

POL486: Networks in International Politics

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Contents

| | | |
|----------|---|----------|
| 1 | Introduction to Network Analysis | 2 |
| 1.1 | Olga V. Chyzh. Network analysis in international relations. In Cameron G. Thies, editor, Handbook of International Relations, pages 158–170. Edward Elgar Publishing, 2025. | 2 |
| 1.1.1 | Networks in International Relations | 2 |
| 1.1.2 | Methodological and Theoretical Contributions | 2 |
| 1.1.3 | The Debate and Normalization of Network Analysis in IR | 3 |
| 1.1.4 | Current Research and Future Directions | 3 |
| 2 | Network Centrality | 4 |
| 2.1 | John F. Padgett and Christopher K. Ansell. Robust action and the rise of the Medici, 1400–1434. American Journal of Sociology, 98(6):1259–1319, 1993. | 4 |
| 2.1.1 | Introduction and Core Argument | 4 |
| 2.1.2 | Core Concepts Explained | 4 |
| 2.1.3 | Historical Context: Florence (1400–1434) | 4 |
| 2.1.4 | Methodology and Data | 5 |
| 2.1.5 | Empirical Findings: Attributional vs. Network Structure | 5 |
| 2.1.6 | Network Dynamics: How the Medici Party Emerged | 7 |
| 2.1.7 | Network Identities: Robust Action and Legitimacy | 8 |
| 2.1.8 | Conclusion | 8 |
| 3 | Communities | 8 |
| 3.1 | Marina G Duque. Recognizing international status: A relational approach. Inter-national Studies Quarterly, 62(3):577–592, 2018. | 8 |
| 3.1.1 | Central Argument and Thesis | 8 |
| 3.1.2 | The Conventional (Attribute-Based) Approach and Its Flaws | 9 |
| 3.1.3 | A Relational Theory of Status | 9 |
| 3.1.4 | Empirical Strategy and Methodology | 10 |
| 3.1.5 | Key Findings | 10 |
| 3.2 | Wayne W Zachary. An information flow model for conflict and fission in small groups. Journal of Anthropological Research, 33(4):452–473, 1977. | 10 |
| 3.2.1 | The Problem of Fission in Small Groups | 10 |
| 3.2.2 | Case Study: A University Karate Club | 11 |
| 3.2.3 | Social Network Models and Their Limitations | 11 |
| 3.2.4 | The Capacitated Network Model | 11 |
| 3.2.5 | Analysis and Results | 12 |

1 Introduction to Network Analysis

1.1 Olga V. Chyzh. Network analysis in international relations. In Cameron G. Thies, editor, Handbook of International Relations, pages 158–170. Edward Elgar Publishing, 2025.

1.1.1 Networks in International Relations

Core Premise: International politics is inherently networked. Actors (states, organizations, individuals) are interconnected nodes, and their relationships (alliances, trade, conflict) are ties.

Significance of Networks:

- Membership in international clubs (e.g., NATO, EU, WTO) offers security, prestige, and economic benefits.
- Exclusion can lead to insecurity and foreign policy revisionism.
- Network embeddedness affects policy options and resource access.

Historical Context: IR scholars have long recognized the networked nature of global politics, but network analysis provided the specific tools to better align theory with empirical evidence.

Critique of Traditional IR Research:

- Network scholars criticized previous IR research, particularly the **dyadic design**, for its failure to account for interdependence among actors.
- The assumption of independence in dyadic analysis can lead to confounding bias, attributing effects to incorrect causes. For example, the US-Japan and US-South Korea relationships influence the Japan-South Korea relationship.

1.1.2 Methodological and Theoretical Contributions

Primary Contribution: Network analysis offered a way to measure previously unmeasurable concepts like system polarity, social power, and prestige. It also generated new research questions about connectivity.

Three Main Research Approaches:

- **Global Network Properties:** Studies focus on properties of the entire network, such as density of fractionalization, to explain outcomes like conflict and cooperation.
 1. **Example:** Maoz (2006) used network analysis to create a theory-informed measure of international system polarization, a concept previously hard to operationalize.
 - **Example:** Cruz, Labonne, and Querubin (2020) found that greater fractionalization (power divided among more clans) in local kinship networks in the Philippines was associated with better public goods provision.
 2. **Actor Positions:** This approach analyzes the positions of individual actors within a network to understand power and influence.
 - **Brokerage/Gate-keeping Power:** Held by actors connecting otherwise discontinued clusters.
 - **Network Centrality:** Used as a proxy for concepts like country prestige (Renshon 2016) or an organization's agenda-setting power (Carpenter 2011).
 3. **Overlapping Membership:** This approach examines how overlapping memberships reinforce each other's effects.

- **Example:** Parkison (2013) showed that sustaining an insurgency depends on the overlap between military networks and personal networks (kinship, friendship).
- **Example:** Eldredge and Shannon (2022) found that countries with high membership overlap in inter-governmental organizations are more likely to object to each other's human rights treaty reservations.

1.1.3 The Debate and Normalization of Network Analysis in IR

The 'Us-vs-Them' Debate: Early proponents of network analysis adopted a provocative framing, creating divisions within IR.

Points of Resistance: Critics argued that the traditional dyadic approach had not impeded major theoretical advances (e.g., the democratic peace) and that research designs should be tailored to the specific question, rather than assuming interdependence as the default.

Mainstreaming the Approach (c. 2016):

- An exchange in *International Relations Quarterly* between proponents and critics marked a key moment.
- A special issue on networks in *Journal of Peace Research* showcased the breadth of applications.
- The field of political methodology quickly welcomed and published inferential network analysis research.
- Subsequently, network research began appearing in top disciplinary journals, at major conferences, and in university curricula.

1.1.4 Current Research and Future Directions

Addressing Endogeneity: Developing tools to separate actor-level effects from network-level effects (e.g., democracy vs. clique size in trade).

Flexible Conceptualization: Re-evaluating the unit of analysis, such as treating alliances themselves as nodes to study action-reaction processes.

Expanding Scope: Applying network analysis to subnational and transnational levels, including rebel groups, NGOs, and political elites.

Social Media Data: Utilizing vast, inherently networked data from social media to study mobilization, censorship, and misinformation.

Future Directions:

- **Develop IR-Specific Theories:** Move beyond borrowing sociological theories to build network theories tailored to IR's unique actors and assumptions (e.g., anthropomorphizing states).
- **Model Hierarchical Networks:** Incorporate asymmetrical and hierarchical relationships, not just horizontal ones between equal actors.
- **Integrate Casual Inference:** Bridge network analysis with experimental and quasi-experimental methods to test network predictions more rigorously.
- **Model Co-evolution:** Better theorize and model the endogenous relationship where actor characteristics are both a cause and an effect of their network ties.

2 Network Centrality

2.1 John F. Padgett and Christopher K. Ansell. Robust action and the rise of the Medici, 1400-1434. *American Journal of Sociology*, 98(6):1259–1319, 1993.

2.1.1 Introduction and Core Argument

Central Claim: The rise of Medicean political control (1400-1434) in Florence, leading to the Renaissance state, was driven by **network disjunctures** within the elite that the Medici alone spanned.

Methodology: To understand state formation, one must move beyond formal institutions, groups, and goals to the **relational substrata** of people's actual lives. **Ambiguity and heterogeneity**, not planning and self-interest, are the raw materials of powerful states and persons.

Key Concept: *Robust Action*, Cosimo de Medici's (1380-1464) control style, characterized by **multivocal identity** as '**sphinx**', which harnessed power from these 'network holes' and resolved the inherent contradiction between 'judge' and 'boss' in organizations.

2.1.2 Core Concepts Explained

Political Centralization and the Judge/Boss Contradiction

- State-building involves centralizing power, a contradictory process requiring both reproduction (rules creating roles, interests, collective action patterns) and control (others' interactions serving one's interests).
- The contradiction: A founder cannot be both an impartial 'judge' (legitimacy through non-self-interest) and a controlling 'boss' (direct intervention undermines legitimacy).

Robust Action:

- **Definition:** A style of control where single actions can be coherently interpreted from multiple perspectives simultaneously (multivocality), serve as moves in many 'games' at once, and blur public/private motivations.
- **Mechanism:** Leads to 'Rorschach blot identities', where others attribute their own distinctive identity to the ego (Cosimo).
- **Goal:** Maintaining **flexible opportunism** and discretionary options in unpredictable futures, rather than pursuing specific, fixed goals. This involves **positional play:** maneuvering opponents into clarifying *their* (not your) tactical lines of action.
- **Resolution of Judge/Boss:** Credible robust action works because the center (Cosimo) appears to have **no unequivocal self-interests**; he 'merely' responds to requests. Control is diffused, as others infer and serve his inscrutable interests.
- **Preconditions:** Requires specific network structures for channeling requests and opaque, coherent interests to be credible.

2.1.3 Historical Context: Florence (1400-1434)

Transition: From late medieval urban factionalism to a regionally consolidated Renaissance state.

Ultimate Causes: Unsuccessful class revolt (Ciompi revolt, 1378-82) and severe fiscal crisis due to wars (Milan and Lucca wars, 1424-33).

Medici's Rise: Cosimo de Medici (1389-1464) founded a dynasty, consolidated a Europe-wide banking network, and sponsored the Renaissance.

Cosmio's 'Sphinx-Like' Character:

- Contemporaries deeply appreciated his power, yet eyewitness accounts describe him as indecipherable.
- He remained in the background, acting through deputies, with little known of his direct responsibilities.
- He never assumed lasting public office and rarely gave public speeches.
- His actions appeared reactive, serving his 'extremely multiple interests'.
- His replies were often brief and obscure, sometimes Delphic or using proverbs, allowing double interpretations.

2.1.4 Methodology and Data

Approach: An 'archaeological dig' into the structural preconditions for Medici's success, focusing on the composition and social network structure of the Medici party versus their opponents, the 'oligarchs'.

Sources: Based on extensive historical work, especially Dale Kent's 'The Rise of the Medici' (1978). Supplemented by 1427/1433 catasto (tax registers), Najemy (1982), and Martines (1963).

Data Types (9 types of relations among elite families):

- **Kinship:** Inter-marriage ties (asymmetric, 1394-1434).
- **Economic:** Trading/business ties, joint ownerships, bank employment, real estate ties.
- **Political:** Patronage and personal loans (multifaceted motives).
- **Personal:** Friendship, *malleadori* (surety) ties.

Definitions:

- **Family:** Operationalized as 'people with a common last name' (clan), consistent with Florentine social reality and data limitations.
- **Elite:** Families meeting any of three criteria:
 - 2+ members speaking in *Consulte e Prtiche* (1429-34);
 - 3+ members qualified for scrutiny (election to high office) in 1433;
 - Magnate clan (215 families identified, 92 for network analysis).
- **Blockmodel Analysis:** Aggregates actors (families) into structurally equivalent 'blocks' based on common external ties with outsiders, not dense internal relations (cliques). Used to visualize marriage and economic networks ('strong ties', fig. 2a) and political/friendship networks ('weak ties', fig 2b).

2.1.5 Empirical Findings: Attributional vs. Network Structure

Attributional Analyses (Challenging Traditional Views):

- **Economic Class (Wealth/Change in Wealth):** Both Mediceans and oligarchs were wealthy, but their wealth distributions were statistically identical and highly heterogeneous. Not a Marxist class struggle.
- **Social Class (Prestige/Political Age):** Oligarch were more skewed towards older participants due to the *absence* of 'new men' from their party, not absence of participants from the Medicean side. Mediceans were more socially heterogeneous, and relative to neutrals, were distinctly 'old-guard patrician'.

- **Neighbourhood Residence:** No statistically significant difference, both parties mirrored each other in geographical concentration, especially in San Giovanni. San Giovanni was the most polarized quarter.
- **Conclusion:** There was a **structural mismatch** between contemporaries' clear cognitives typifications (oligarchs as old, wealth patricians; Mediceans as heroes of rising new men) and the objective heterogeneity and overlap of social groups at the behavioural level. Classical group theories of parties (pluralist/neo-Marxist) are insufficient.

Social Network Structure (Blockmodel Analysis):

- **Predictive Power:** Marriage and economic blockmodels remarkably predict political partisanship, despite attributional identity. The Medici family itself bridged both sides.
 - 93% of families within the 'Medicean circle' were Medici partisans.
 - 82% of other partisan families (excluding neutrals) joined the oligarch side.
- **Medici Party Structure:** An extraordinarily **centralized 'star' or 'spoke' network system**.
 - Medici partisans were connected to other partisans and the oligarch elite almost solely *through the Medici*.
 - Medici partisans had remarkably few intraelite network ties, being 'structurally impoverished'.
- **Oligarch Party Structure:** Densely interconnected, especially through marriage, but this density led to **cacophony and cross-pressure**, not cohesive collective action (e.g., Rinaldo Albizzi's failed mobilization).
- **The Structural Atomization Puzzle:** Why did this centralized spoke system maintain itself.
 - Medici followers had clear incentives to form cross-ties to alleviate dependence.
 - The Medici discouraged **multiplex ties** (overlapping marriage and economic relations) with their followers, and also segregation of types of ties with the Medici themselves.
- **Resolution: Double Segregation of Attributes**
 - **Patrician Supporters:** Wealthy, old patricians (e.g., Guicciardini, Tornabuoni blocks) inter-married with the Medici, but resided *outside* the San Giovanni quarter.
 - **New Men Supporters:** Connected to Medici through economic or personal loan ties (e.g., Ginori, Orlandini, Cocco-Donati blocks), but resided *within* San Giovanni.
 - **Mechanism:** Patricians and new men despised each other and had limited interaction. Only the Medici linked these segments. This structural isolations inhibited defensive counter-alliances ('revolt of the colonels').
 - **Medici Strategy:**
 - * In marriage and friendship, Medici were highly selective (snobbish, marrying other patricians).
 - * In the economic sphere, they associated heavily with new men, unlike other elite families.
 - * Their distinctiveness was *associating with new men at all*, not representing them.
 - **New Men's Responsiveness:** 90-96% of new men economically/politically tied to Medici became active partisans. This was not due to active Medici mobilization of new men as a whole, but the *oligarchs extraordinary inaction* towards them, leaving new men 'structurally available'. Oligarchs' polemics branded Medici as 'class traitors' ("heroes of then new men").
- **Control Mechanisms:**
 - Spoke structure ensured dependence and channeled communication through Medici.
 - Double segregation prevented counter-alliances among partisans.
 - Formal affine relations with distant patricians (less frequent contact) contrasted with friendly, useful business ties with local new men (where status gap ensured deference).
 - Attributional heterogeneity made Medici a potent 'swing vote'.
 - **Contradiction was key to control**, especially with intense surrounding cognitive group identities.

2.1.6 Network Dynamics: How the Medici Party Emerged

No Grand Design: Cosimo did not design his party or initially intend to take over the state. The network patterns emerged from oligarchs' previous actions and inadvertently channeled material to the Medici.

1. Dynamics of Patrician Marriage (1385-1420):

- **Context:** Oligarchs' reconsolidation of control after the Ciompi revolt (1378).
- **Historical Trend:** Increasing rates of **neighbourhood exogamy** in Florentine elite marriage. This dissolved older 'neighbourhood solidarity' mode of elite organization (quasi-feudal, intra-neighbourhood hierarchies).
- **Elite Closure (Post-Ciompi, 1382):**
 - * **Shunning 'Class Traitors':** Patrician families (like Medici) who sympathized with Ciompi were severely ostracized in marriage by victorious oligarchs. This created the **structural barrier** seen in Figure 2a between oligarchs and Medicean patrician blocks (Guicciardini, Tornabuoni).
 - * **Oligarch Co-optation and Cross-Neighbourhood Cycles:** Oligarchs began forming **cross-neighbourhood marriage cycles** to co-opt potentially bridging "swing vote" families (e.g., Rondinelli). This created a dense, citywide elite, closing in on itself.
 - * **Outcast Patrician Exogamy:** Structurally isolated, outcast patricians (like Medici) were forced to marry fellow isolates *outside* their neighbourhoods to preserve status, leading to higher exogamy rates among them.
- **Medici's Anomalous Position:**
 - * **Survival:** Veieri di Cambio's (Medici clan head) defusion of a pro-Alberti revolt in 1393 and Giovanni de Medici's later circumspection (avoiding politics, squelching discontent) saved the Medici name from utter ostracism. This earned them begrudging oligarch gratitude.
 - * **Limited Co-optation:** Oligarchs slowly relented in the 1420s, allowing some intermarriage with Medici (e.g., Albizzi, Gianfigliuzzi blocks), but only after the Medici were already deeply isolated.
 - * **Exploiting Structural Holes:** Oligarchs over-focused on containing San Giovanni (Ricci's old home), creating a 'structural hole' in the Santo Spirito quarter. The Medici gradually exploited this, directing 100% of their own marriages to Santo Spirito by the early 1430s, often 'wife-receiving' (less status-picky).
- **Adaptive Learning:** Elite tactics evolved not from grand strategies but as a mutually adaptive learning process, with families making 'boundedly rational local action' from their egocentric network positions.

2. Dynamics of New Men Economic Ties (1420s-1430s):

- **Catalyst:** Milan and Lucca wars (1424-33) led to devastating tax extraction, threatening family patrimonies.
- **Neighbourhood Politics Revival:** Tax assessments by neighbourhood intensified local politics.
- **Oligarch Repression:** Patricians legislatively targeted new men; successful repression abolished new men's nascent corporate forms (religious confraternities), leaving them without local support.
- **Medici as Exception:** Locked in by their dense marriage network, most oligarchs rejected appeals from new men. The Medici, with their 'structurally contradictory position', had the discretion to respond to pleas from San Giovanni new men.
- **Medici Self-Consciousness:** The surge of supplication from San Giovanni new men during the Milan war galvanized the Medici into self-awareness as a political party. Oligarch actions (e.g., Rinaldo Albizzi's class alliance request to Giovanni de Medici, which Giovanni equivocally refused) further solidified the Medici as a distinct faction.

2.1.7 Network Identities: Robust Action and Legitimacy

Credibility of Robust Action: The contradictory attributions of ‘Medici self-interest’ (hero of new men vs. patrician) were credible because the disparate groups of Medici supporters rarely had the opportunity to compare notes privately. Even if they had, low trust would have prevented agreement.

Opaque Self-Interests: Medici goals (money, prestige, power) were tied to specific roles, not an overarching utility function. In chaotic times, the “games themselves are all up for grabs”, making revealed preferences impossible to infer *a priori*. Cosimo’s and Giovanni’s “shrewd and multivocal opportunism” was a feature of varying game structures, not fixed personal goals.

Legitimacy (*Pater Patriae*):

- Cosimo was enshrined as *pater patriae* upon his death, transmuting his ambiguity into public interest.
- He achieved this not by directly defeating oligarchs or slinging mud, but by **positional maneuvering**.
- His ‘reactive character’ forced oligarchs into aggressive, self-interested offensive actions (e.g., repression, attempted seizure of city hall).
- During the fiscal crisis, Cosimo channeled his bank’s assets into state debt funding, gaining the appearance of Florence’s ‘financial saviour’ while his opponents faced ruin.
- This led new men and political neutrals to delegitimize the oligarchs (labeling them as self-interested) and embrace Cosimo as saviour of the republic, leading to his triumphal recall from exile.
- His robust, multivocal actions gained him the “legitimizing aureole of protector of the status quo”, transforming his party into a state.

2.1.8 Conclusion

State centralization and the Renaissance arose from tumultuous historical events filtered through elite transformation. Cosimo did not create the Medici party but shrewdly learned network rules. He used a shroud of **multiple, impenetrable identities** to maintain robust discretion and Solomonic legitimacy.

Understanding state building requires delving into the **relational substratum** of lives, recognizing the **localized, ambiguous and contradictory nature** of actions, networks, and identities. This heterogeneity explains the birth of political power.

3 Communities

3.1 Marina G Duque. Recognizing international status: A relational approach. *Inter-national Studies Quarterly*, 62(3):577–592, 2018.

3.1.1 Central Argument and Thesis

Problem: International relations scholarship relies on the concept of ‘status’ to explain phenomena like war and foreign policy, but lacks a clear understanding of what status is and how it is achieved.

Critique of Conventional View: Previous research treats status as a function of a state’s attributes, particularly material capabilities like wealth and military power. This approach is a form of material reductionism and fails to capture the social nature of status.

Author’s Thesis (Relational Approach): Status is not derived from state attributes but from **social recognition**. It is a relational process where a state gains admission into a ‘club’ after being deemed to follow its rules of membership. Status is therefore influenced by two key social processes:

- **Self-reinforcing Dynamics:** Recognition breeds more recognition.
- **Social closure:** A state's existing relationships and its similarity to other states influence its ability to achieve status.

3.1.2 The Conventional (Attribute-Based) Approach and Its Flaws

Definition: Defines status as a state's ranking on valued attributes, such as economic military, and technological capabilities.

Key Flaws:

- **Material Reductionism:** Reduces status to material power, making the concept analytically redundant.
- **Fetishism:** Mistakenly treats social relations as inherent properties of states. It equates status with possessing symbols (e.g., nuclear weapons), but these attributes have no intrinsic value without social agreement.
- **Reification:** Treats the status order as external to states, making status achievement an autonomous act rather than a social process of recognition.
- **Empirical Mismatch:** Fails to explain why some states with significant material resources receive low status (e.g., North Korea as a 'rogue state') or why others receive more recognition than their capabilities would suggest (e.g., Italy, Egypt).

3.1.3 A Relational Theory of Status

Definition (from Max Weber): Status is an "effective claim to social esteem in terms of positive or negative privileges". This has four key dimensions:

1. **Effective Claim (Recognition):** A state's claim to status must be recognized by others to be effective. Status involves admission into a 'club' based on following its distinctive lifestyle and rules.
2. **Social Esteem (Symbolic):** Status is based on 'social honour', which can be attached to any symbol, material or ideational. The value of attributes is socially constructed, not intrinsic.
3. **Social Hierarchy (Privileges):** The status order is a hierarchy that grants privileges to high-status members and disadvantages to low-status ones. This is maintained through **social closure**, where high-status groups form dense internal ties and justify their privileges based on their distinctiveness.
4. **Conventions (Practices):** The status order is regulated by conventions (norms and rules) that emerge from the practices of states themselves.

Two Key Relational Processes:

1. **Status is Self-Reinforcing:** Because status comes from peer attribution, states that are already highly recognized are more likely to attract additional recognition. This is a purely structural effect.
2. **Social Closure Shapes Status:** This has two implications:
 - **Connectedness matters:** A state's existing relationships, especially with high-status actors, influence its ability to gain status.
 - **Similarity begets recognition:** States tend to recognize other states that have similar values (e.g., democracy) and resources, a concept known as **homophily**.

3.1.4 Empirical Strategy and Methodology

Data: The network of diplomatic embassies from the Diplomatic Contacts Database.

- **Rationale:** Establishing an embassy is a costly and symbolic act of recognition. The network of embassies provides a comprehensive map of recognition practices.

Unit of Analysis: The **network of embassies** (a relational measure), not just a state-level count of embassies received. This preserves information about the structure of relationships (i.e., who recognizes whom).

Method: Temporal Exponential Random Graph Model (TERGM):

- **Advantage:** This model can test for both attribute-based (exogenous) effects and relational/structural (endogenous) effects, such as reciprocity and popularity. It also avoids statistical biases common when analyzing relational data.

3.1.5 Key Findings

The Relational model performs much better in explaining embassy ties than conventional attribute-based models.

Relational dynamics are powerful drivers of status recognition:

- **Popularity (Self-Reinforcement):** States with more embassies are significantly more likely to attract additional ones. A state that is one standard deviation above the mean in embassies received is **2.4 times more likely** to get another one.
- **Reciprocity:** States are **almost six times more likely** to have an embassy in another country if that country reciprocates.
- **Transitivity:** States are more likely to establish an embassy where their existing diplomatic partners also have a presence.

Similarity (Homophily) is crucial: States are significantly more likely to recognize other states that are similar to them in terms of democracy, human rights, economic freedom, and military spending. The relevance of attributes is socially defined.

State attributes have mixed and often counter-intuitive effects:

- While military capability positively correlates with recognition, higher wealth (GDP per capita) and possessing nuclear weapons are associated with a *reduced* likelihood of receiving an embassy.

Fundamental Values Matter: Values like democracy, human rights, and economic liberalism are at least as important for gaining recognition as material resources.

3.2 Wayne W Zachary. An information flow model for conflict and fission in small groups. *Journal of Anthropological Research*, 33(4):452–473, 1977.

3.2.1 The Problem of Fission in Small Groups

Central Issue: How and why fission (splitting) occurs in small, bounded groups is a long-standing topic of study in social anthropology.

Traditional Perspectives: Fission has been studied through lenses like descent theory and ecological adaptation.

Proposed Model: This study uses a new formal model based on **information flow** within a social network to analyze and predict fission.

Core Thesis: Fission is the result of an **unequal flow of sentiments and information** across the ties in a social network. This differential sharing leads to the formation of subgroups with greater internal stability, eventually causing a split.

3.2.2 Case Study: A University Karate Club

Context: The model was developed using data from a university karate club observed over three years (1970-1972).

The Conflict: A dispute arose between the club's instructor, **Mr. Hi**, and the president, **John A.**, over the price of lessons.

Factionalization: The club divided into two ideological factions:

- **Mr. Hi's supporters:** Viewed him as a spiritual mentor.
- **John A.'s supporters:** Viewed Mr. Hi as a paid employee attempting to raise his salary.

Process of Fission:

- Factions were not formally organized but emerged from existing friendship networks during political crises.
- Crises strengthened friendship bonds *within* factions and weakened bonds *between* them through selective interaction.
- After a series of confrontations, the officers, led John A., fire Mr. Hi.
- Mr. Hi's supporters resigned and formed a new club, completing the fission.

3.2.3 Social Network Models and Their Limitations

Standard Social Network Model: Represents individuals as points (**nodes**) and their relationships as lines (**edges**).

- **Graph Representation:** A visual diagram of nodes and edges.
- **Matrix Representation:** A square matrix of 0s and 1s, where a 1 indicates an existing relationship between the individuals presented by the row and column.

Key Limitation: Standard social network analysis is **static** and structural, ignoring the **processual aspects** of social activity. It is therefore inadequate for analyzing the process of fission.

3.2.4 The Capacitated Network Model

A Processual Model: This model views the network as a system of channels for information flow, enabling a processual analysis.

Model Specification: Defined as an ordered triplet (**V**, **E**, **C**).

- **V:** The set of individuals (nodes) in the network;
- **E:** The **existence matrix**, a standard 0/1 social network matrix indicating if a tie exists.
- **C:** The **capacity matrix**, which quantifies the relative strength (or potential for information flow) of each existing edge.

Determining Edge Capacity:

- Directly measuring "political information" flow is impossible.

- **Assumption:** The amount of information transmitted between two individuals is a **linear function** of the number of different social contexts in which they interact.
- **Method:** A scale of 8 interaction contexts was created (e.g., academic classes, bars, karate tournaments). The value for each edge in matrix C is the total number of contexts in which that pair of individuals was observed interacting.

3.2.5 Analysis and Results

Technique: The **maximum flow-minimum cut** labeling procedure.

- This technique models information as flowing from a **source** (Mr. Hi) to a **sink** (John A.).
- A **minimum cut** is the ‘bottleneck’ in the network – the break with the smallest capacity that separates the source from the sink.
- The **Max-Flow Min-Cut Theorem** states that the maximum possible flow between a source and a sink is equal to the capacity of the minimum cut.

Hypotheses Tested:

1. The minimum cut in the network will align with the factional divide.
2. The minimum cut will accurately predict membership in the two new clubs formed after the fission.

Findings: The model was highly accurate.

- It predicted faction membership with **100% accuracy**.
- It predicted membership in the post-fission clubs with **97% accuracy**.
- The single error involved an individual who was structurally part of John A.’s faction (and correctly placed on the sink side of the cut by the model) but joined Mr. Hi’s club for an overriding personal reason (an upcoming black belt test).

Uniqueness: The minimum cut was proven to be unique by reversing the network (source becomes sink) and re-running the analysis, which identified the same cut.