here are generalizable ways to gauge the potential for socialization and other forms of interest manipulation in any network, including networks made up of individual people or organizations.

Betweenness Centrality and Brokerage

Many important historical and contemporary international actors, such as empires, dependencies, and protectorates interact with each under hierarchical, rather than anarchical, relationships. In these relationships, one state subordinates some or all of its sovereignty to a dominant state in exchange for social order. David Lake (2007; 2009) develops a groundbreaking theoretical framework for identifying and understanding hierarchies. His theory is that the legitimate authority of the dominant state in a hierarchy relationship rests on the provision of a stable international social order for the subordinate, lessening their need to spend on defense. To test his theory, Lake measures alliance hierarchies from 1950 to 2000 by counting up the number of alliance partners that each subordinate has that are not also partners of the dominant state—in this case, the United States. He divides 1 by this number to produce a measure of hierarchy vis-à-vis the United States, where higher values represent fewer independent (or politically autonomous) alliances and thus greater hierarchy. He uses this measure in statistical analysis to show that states subordinate to the United States in international alliance hierarchies are likely to spend less on defense.

Lake's analysis derives hierarchies from states' network positions. His measure of alliance hierarchies is closely related to a network concept (structural similarity) that is best used to determine whether two actors hold similar network positions rather than whether one actor is dominant over the other. Structural similarity is related to his theory,[27] but network centrality, and in particular flow

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[27] Lake uses a measure derived from an intermediate step in the process of calculating the "S"

betweenness centrality, offers a better fit between Lake's theory of international hierarchy and his empirical tests and provides for generalization.

In Lake's theory, hierarchy is present when the subordinate state has either weak or no independent ties to other states. In these situations, the subordinate state must rely on its ties to the dominant state when interacting with other states. In other words, the dominant state is the broker between the subordinate state and other states (Nexon and Wright 2007), acting on the subordinate state through the first face of power, decreasing that state's defense expenditures to a level below what that state would otherwise in a state of anarchy. In networks, brokerage power is measured through betweenness centrality-type measures. In this case, the most appropriate measure to test this theory is flow betweenness centrality, since it considers all possible paths for brokerage instead of simply the most direct ones.

Figure 3 illustrates the advantages of using flow betweenness to measure hierarchy. In 1950, the United States was the sole broker between European and Latin American countries. While Lake's measure captures some useful aspects of the alliance network, his measure of hierarchy does not distinguish between a state that is only allied to one country (for example, Mongolia to the USSR) and a state that is allied to many countries other than the United States, whether through the same alliance or not (for example, Brazil is allied to 19 other states as well as to the United States).[28]

--Insert Figure 3 about here--

Lake's theory has global implications, but his empirical measure analyzes only one dominant state at a time (the United States in his case) and does not take into account other dominant powers operating in the network. Consequently, the UK's connection to another broker (Egypt) counts the same in Lake's

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similarity of alliance portfolios (Signorino and Ritter 1999). For a discussion of structural similarity measures, see Hafner-Burton and Montgomery 2006.

[28] Like Lake's measure, conventional betweenness centrality does not distinguish between these two cases, since it calculates only the shortest, most direct path.

measure (though not in his theory) as the UK's connection to an isolate (Iraq) and a very strong broker (the USSR). Flow betweenness measures, however, gauge the importance of each and every node to the entire network and so provide an alternative way to test his general theory.

Are Lake's findings evidence of hierarchy generally or the U.S. alliance hierarchy specifically? By measuring the effects of strong and weak brokerage positions through the entire network, we can use this alternative measure to test whether hierarchical relationships have the same effect throughout the international system, or whether the effect is different for states that are specifically subordinate to the most central state in the network, the United States. Lake tests whether states subordinate to the United States will spend less on their defense effort; we test this hypothesis with respect to all subordinate states, as well as all dominant states. We also test whether there is a separate, stronger effect specific to the lead state; that is, whether subordinate states that are allied to the United States will make even less of a defense effort than states that are in otherwise similar positions that are not allied to the United States. Finally, to distinguish between marginal states that are entirely dependent on one other state (such as Iraq in the figure above), which have a flow betweenness of zero, and states that are complete isolates with no alliances, which also have a flow betweenness of zero, we include a dummy variable for having no allies. --Insert Table 3 about here--

Table 3 illustrates the results. Model 1 of Table 3 replicates Lake's (2007) analysis (his model 3 on page 74), in which the dependent variable is defense spending as a percentage of GDP.[29] Following Lake, we test for a unique U.S. effect alone in Model 2. Our results provide additional support for Lake's findings. Simply being allied to the most powerful state (in this case the United States) decreases the defense effort by about the same as Lake's index of independent alliances. What about hierarchical relationships with states other than the US?

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[29] Following Lake, we our model is a Time-Series Cross-Sectional regression with correction for first-order autoregression and panel corrected standard errors. All independent variables are lagged one year.

Model 3 replaces Lake's measure of US alliance hierarchies with our variable *Alliance Flow Betweenness*, measuring the effects of strong and weak brokerage positions throughout the entire network, while also including a dummy for states with no alliances (*No Allies*) at all. If the theory were generally true—the international alliance system had hierarchical effects but not a US-specific effect—we would expect the estimate for flow betweenness to be positive and significant, but in this regression it is not. If there is a general effect of alliance hierarchy, as Lake posits, it is being masked by the US-specific alliance effect. There is something special about being in a subordinate relationship to the US that affects military spending. It is possible that US alliances are more voluntary than others; for example, the USSR's allies during the Cold War had to be kept in line through coercion as well. Alternatively, simply being allied to the most powerful state in the system may have an additional effect.

In Model 4, we further probe Lake's theory by controlling for the US-specific alliance effect, including the variable *US Ally*. We find that flow betweenness is positive and significant. States with low centrality (flow betweenness) in the alliance network—those more dependent on others—are likely to spend less on their military than other states, just as Lake predicted. Conversely, states with high centrality (in Figure 2, the United States, the USSR, the UK, France, and Egypt) are likely to spend more. States with no alliances at all, however, also make less of a defense effort in Models 2, 3, and 4–this may be an effect of being minor states that are less involved in the international system.

The magnitude of these effects is substantial. The average alliance flow betweenness centrality for states that possess at least one alliance is 0.0154 (about Libya in 1989). The maximum flow betweenness centrality by a state other than the US is 0.188 (France in 1963), while for the US the maximum is 0.476, reached in 1955. Moving from the mean to the minimum (zero) decreases a state's defense efforts by about a half a percent of GDP, while moving from the mean to the French level in 1963 increases it by about 4.7 percent of GDP; increasing it to the maximum US level leads to an increase of 12.5 percent of GDP.

These centrality measures inform Lake's important findings by providing a more general analysis of the theory that includes, but is not limited to, alliances with the United States as a broker. While states

with higher flow betweenness centrality are likely to spend more on their military than other states, subordinate states in alliances with brokers other than the United States, such as Egypt, France and the USSR, spend less. But there is something special about the US alliance hierarchy which provides bigger incentives for subordinates to spend less on defense. Lake's theory about legitimate authority applies mostly to the United States—as he shows—and to a lesser degree to other dominant and subordinate states. However, the results also suggest other effects at work, including an effect of being out of international competition entirely.

These brokerage measures, and others like them, can be used more generally to gauge bargaining power and its effects on other actors in any network.

Closeness Centrality and Efficiency

Scholars have long argued over whether international trade helps or hurts workers in the developing world. Trade could generate a "race to the bottom," by creating incentives for minimum regulatory standards in developing countries. Or trade could generate a "California effect," where strong regulatory standards in one location diffuse to other locations (Vogel 1995).

Brian Greenhill, Layna Mosley and Aseem Prakash (2009) provide convincing evidence in support of the California effect. Using data on 90 developing countries from 1985 to 2002, they show that superior labor standards tend to diffuse from importing to exporting countries in the trade network through supply chains. When there is considerable market share at stake, the exporting country tends to ratchet up their labor standards and converge towards the best practices of the importing country. This regulatory diffusion process depends not on how open any individual is to the global trading system overall, but on the composition of its trade, in terms of trading partners. To test their theory of diffusion, the authors create a network measure based on trade flows—the weighted average of labor laws among developing countries' export partners—and find that high labor standards in the export destination are associated with improvements in labor laws—although not labor practices—in the exporting country in subsequent years.

In order to control for other sources of regulatory standardization, Greenhill, Mosley, and Prakash include dummy variables measuring whether a pair of countries belonged to preferential trade agreements (PTAs) with different levels of human rights standards. They find that membership in PTAs with human rights conditions is associated with greater legal protections for labor rights, but only if those conditions are enforceable (or "hard," see Hafner-Burton 2005). Here, we extend their analysis and consider their theory of diffusion through the network of PTAs and the trade network.

Regulatory standards can diffuse through supply chains in a trade network made up of trade flows between states and trade agreements.[30] A dummy variable is a reasonable way to test the effect of PTAs with hard standards on member countries' labor laws because we expect that effect to be direct and institutionally driven: countries that violate a hard PTA's rules by racing to the bottom in labor standards risk being punished and this risk provides member countries with direct incentives to create stronger labor laws. Soft PTAs do not provide these incentives, as the agreements cannot punish or materially reward member states for creating strong labor laws. Consequently, these soft agreements are not likely to directly spread standards to member states, as hard PTAs do—their evidence confirms this view. Similarly, it demonstrates that sheer volume of direct trade alone does not spread standards.

However, both political scientists and sociologists argue that norms and standards can still diffuse through networks without enforcement capacity and that states can have their interests and identities changed as information diffuses to them, whether through copycat behavior, persuasion, or coercion. These theories imply that trade networks may diffuse standards by shaping the information environment, increasing the salience of such standards, making it more likely that they will make it onto the agenda of exporting countries (the second face of power). Presumably, the more efficiently information on standards

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[30] Layna Mosely pointed out to us that trade networks can also facilitate diffusion through multinational corporations (MNCs). Their requirements for their supply chains also affect diffusion. However, measuring MNC diffusion rather than diffusion through general trade or PTAs is beyond the scope of this article.

can diffuse, the more quickly actors will take up the norms, put them on the agenda, and possibly even put them into practice. In this model, norms spread not through direct persuasion and socialization (as with the spread of democratic norms discussed above), but rather through indirect "mimesis"; as countries become aware of globally dominant regulations of labor laws in their network, they adopt additional laws to mimic those regulations. However, this mimicry is also likely to be shallow: decoupling between laws and practices is likely to occur, as laws are adopted without enforcement mechanisms (DiMaggio and Powell 1983; Meyer et al. 1997). We examine this long-standing theory of diffusion by looking to see whether countries that hold central positions in trade and/or PTA networks are more likely to adopt the standards.

For our purposes, a closeness centrality measure is the best way to explore the possibility that regulatory standards diffuse through the soft PTA and the trade flow networks, since we are interested in the efficiency with which regulatory ideas spread. In this case, we use information centrality because it takes into account both path strength and length, since the signals from the international community are more likely to reach target countries if paths are efficient, or strong and short. The trade network consists of direct links between states, and is highly dense; consequently, we omit it from the figures.

Since the soft PTA network consists of two entities (states linking to PTAs, which in turn link to other states), we perform a two-mode analysis in which both the information centralities of states and PTAs are measured.[31] Figure 4 illustrates the soft PTA network in 1990, in which a number of prominent PTAs link together countries. The size of each node indicates its relative information centrality; Lomé, for example, being linked to a large number of countries, some of which are also linked to other PTAs with

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[31] Information centrality requires a connected graph, which only exists for a subset of years. For example, in Figure 3, there are two distinct network components. We measure information centrality for each component separately, and use a "weak" symmetrizing rule: if a tie exists from either actor, it is assumed a link exists. We dichotomize the data in both cases; using valued data instead does not significantly change the results. Soft PTA data are from Hafner-Burton (2005).

soft human rights requirements, is highly central as a PTA, while a smaller cluster of Southeast Asian

PTAs can be seen in the lower-left corner. European countries belonging to the EEC, Lomé, and other

soft PTA regimes, are highly central, while states belonging to just one of the three soft SE Asian PTAs

have a very low information centrality.

--Insert Figure 4 about here--

Tables 4 and 5 show our findings. In Table 4, we replicate Model 1 in Table 2 (page 679) of

Greenhill et al., where the dependent variable is labor laws, ranging from 0 to 28.5, while in Table 5, we

replicate Model 1 in Table 3 (page 680), with the dependent variable of labor practices, which ranges

from 0 to 27.5.[32] In each table, we then add in *Soft PTA Information Centrality* in Model 2, *Trade*

Information Centrality in Model 3, and both centralities in Model 4. Table 4, Model 4 shows that labor

standards may diffuse through the network in four ways: (1) through indirect network relationships

between states in PTAs with soft human rights standards; (2) through network relationships between

states through general trade; (3) through supply chain relationships with trade significant partners; and (4)

through direct membership in PTAs with hard labor standards.

--Insert Table 4 about here--

An increase from minimum to maximum information centrality in the soft human rights PTA

network in Table 4, Model 4 yields a 1 point increase in labor laws in a year, or about the same as direct

membership in a hard human rights PTA. An increase from minimum to maximum information centrality

in the trade network in Model 4, by contrast, increases labor laws by 1.38 points.

--Insert Table 5 about here--

Table 5, Model 4, by contrast, shows that labor practices—as opposed to standards—diffuse

through the network in only one way: through network relationships between states through general trade.

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[32] We follow them in using an ordinary least squares regression with random effects and robust

standard errors clustered by country, lagging all independent variables by a year and including a lagged

dependent variable.

Trade information centrality has a very significant effect, increasing protections for labor rights by 1.78 points when increasing centrality from minimum to maximum, while soft human rights PTA information centrality (as well as the bilateral trade context and direct hard PTA ties) is insignificant. The anomalous result Greenhill, Mosley, and Prakash discovered for labor practices—that soft PTA membership has a deleterious effect on labor practices—has become statistically insignificant.

The information centrality measure confirms and extends the exemplary analysis of Greenhill, Mosley, and Prakash of the diffusion of regulatory standards. Trade law standards diffuse not only through direct ties created by trade flows and hard PTA requirements, as they show, but also through trade and PTA networks more generally. However, labor practices are only affected by the information diffusing through the more general trade network. States that are better connected to the network through trade are likely acting in anticipation of future labor requirements as other parts of the network slowly ratchet upwards, whereas in the case of PTA connections they are simply meeting the letter of the law as required.

This measure of information centrality is also generalizable to any situation where efficiency— path strength and length—are important, providing a reasonable way to measure diffusion in any network.

CONCLUSION

A network approach to power in politics has much to offer the discipline of political science. In this article, we have concentrated our efforts on one family of network measures that we believe is among the most important, centrality, demonstrating broadly how these measures can inform the study of politics. We demonstrate this through all three faces of power: direct alteration of behavior through hierarchies of alliances, socialization to different interests and identities by democratic international organizations, and manipulation of domstic agendas for labor laws and practices of states through trade networks. Specifically, we have argued and then demonstrated that degree, betweenness, and closeness centrality can give an actor the political advantages of access, brokerage and efficiency, all of which can translate into political power.

This is just the beginning. Although our analysis is limited to centrality measures, network analysis allows for a multitude of structural measures of positions within networks. Centrality can inform debates not only on politics but also on any other issues that involves exchange through network ties. In addition to centrality, a variety of other network concepts and measures—such as structural equivalence—can also inform the discipline. Although our empirical applications are focused on international relations and political economy, centrality measures can inform research on power and politics in other fields, such as American politics, as well as other disciplines, including sociology and economics.

Presently, network analysis remains underused, as a small but growing community of scholars takes up network tools and applies them to the study of politics.[33] The potential for theoretical and empirical innovation for the field, however, is vast. Network tools in general, and centrality concepts in particular, offer new ways to measure and test long-standing concepts and theories that have yet to be fully explored, and they offer new insights into the nature of politics as a set of relations among actors at all levels involved in relationships of all kinds. This article is part of a broader effort to popularize network analysis inside the discipline of political science for the purposes of advancing our knowledge of the world.[34]

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[33] This has particularly been the case in International Relations (Dorussen and Ward 2008, Elkins 2009, Elkins, Guzman and Simmons 2006, Hafner-Burton and Montgomery 2006, 2008, Ingram, Robinson and Busch 2005, Manger, Pickup and Snijders 2008, Maoz 2009, Maoz, et al. 2005, 2007, Ward and Hoff 2007, Ward, Siverson and Cao 2007) and, increasingly, in American Politics (Fowler 2006a, 2006b, Fowler and Jeon 2008, Fowler, et al. 2007, Heaney and Rojas 2007).

[34] For a good treatment of this, see Christakis and Fowler 2009.

FIGURES

Figure 1: Sample Networks

A:Degree Centrality among States

B:Betweenness Centrality among Organizations

C:Closeness Centrality among People
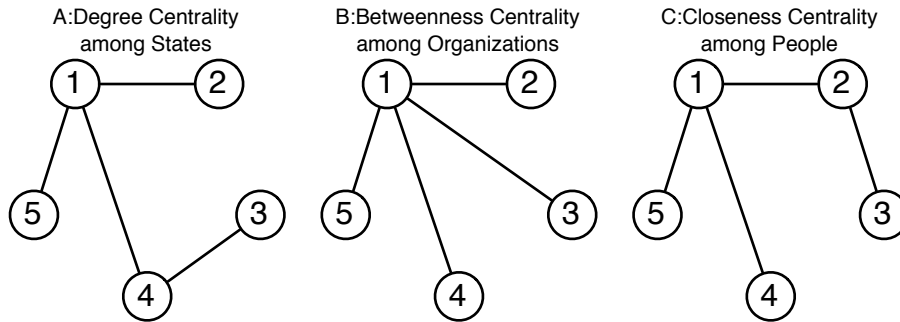
Table 1: Sample Network Centrality

Network (measure)	A: States (Degree)	B: Organizations (Betweenness)	C: People (Closeness)
Actor 1	.75	1	.8
Actor 2	.25	0	.67
Actor 3	.25	0	.44
Actor 4	.5	0	.5
Actor 5	.25	0	.5

Figure 2. IO Democracy Network, 1950. Round nodes are states, diamond nodes are democratic IOs. Node size indicates potential for *socialization by democratic states through IOs*, while the number of incoming ties from IOs indicates potential for *socialization by democratic IOs*. Only states that belong to a democratic IO are pictured.

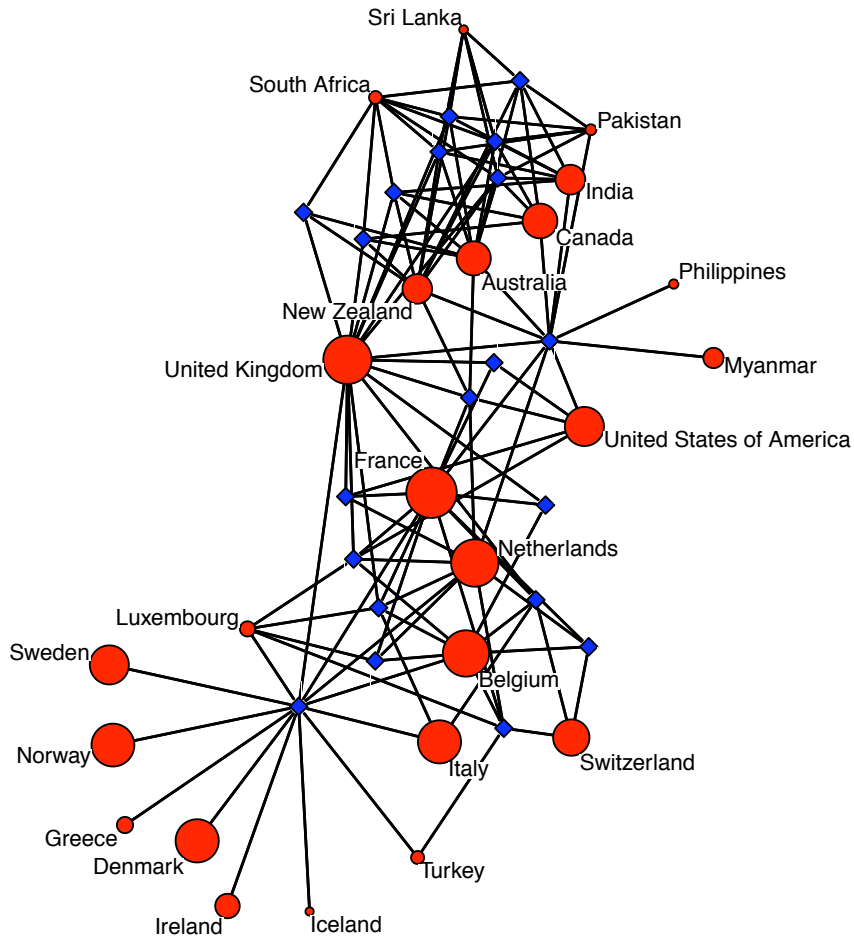**Table 2. Fatal Militarized Disputes and Centrality, 1885-2000**

	Model				
	1	2	3	4	5
Joint Democratic IOs	-0.0791*			-0.0787*	
	-0.0319			-0.0316	
Democratic IO		-0.0963**			-0.0953**
Socialization$_s$		-0.0361			-0.036
Democratic State			-8.5889***	-8.6261***	-7.5778**
Socialization$_s$			-2.0432	-2.0454	-2.5702
Democracy$_s$	-0.0627***	-0.0635***	-0.0563***	-0.0450***	-0.0500***
	-0.0112	-0.0116	-0.0113	-0.0117	-0.0123
Dependence$_s$	-52.0107**	-62.3092**	-38.8215*	-32.7151*	-54.2193**
	-15.8729	-20.9644	-15.1517	-14.9977	-20.2768
Contiguity	1.6353***	1.6298***	1.6482***	1.6404***	1.6212***
	-0.143	-0.145	-0.1424	-0.1424	-0.1445
Distance	-0.6933***	-0.7067***	-0.7123***	-0.7112***	-0.7169***
	-0.0481	-0.0486	-0.048	-0.0479	-0.0484
Major Power	1.3484***	1.4919***	1.4718***	1.4970***	1.5603***
	-0.1188	-0.1217	-0.1218	-0.1223	-0.1236
Cumulative MIDs	0.1175***	0.1132***	0.1146***	0.1145***	0.1130***
	-0.0075	-0.0077	-0.0074	-0.0075	-0.0076
Joint IOs	-0.0013	-0.0004	-0.0026	0.002	0.004
	-0.0049	-0.0049	-0.0046	-0.0048	-0.005
_cons	-0.9392*	-0.7871	-0.5229	-0.5264	-0.5095
	-0.4015	-0.406	-0.407	-0.4065	-0.4116
N	454380	448087	454380	454380	448087

NOTE: * = p<.05; ** = p<.01; *** = p<.001

Figure 3. International Alliance Network, 1950. Only states that have at least one alliance are pictured.
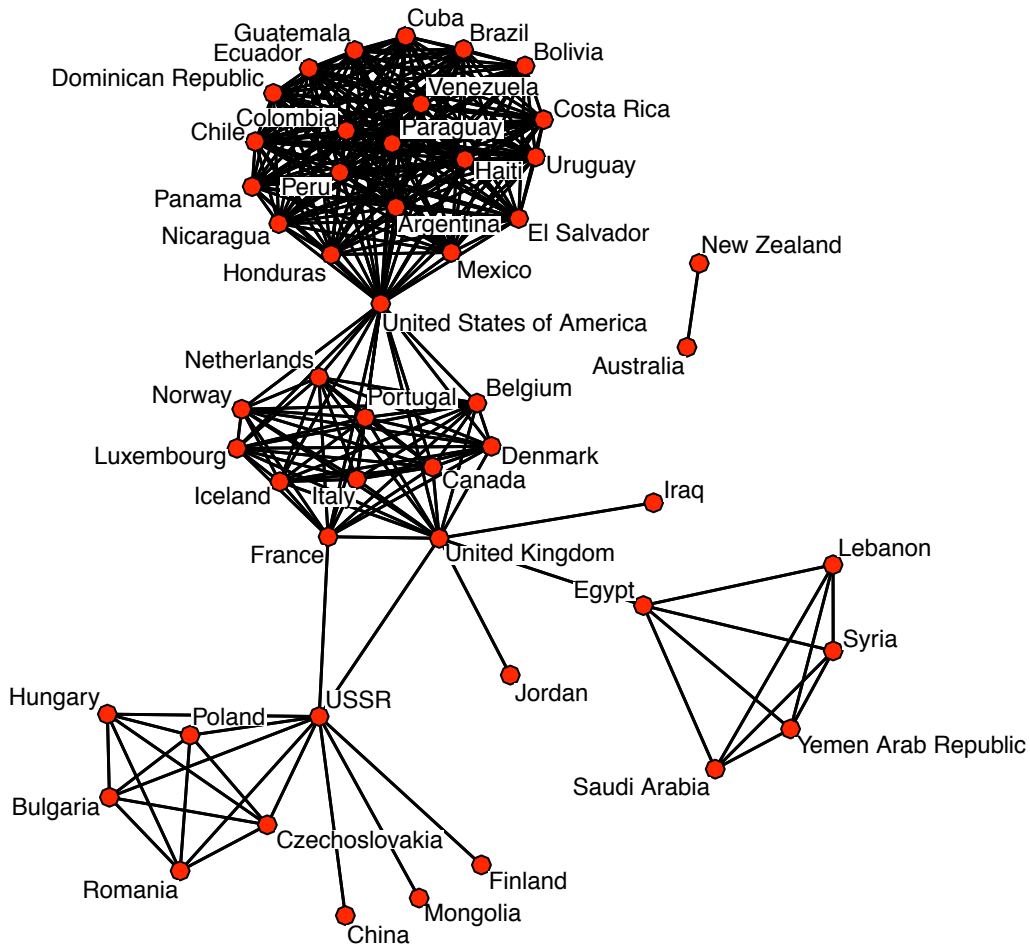
Table 3. Defense Effort and Alliance Flow Betweenness, 1950-2000

	Model			
	1	2	3	4
Index of Independent Alliances	-0.0090***			
	(0.0027)			
Alliance Flow Betweenness			0.0417	0.2709*
			(0.0950)	(0.1120)
No Allies		-0.0043***	-0.0020*	-0.0039***
		(0.0012)	(0.0009)	(0.0012)
US Ally		-0.0096***		-0.0121***
		(0.0027)		(0.0031)
Lagged Defense Effort	0.6440***	0.6558***	0.6789***	0.6593***
	(0.0728)	(0.0714)	(0.0689)	(0.0708)
Index of Military Personnel	-0.0018	-0.0019	-0.0029	-0.0022
	(0.0018)	(0.0018)	(0.0017)	(0.0017)
Index of Exchange Rate Regime	-0.0000	0.0003	-0.0011	0.0000
	(0.0012)	(0.0012)	(0.0012)	(0.0012)
Index of Relative Trade Dependence	0.0077	0.0092	0.0070	0.0100
	(0.0075)	(0.0075)	(0.0073)	(0.0074)
MID Involvement	0.0033***	0.0033***	0.0031**	0.0033***
	(0.0010)	(0.0010)	(0.0010)	(0.0010)
Number of other Allies	0.0003**	0.0001	-0.0001	0.0000
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Real GDP Per Capita	0.0000*	0.0000*	0.0000	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Democracy (Polity2)	-0.0003*	-0.0003*	-0.0004**	-0.0003*
	(0.0001)	(0.0001)	(0.0002)	(0.0001)
Constant	0.0026	0.0057**	0.0039	0.0054**
	(0.0017)	(0.0021)	(0.0020)	(0.0020)
N	4522	4522	4522	4522

NOTE: * = p<.05; ** = p<.01; *** = p<.001

Figure 4. Soft Human Rights PTA Network, 1990. Round nodes are states, diamond nodes are PTAs. Node size indicates information centrality in the network.
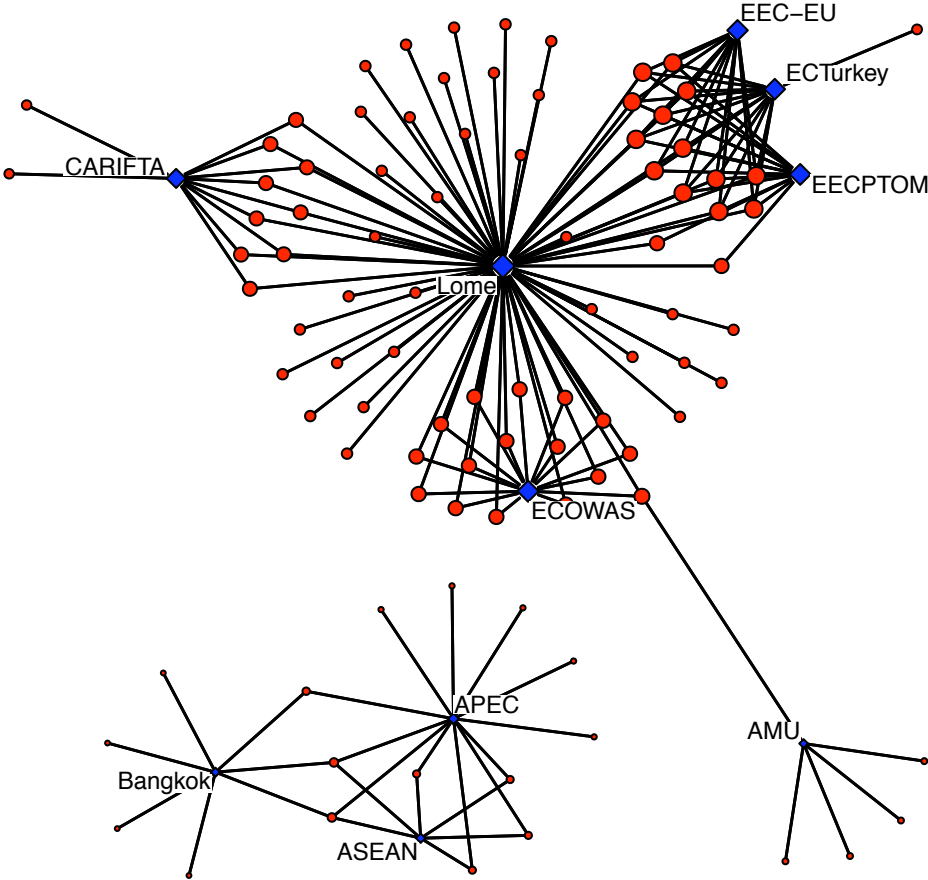
Table 4. Labor Laws and Information Centrality, 1985–2002

	Model			
	1	2	3	4
Soft PTA Information Centrality		0.3654*		0.4449*
		-0.1681		-0.1876
Trade Information Centrality			0.0192	0.0258*
			-0.0107	-0.012
Bilateral trade context: law	0.2005**	0.1847**	0.1825**	0.1681**
	-0.0638	-0.0605	-0.0618	-0.0613
Total trade	-0.0059	-0.0068	-0.0063	-0.007
	-0.0042	-0.0041	-0.0042	-0.0042
FDI inflows	0.0032	-0.0069	-0.0006	0.0005
	-0.0256	-0.0238	-0.0252	-0.0249
Hard PTA	0.8624*	0.9194*	1.0747**	1.0252*
	-0.3966	-0.3988	-0.4104	-0.4095
Soft PTA	-0.2914	-0.1649	-0.0515	0.048
	-0.1948	-0.2111	-0.2209	-0.2487
GDP per capita	-0.4773**	-0.4219**	-0.4934**	-0.4315**
	-0.1639	-0.1616	-0.1633	-0.163
Democracy	0.0383*	0.0375*	0.0424*	0.0423*
	-0.0186	-0.0183	-0.0191	-0.0189
Population	-0.3819***	-0.3775***	-0.4051***	-0.4065***
	-0.0861	-0.0861	-0.0893	-0.0884
Civil war	0.1002	0.1811	0.1167	0.1639
	-0.2183	-0.2322	-0.2221	-0.2326
Lagged dependent variable	0.6411***	0.6281***	0.6276***	0.6219***
	-0.03	-0.0312	-0.0314	-0.032
Constant	13.1921***	13.2502***	13.8619***	13.4943***
	-2.3616	-2.3449	-2.3752	-2.37
N	1424	1338	1337	1337

NOTE: * = p<.05; ** = p<.01; *** = p<.001

Table 5. Labor Practices and Information Centrality, 1985–2002

	Model			
	1	2	3	4
Soft PTA Information Centrality		-0.241		-0.1019
		-0.1749		-0.1745
Trade Information Centrality			0.0356**	0.0332**
			-0.0114	-0.0116
Bilateral trade context: practice	0.0754	0.0703	0.0108	0.0134
	-0.0572	-0.0647	-0.074	-0.0735
Total trade	0.0044	0.0059	0.0057	0.0057
	-0.0038	-0.0038	-0.0037	-0.0037
FDI inflows	-0.0529*	-0.0595*	-0.0529	-0.053
	-0.0255	-0.0271	-0.0275	-0.0275
Hard PTA	0.0823	0.284	0.4632	0.4862
	-0.4782	-0.541	-0.5311	-0.5384
Soft PTA	-0.7382**	-0.7773**	-0.3927	-0.3814
	-0.2745	-0.2853	-0.296	-0.3031
GDP per capita	-0.6577***	-0.6932***	-0.6293***	-0.6214***
	-0.1573	-0.155	-0.1477	-0.1418
Democracy	-0.0089	-0.0052	-0.0065	-0.0064
	-0.0196	-0.0196	-0.0191	-0.0188
Population	-0.4827***	-0.4454***	-0.4398***	-0.4281***
	-0.1123	-0.113	-0.1088	-0.107
Civil war	0.0702	0.0565	0.0094	-0.016
	-0.3111	-0.3065	-0.3003	-0.2927
Lagged dependent variable	0.5491***	0.5686***	0.5960***	0.6094***
	-0.0267	-0.0278	-0.0276	-0.0273
_cons	20.4188***	19.8192***	18.7995***	18.3240***
	-2.5937	-2.7867	-2.7776	-2.745
N	1424	1338	1337	1337

NOTE: * = $p<.05$; ** = $p<.01$; *** = $p<.001$

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