

INTERNATIONAL RELATIONS: A SYSTEMATIC STUDY OF NETWORKS

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Abstract: According to the literature on international relations study, networks are a distinct form of organisation, distinct from markets or state hierarchies. On the contrary, network analysis can investigate and measure emergent properties of persistent patterns of relations between agents that can define, enable, and constrain those agents. Tools for recognising and assessing network structure are provided by network analysis, as are ideas that link structure to outcomes in situations outside international relations. According to network analysis, power in international relations is defined in three ways: access, brokering, and exit choices. The ability of actors to expand their power by enhancing and utilising their network positions and the fungibility of network power are two of the most critical concerns in international relations. To date, the relevance of network analysis in international relations has been proved in the exact definition of international networks, the examination of network impacts on major international outcomes, and a new data source for network theory. On the other hand, network analysis has the potential to provide meaningless results, unsubstantiated claims, and arbitrary measurements. Proposals for future use of network analysis in regard to international relations include importing a toolbox to further study on international networks, testing existing theories in the domain and testing theories in relation to international relations using network analysis.

Keywords: Social network, International relation, Interstate conflict, International governmental organization (IGO), Democratic peace

Introductions:

It's been twenty years since the study of international has made major advances in several areas. In the last two decades, we've learned more than we had in the prior eighty years of the twentieth century about what causes war and what makes a peaceful world possible. However, despite the ongoing debates in international relations, the scientific study of international relations can tell us—in the most precise terms possible in the social sciences—that the likelihood of dyadic conflict and war is greatly reduced by joint democracy, participation in international organisations, alliances, and economic interdependence. Geopolitical proximity, conflict history and military capability parity, as well as the status of the dyad members (major, regional, or tiny) are all factors that raise the likelihood of war between states.

It's well-known, for example, that the great majority of states have been involved in only a small number of disputes and wars, whereas a few states have been involved in the vast majority of disputes and conflicts. A small percentage of politically relevant dyads have been responsible for the vast majority of the past two centuries' MIDs and wars. In most cases, these dyads are made up of long-term enemies; pairs that are constantly at odds with one another. These conflict-prone states and dyads can also be identified by their traits. Powerful, well-developed countries with a large number of neighbours are among the highest-risk populations in terms of conflict exposure. Duos that share democracy are more likely to favour peace [5].

The presence of networks has traditionally characterised international politics. TANs and terrorists and criminals organised in "dark" networks are examples of networked actors.

There has been a tendency to view international network structures like governments and traditional international organisations as hierarchical, while treating them as more akin to markets in their ephemerality. Analysis of networks provides a more expansive perspective: networks are made up of relationships that build structures, which in turn can constrain or enable agents. It is possible to construct and test hypotheses regarding these structures through the use of network analysis. It answers fundamental concerns about international relations, such as how and when terrorist organisations are formed, strengthened, and disbanded [6]. Do military and other foreign relations influence states' proclivity for conflict? Is it better or worse for the world's poor to be a member of preferential trade agreements and other international organisations? What's the greatest way to put a stop to the spread of weapons?

Existing structural techniques in international relations that focus on the qualities of actors and static equilibria are supplemented by network analysis. Instead, it focuses on the dynamic processes that generate structures between actors through material and social ties. Measurement and operationalization of processes like socialisation and diffusion are also provided, and new paths for rethinking basic concepts in international relations, such as power, are opened up. On the other hand, network analysis has the potential to provide meaningless results, unsubstantiated claims, and arbitrary measurements.

We examine the existing and future benefits of network analysis in international relations. A comparison of the network perspective to other approaches to international affairs is presented in the first section. After that, we'll go over some of the basics of network analysis and talk about the new dimensions it can lend to the study of power in international politics. After a brief survey of the existing use of network analysis in international relations research, we propose a network analysis research agenda for the future of the discipline [1].

Literature of Networks: A General Approach and IR Uses

Wasserman and Faust point out that the development of social network analysis has taken place in a variety of social science fields. These investigations were pioneered by sociologists, social psychologists, and anthropologists. Many other areas have used these social network ideas since then. Similarly to the rational choice approach, the social network approach has a set of foundational assumptions and analytical tools that may be used to a wide range of problems in a variety of disciplines.

A range of analytical measures used in network analysis allows the system of relationships and the relationships between units to be described in a systematic manner. There are a number of metrics that can be used to describe the complete system. Subsystems can be described using other methods. There are still others that allow you to compare different subsets of the system. It is also possible to compare units by using a variety of metrics. Network analysis may be used in a wide range of contexts because it provides a consistent framework for describing social relationships at many levels. This, as we'll argue, is a good fit for the study of international relations.

The rational choice approach in international relations research has garnered a lot of attention, whereas the social network approach has received little attention. International transaction flows were studied in its infancy using this method. Since then, there has been minimal evidence of IR experts employing network methodologies to study international issues. Many sociologists have attempted to examine the "global system" by using network methodologies to analyse various parts of it. In Knoke (1990), a study of the literature on political networks, international relations applications by political scientists are essentially non-existent.

Maoz (2001) was one of the few recent attempts to investigate international political problems using a network analytic technique. He used a relatively crude network idea in an attempt to tackle the level of analysis difficulty in the democratic peace phenomena [4]. This effort sounded promising because it indicated that democratic peace could be solved by better understanding democratic states' interactions with their politically relevant international environment (PRIE). For example, we came up with the idea that international politics may be viewed as interconnected. Using a network approach, we argue that a multilayered and evolving view of international politics is attainable in these publications. In these works, we used a systemic approach. To highlight the possibilities of this technique, we should focus on the following study.

In International Politics, the Analytic Concept of Networks:

According to international relations theory, networks can enhance collective action and cooperation, exert influence, or function as a mechanism of international government. The global activist network, as defined by Keck and Sikkink, is perhaps the most well-known example. As characterised by Keohane and Nye, trans-governmental cooperation has a clear philosophical genealogy in international relations that predates the September 11 attacks and is at the root of governance networks. Since the 1970s, international relations have largely ignored networks' role in constraining and enabling individuals and influencing international outcomes. Rather than focusing on the effects of networks on their environments (for example, the implications of transnational activist networks on international accords), research has concentrated on the effects of network structures on players and outcomes within those networks (for example, the effects of the network of intergovernmental organisations on conflict). When comparing networks to other organisational structures, such as state hierarchies or markets, little attention has been paid to the variance among networked companies and the impact of that variation [7]. International politics is heavily influenced by networks, which represent a distinct manner of inter- and transnational governance. Research on these subjects continues to be vital. When it comes to international relations, the term "network" is typically used to refer to any nonhierarchical method of organisation that isn't hierarchical.

Instead of being a technique for studying a specific type of organisation, network analysis may also be used to analyse and assess structures in great detail. International relations have traditionally been dominated by the neorealist idea of structure, which is based on the distribution of material capacities among units. When it comes to defining structures, a network approach sees them as emergent qualities that emerge from the enduring patterns of relations between agents. From their impacts, we are interested in network structures like other structural approaches to international affairs. There must be proof of these impacts, not just anecdotal evidence. The goal of network analysis is to uncover patterns of interactions, such as hubs, cliques, or brokers, and to link such relationships to outcomes of interest. As vital as or even more significant than determining such results are the structural relations between units. A result is that there is no separation between the ideas and actions of individual agents (or the observations of individual conduct). This is in contrast to neorealist ideas of structure, which tend to be more static. As an international relations expert, you may be familiar with the monadic, dyadic, and systemic levels of analysis, which are all possible with network analysis. early international relations network analysts studied the architecture of the international system that emerged as a result of trade, IGO participation, and diplomatic contact in the late 1960s and early 1970s. These early studies often did not use network analysis to test theories or forecast the implications of network effects on international politics. Using network analysis and concepts from dependence and world-systems theory, the second wave of sociological study emerged in the late 1970s to

investigate the structural causes of global inequality. Due to the fact that its theoretical foundations are no longer part of mainstream political science, this research has failed to find an audience in international relations. It wasn't until the late 1990s that the techniques of network analysis and international relations were brought together in a new wave of network applications. To further appreciate this integration, the concepts and methodologies of network analysis, mostly created outside international relations, require an introduction.

Network Analysis:

The focus of network analysis is on the connections between nodes (or agents). It is possible for nodes to be individuals or corporations, such as businesses and governments. Instead of focusing on the characteristics of individual nodes, network analysis examines the relationships between them. As a result of these three underlying principles, it is possible to define, enable, or restrict nodes' behaviour: nodes and their behaviours are mutually dependent, not autonomous; ties between nodes can be conduits for the transmission of both material (such as weapons, money, or disease) and nonmaterial products (such as information, beliefs and norms). Unlike the study of network forms of organisation, no assumptions are made about the homogeneity and other features of the nodes or links in a network in network analysis [3]. Therefore, network analysis can be used to study any type of relationship, including those between businesses and their employees. These fundamental principles of network analysis are complemented by methods for calculating and visualising structural properties of individual nodes and groups and the network as a whole; making predictions about network formation, growth, and dissolution; and investigating the influence of networks on the behaviour of actors.

- **Measuring Network Properties:**

The size and frequency of interactions between two nodes are considered while determining the strength of a connection. Both binary ties, such as when two countries acknowledge one another, and more complex ties like the amount of phone calls between terrorist cell members are examples of ties. Asymmetrical or symmetrical ties are also possible (stronger in one direction than the other direction, as often occurs in international trade). Relationships in a network don't have to be positive or cooperative; they can also be bad, such as a long-standing rivalry between two countries. Many sources can be used to create links: direct networks between persons or trading partners; alliances; and implicit networks of nodes linked by common identity or geography.

One typical technique to measure international connections is to look at the ties between five countries that are members of an affiliation network of seven hypothetical IGOs, as depicted in Figure 1. We begin with an affiliation matrix (where 1 represents a state's membership in a particular IGO) and then multiply the matrix by its transpose to transform it to a sociomatrix, a standard manner of describing network data. Row United States and column France both have a value of 4, which shows that the United States and France share membership in four IGOs, indicating a tie of strength 4. Figure 1 depicts the sociomatrix as a whole, which shows the distribution of ties across the network.

There are two major structural aspects revealed by a network's tie distribution: the centrality (importance) of the network's nodes and the network's breakdown into subgroups. Degree, proximity, and betweenness are all ways to describe a network's level of centrality. Degree centrality is a node's ability to connect to all other nodes in a network by the total of its ties. Node-to-node connectivity is measured using this metric. It is determined by the distance between each node and every other node. This metric could be used to determine the time it takes for information or resources to reach a certain node in a network. For example, the number of shortest paths passing through a given node is used to calculate betweenness

centrality, which indicates the network's dependence on that node to maintain its connectivity.

Affiliation matrix	IGO1	IGO2	IGO3	IGO4	IGO5	IGO6	IGO7
United States	1	1	1	1	0	0	0
France	1	1	1	1	1	0	0
China	0	0	0	1	1	1	1
North Korea	0	0	0	0	0	1	0
Iran	0	0	0	0	0	0	1

Sociomatrix	United States	France	China	North Korea	Iran
United States	4	4	1	0	0
France	4	5	2	0	0
China	1	2	4	1	1
North Korea	0	0	1	1	0
Iran	0	0	1	0	1

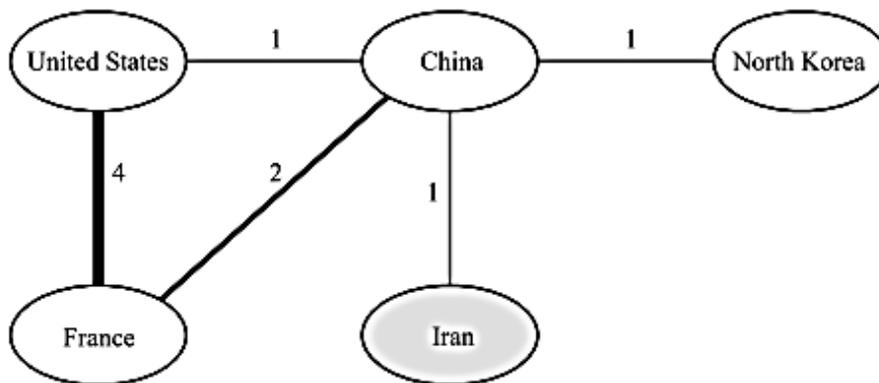


Figure 1. A sample international network

For example, degree centrality does not take into consideration the relevance of other nodes or all pathways (in the case of closeness and betweenness centrality). These values are also incorporated into other metrics. Eigenvector centrality, for example, combines the number of nodes linked and their strength and other nodes' centrality. In a similar manner, information centrality weights paths based on both distance and strength of connection, taking into consideration the probability of transmission along all feasible paths. By taking into account all possible paths between nodes, flow betweenness centrality can be used to determine how much control one actor has over the overall network's resources. Any of these centrality ideas can be used to measure the degree of centralization in a network, or how much other nodes rely on a single node.

For example, in Table 1, the six metrics of centrality defined above are applied to Figure 1 and the centralization of the network is calculated. Eigenvector centrality takes into account not just the inbound ties but also the centrality of the nodes that are connected to them. In this case, France comes out on top, while the United States and China are tied for second. The United States has a stronger eigenvector centrality than China because of its strong linkages to a particularly important actor (France). China ranks highly on both criteria of betweenness and centrality. Both the United States and France have a high information centrality because of their strong mutual ties, which is measured by the likelihood that information will be sent forward along certain ties (in proportion to their strength). As a result of China's position in the network, it is highly concentrated in terms of betweenness and

closeness centrality (since all paths from one part of the network to the other must pass through it). It has a low degree of centrality when it comes to measurements of tie strength, such as information centrality and degree.

As part of network analysis, subgroups are also partitioned by network ties. If a pair of nodes have strong relationships to each other (cohesive subgroups) or similar ties to all other nodes, they are part of the same group (structurally similar clusters). Here, we focus on one type of cohesiveness (clique) and one type of structural similarity (similarity) that exist, as with centrality (structural equivalence). Cliques are groups where each member has a strong connection to every other member in excess of a specified threshold. While the United States and France form a four-clique, the United States and China form a one-clique, since they all have relationships of strength one or more to each other. Each member of a structurally equivalent cluster has ties of equal strength to all of the other members of the network. Figure 1 shows that Iran and North Korea are architecturally identical since they share the same strength ties to the same node (s) It is possible to represent a network as a block model in order to study the relationships between groups of nodes and to discover macrostructures after partitioning the network into structurally related groups. A variety of network analysis programmes can be used to map and measure these basic network structures.

<i>Function</i>	<i>United States</i>	<i>France</i>	<i>China</i>	<i>North Korea</i>	<i>Iran</i>	<i>Network centralization</i>
DEGREE	5.00	6.00	5.00	1.00	1.00	0.25
EIGENVECTOR	0.61	0.66	0.42	0.08	0.08	0.68
BETWEENNESS	0.00	0.00	5.00	0.00	0.00	0.83
FLOW BETWEENNESS	0.13	0.25	0.60	0.00	0.00	0.51
CLOSENESS	0.67	0.67	1.00	0.57	0.57	0.89
INFORMATION	1.43	1.52	1.79	0.86	0.86	0.42

Table 1. Figure 1's centrality scores

Network Creation and Growth:

Relational and individual mechanisms for creating new connections in a network can be studied using network analysis. A node's location in an existing network can influence the likelihood of a tie being formed, while a node's specific features can influence a tie's likelihood. Figure 2 adds Pakistan as a node and uses dotted lines to indicate possible linkages resulting from the various processes.

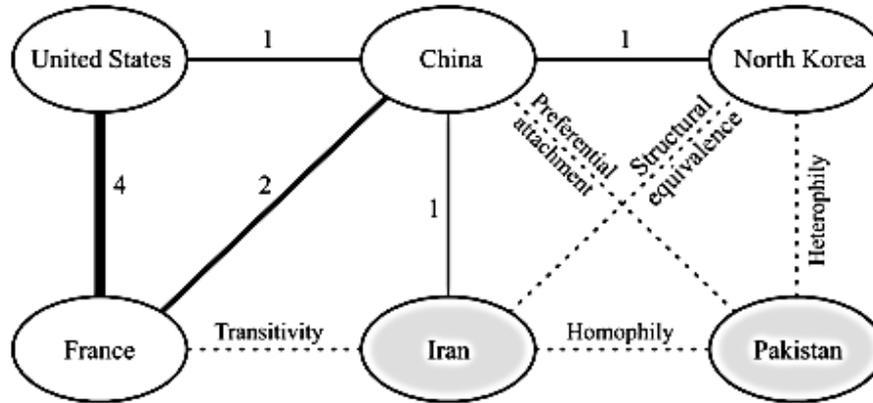


Figure 2. Sample international network with an additional node (Pakistan), demonstrating potential mechanisms for new ties

In network analysis, structural balance and structural equivalence are two of the most common related processes. Structured balance (or transitivity) theories claim that there can be no more than two positive and two negative links among any three nodes. My buddy's friend is my friend, and my enemy's enemy is my friend. Figure 2 shows that Iran and France have (good) relations to China, therefore we might predict a link between the two countries. Structureal equivalence may predict that nodes in comparable places with respect to other nodes will behave in similar ways. As long as they aren't competing for resources, they could build a friendship. For example, in Figure 2, North Korea and Iran appear to have similar positions vis-à-vis China. Structural balance may also play a role in North Korea and Iran's potential for cooperation.

Network links can be formed through homophily or heterophily, where nodes develop ties based on shared properties, or they can be formed through homophily and heterophily. The two countries depicted in Figure 2 (Iran and Pakistan) may form a connection because of their comparable geographical and postcolonial status. A linkage might also be formed between Pakistan and North Korea, which both possess centrifuge enrichment and ballistic missile technology.

As a final point, existing network connections can also influence the formation of new relationships. More connections are formed between central nodes under preferential attachment settings than between less-central nodes. Figure 2 shows that due to China's importance as a link in the network, Pakistan may want to ally itself with China (by information, betweenness, and closeness measures). Trade, IGOs, and democracy are only a few of the networks in which states may already have a strong connection. Over time, even one-way ties might be reciprocated. Using exponential random graph models, it is possible to measure these network mechanisms simultaneously. As part of agent-based models, they also appear [8].

• **Network Effects:**

Individual nodes, groups of nodes, and entire networks can all have an impact on the processes and results of interest. They should be viewed as hypotheses to be tested rather than principles that inherently apply to international relations because their translations are extremely reliant on specific settings and assumptions. A sociological study has shown that the most prominent members of networks have the most social capital. Social capital is the value of belonging to a network [9]. Each of the two conflicting views on social capital places a different emphasis on various structural positions. One school believes that nodes situated between network clusters in structural holes have a high social capital; 26 the second believes that well-connected nodes have more resources to draw from through their network

connections have more social capital than those that are less well connected. Nodes with a high degree of closeness or information centrality will also have an advantage over marginal nodes when it comes to receiving information. These hypotheses are helpful because of knowledge and capital asymmetries, which have an impact on international political processes and outcomes. Conflict theories rely significantly on ideas about the allocation of material capital, which in turn creates a degree of ambiguity regarding the result of war. An analogy for international relations could be drawn from this argument.

There are other hypotheses that can be drawn from studies of individual behaviour in social networks. Individual nodes may modify their properties as a result of their interactions with other nodes in a specific subgroup. Cohesive subgroup members treat those who are not part of their group with hostility. Clusters of structurally similar nodes are more likely to respond in similar ways because they encounter the same constraints and opportunities. However, it is not necessarily a sign of collaboration if one's behaviour is similar to the other. Due to the tasks they play, even structurally identical nodes may compete. With regard to trade privileges and help from the former colonial power, two postcolonial preferential trading nations may compete. Network dynamics have a significant impact on conflict and cooperation. There is a correlation between degree centrality and conflict in social networks. It is possible to test these hypotheses in the context of international relations by using network position and a few assumptions about individual nodes. According to constructivist theories of international relations, state behaviour in international politics may be influenced by socialisation processes. It is possible to measure the origins of norms diffusion and socialisation by analysing the degree of links between states, collective state identities like security communities, as well as the relevance of individual countries.

In the final theoretical transfer from network analysis, we discuss network efficiency and robustness. There are a number of factors that influence the efficiency and resilience of a network, including its topology. There is a trade-off between efficiency and robustness in most networks: redundant links make a network more robust, but they may also make it more inefficient. Investment in important hubs (such as China in Figure 1) may make the network more efficient, but the removal of those few nodes (such as the network in Figure 1) can disrupt the network. This is because betweenness measures indicate that a network is highly centralised (most paths go through a few nodes). Using "shortcuts" to connect nodes in a centralised setup maintains resilience and boosts work efficiency. Some terrorist networks and extremely trustworthy organisations employ this type of simultaneous centralization and decentralisation (HROs).³² Many illicit and legal networks of interest to international relations experts have substantial tradeoffs between resilience and efficiency.

Networks and Power in International Relations:

In international relations, network analysis has the potential to question long-held assumptions about power. Nodes' power is measured by the number of connections they have to other nodes in the network, which is determined by a structural analysis of the network. Attributes like material resources are no longer the primary source of power. A network perspective on power in international relations may also help to improve and extend existing network analyses.

- When it comes to network power, defined by Knoke as "prominence in networks where valuable information and limited resources are moved from one player to another," centrality is often a component. For example, a network node with a high degree of centrality (strong linkages to many other nodes) may have social influence, since it has easy access to other nodes' resources and knowledge. According to this theory, France is the most powerful state depicted in Figure 1. Even if a node's social influence may allow that node to get access to the benefits of other network members,

it may also allow that node to affect the flow of information among network members and alter common understandings of relative capabilities, common interests, or norms. According to some international relations specialists, degree centrality is social power. "Withhold social benefits such as membership and recognition or execute social sanctions such as marginalisation as a tactic of coercion" and "expect extra support in a conflict," Hafner-Burton and Montgomery argue. State and society with privileged positions in global politics can, to a great degree, establish agenda, frame debates, and implement policies that benefit them," says Backfield in a revision of world polity theory. "structural inequality" refers to the degree of centralization in the IGO network, according to his concept. When these ideas are applied to eigenvector or other concepts of centrality that incorporate the centrality of every node, they can be reworked. For example, a state that has a large number of connections (such as memberships in organisations or trade flows) with regional neighbours that are not well-connected may be less powerful than a state that is part of a network with many other high-centrality members. However, a network analysis adds an essential qualifier: access may limit one's autonomy as well as give avenues for influencing the world around them. Network influence is rarely one-directional, even when it is unequal. Conflicts may arise between states that are part of an alliance network; trade ties can be used for economic penalties; normative bonds can be used to coerce compliance through name and ridicule; and phone and email records can be used to destroy a terrorist network. State positions can be viewed as anticipated to play specific responsibilities due to the structure and ties of the network. When it comes to network effects, maybe no modern state is better represented than Germany, which has strong linkages to both the Atlantic and worldwide networks. The European Union's institutions reflect Germany's predominance in Europe's economy, which is reflected in their policies (EU). These networks of influence also constrain German policy, particularly its security policy. It is impossible to forecast Germany's foreign policy orientation based just on its military or economic capabilities. Since the end of World War II, the German elite has maintained a system of reciprocal constraints inside complex, overlapping networks.

- Access to the network is limited to one dimension. Another method by which a node's influence can grow is through its exclusive linkages to other, weaker links in the network, such as China in Figure 1. For example, a node that bridges structural gaps in the network can become a broker and earn influence; social capital can be used to gain social power. Because it may be the only link to the wider network, a node that functions as a bridge or broker might gain influence through its centrality (defined as betweenness). It's tough to establish relations between Iran and North Korea in Figure 1 (just as it is in real life). To put it another way: Brokerage power and potential leverage are like each other, in that power comes from connections with those who are less central, while influence comes from connections with other nodes who are more central than you are. Brokering power is particularly common in networks with "small-world" features, such as dense local connection coupled with short global links.

Imperial systems are a good illustration of how much authority is given to a network broker. Most definitions of empire focus on the relationship between the imperial metropolis and its periphery territories. An equally essential aspect is that power is seized by metropolis due to weak ties between nodes on periphery, according to network theory. In addition to its inherent military or economic strengths, the metropolis gains negotiating power with its colonial

possessions by its capacity to establish and sustain exclusive or near-exclusive linkages with societies on the periphery [2].

- Network power is derived from the capacity to de-link from the network, rather than from its position in the network. Networks and markets share a lot of parallels, and this type of power shows that. Less embedded nodes generally wield exit power at the edges of networks, where negotiating power is the power of brokers and social power belongs to strongly linked nodes. People who are being targeted by the network's strategic efforts to abuse bargaining power may threaten to leave if it goes on much longer than expected. So the presence of external options in gauging network power becomes crucial. Both Iran and North Korea are in a precarious position in Figure 1. Still, North Korea's alternatives are limited due to its utter reliance on China, whilst Iran relies less on the country. When deciding how to link to networks, exit threats are less credible if nodes preferentially link to better connected nodes in a network. As a node's social power dwindles, the likelihood of an escape increases. Those nodes with negotiating power will try to minimise the danger of leaving, either by improving their appeal to network partners or by utilising coercion. Back to the typical imperial network, escape was limited by force and the lack of political "space" that had not been conquered (exit from one empire risked capture by another). Despite the fact that criminal and terrorist organisations may use coercion to keep people from leaving, the behaviour of these groups typically implies that they are competing with one another for members and that preventing people from leaving has a high reputational cost.

Conclusion:

Using social network analysis to study international relations presents an essential theoretical question: can international relations represent society, and how? The English School, world polity theorists, and others who have advocated a sociological approach in international relations have maintained that "society" is more than a metaphor for the international system. Several recent research on socialisation by international institutions have recognised the connections between other social forces and those at action between nation-states and their administrations. It is possible to use network analysis to evaluate these assumptions and to investigate how international society varies from a more individualistic society. Network analysis puts new insight on familiar aspects of international relations in each of these situations. On the other hand, network analysis has to be tailored to the specific needs and difficulties of the field.

Network analysis, like previous foreign policy innovations, has both potential and risk. Organizations such as TANs and dark networks can be tested for their behaviour and survivability through precise network structure measurements. For international relations, the findings and assumptions of network analysis in various fields should be studied carefully. In addition, the transmission of findings from personal social networks must be properly examined. In a networked world, the problem of investigating networks of individuals, countries, or other units does not go away in international relations. It's also possible to re-examine basic notions like power, diffusion, and socialisation using network analysis if these difficulties can be overcome. Network analysis, taken to its logical conclusion, may provide some empirical support for the idea of a global society. Datasets that are daunting in their novelty and scale are reliant on this promise, of course. New tools and theories may bring with them a slew of benefits and drawbacks that observers may disagree on. It is only via a more thorough understanding of network analysis by individuals involved in international relations that we will be able to analyse this balance accurately.

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