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Network analysis is a fundamental approach to the study of social structure. This chapter traces its development, distinguishing characteristics, and analytic principles. It emphasizes the intellectual unity of three research traditions: the anthropological concept of the social network, the sociological conception of social structure as social network, and structural explanations of political processes. Network analysts criticize the normative, categorical, dyadic, and bounded-group emphases prevalent in many sociological analyses. They claim that the most direct way to study a social system is to analyze the pattern of ties linking its members. By analyzing complex hierarchical structures of asymmetric ties, they study power, stratification, and structural change.



NETWORK ANALYSIS: SOME BASIC PRINCIPLES

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Network (or structural) analysis mystifies many. Some reject it as mere methodology lacking due regard for substantive issues. Some, not having played with blocks and graphs since grammar school, flee from unusual terms and techniques. Some use network concepts as an extra set of variables added on like a turbocharger to boost explained variance. Some dismiss one portion for the whole, saying for example that their study of class structure has little need for the supposed focus of network analysis on friendship ties. Others scorn it as nothing new,

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claiming that they too study social structure. Still others expand its approach to nonhierarchical, nongroup structures into a network ideology that advocates egalitarian, open communities. Some even use it as a verb, *networking*, to mean the deliberate creation of networks for instrumental ends.

These misconceptions arise because many observers (and practitioners) mistake the parts for the whole. They would harden network analysis into a method or soften it into a metaphor. Or else they would limit its power by treating all units as equal in resources, all ties as symmetric, and all content as information. Yet the power of network analysis resides in its fundamental approach to the study of social structure and not as a bag of terms and techniques.

My objective is to present, simply and clearly, an integrated statement explaining the development of network analysis and distinguishing its characteristics and analytic principles—I view network analysis as a broad intellectual approach and not as a narrow set of methods. I shall also demonstrate the current intellectual unity of three distinct research traditions and present the study of asymmetric ties as an intrinsic part of the network approach. Not all network analysts would agree with my views. Indeed, some of those whose work I discuss would not even consider themselves to be network analysts. Nevertheless, as this is the first such attempt in sociology, I offer it *faute de mieux*.

Network analysts start with the simple, but powerful, notion that the primary business of sociologists is to study social structure. While this focus on social structure may seem obvious, notice what it does. It deemphasizes analyses of why people act and emphasizes the

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structural constraints on their actions. It shifts attention away from seeing the world as composed of egalitarian, voluntarily chosen, two-person ties and concentrates instead on seeing it as composed of asymmetric ties bound up in hierarchical structures. This shift has important consequences at all analytic scales. In studying communities, for example, it abandons spatial determinism and does not assume automatically that all communities are bound up in local solidarities. In studying world systems, it moves away from sorting countries into traditional or modern categories on the basis of their internal characteristics (such as level of industrialization) and leads to the categorization of units on the basis of their structural relationships with each other.

The most direct way to study a social structure is to analyze the patterns of ties linking its members. Network analysts search for *deep* structures—regular network patterns beneath the often complex surface of social systems. They try to describe these patterns and use their descriptions to learn how network structures constrain social behavior and social change. Their descriptions are based on the social network concept of *ties* linking *nodes* in a social system—ties that connect persons, groups, organizations, or clusters of ties, as well as persons. This emphasis on studying the structural properties of networks informs the ways in which analysts pose research questions, organize data collection, and develop analytic methods.¹

Network analysts want to know how structural properties affect behavior beyond the effects of normative prescriptions, personal attributes, and dyadic relationships. They concentrate on studying how the pattern of ties in a network provides significant opportunities and constraints because it affects the access of people and institutions to such resources as information, wealth, and power. Thus network analysts treat social systems as networks of dependency relationships resulting from the differential possession of scarce resources at the nodes and the structured allocation of these resources at the ties. Some analyses record multiple types of ties between individuals in order to study the complex ways in which these multistranded ties link specific members of a social system. Other analyses focus on a few types of ties in order to study their overall pattern in a social system.

Network analysis has developed independently from other structural approaches in the social sciences, although it shares their general

affinity for interpretation in terms of underlying deep structures (Mullins, 1973; Parret, 1976).² In sociology, network analysis has had neither a basic programmatic statement nor a standard text. Rather, it has accumulated partial principles and conclusions from empirical studies and oral lore. There have been three distinct research traditions, and most members of each have not known the others' work in detail. Instead of one standard model, network analysts have used a number of fuzzy models with shared family resemblances. Much work is now coalescing, however, and researchers have begun to publish widely, form common groups, and start their own journals.³

Research Traditions

The Concept of the Social Network. Anthropologists usually pay a good deal of attention to cultural systems of normative rights and duties prescribing proper behavior within such bounded groups as tribes, villages, and work units. Normative analyses run into difficulty, however, when studying ties that cut through "the framework of bounded institutionalized groups or categories" (Barnes, 1969, p. 72). To study such crosscutting relationships, several anthropologists have shifted attention from cultural systems to systems of concrete ties (Nadel, 1957; Barnes, 1971). While anthropologists had long used network concepts as partial, allusive descriptions of social structure (Sundt, 1968; Radcliffe-Brown, 1940; Bohannan, 1954), several analysts started developing these concepts more self-consciously and systematically in the 1950s, defining a network as a set of ties linking social system members across social categories and bounded groups.

Researchers began using network concepts to study Third World migrants from rural areas to cities. These migrants were no longer members of solidary village communities, and conventional modernization theory suggested that they would become rootless members of urban mass society (Kornhauser, 1968). Network analysts demonstrated that many migrants continued to maintain ties to their ancestral villages as well as to form new urban ties. The migrants' complex social networks, composed of both rural and urban ties, helped them to obtain resources from both the village and the city in order to cope with the demands of modern life (Mitchell, 1961; Mayer and Mayer, 1974). Hence the network analysts refused to accept the

weakening of village solidarities as proof of the loss of community. Instead, by tracing ties and resource flows, they showed how the migrants were able to maintain viable—though spatially and socially dispersed—network communities composed of rural and urban ties. Thus their network approach enabled these anthropologists to account for the continuing communal integration of migrants under conditions of capitalistic transformation, urbanization, and long-distance spatial and social mobility.⁴

Network analysts soon started studying all ties and not just the residual ones that crossed group and category boundaries. They elaborated the original sensitizing metaphor of the social network into a series of concepts to analyze the structure of ties. Elizabeth Bott (1971), for example, studied small-scale social integration by calculating network *density* (the ratio of observed ties in a network to the maximum number of possible ties). She found that husbands and wives who were members of separate, densely knit kinship networks tended to have more segregated marital relations than did couples who were members of loosely knit networks. In recent years, several ethnographers have adopted mathematical tools (Kapferer, 1972; Seidman and Foster, 1981) while others have used the study of interpersonal networks to analyze political-economic structures of power and dependency (Blok, 1974; Pickvance, 1975; Roberts, 1978; Bodemann, 1980). Their work has continued to be descriptively rich, emphasizing the variety of ties in social systems and the resources that flow through these ties.

Social Structure as Social Network. In the past twenty years, many sociologists have worked to expand network concepts into a comprehensive structural formulation. Greatly increasing the scope and claims of network analysis, they seek to treat all social structures as social networks. In the words of one influential paper: “The presently existing, largely categorical descriptions of social structure have no solid theoretical grounding; furthermore, network concepts may provide the only way to construct a theory of social structure” (White, Boorman, and Breiger, 1976, p. 732).

The diversity of contemporary research is a result of sociologists linking network concepts with a variety of technical and substantive concerns. Their work has combined the original organizing network concept with a Simmelian emphasis on the pattern of ties affecting social behavior (as in Simmel [1908], 1971), a sociometrically based

desire to measure network properties quantitatively (as in Freeman, 1979), an epidemiological and communications interest in resource diffusion processes (as in Coleman, Katz, and Menzel, 1966; Rogers, 1979), and a contemporary bent for mathematical reasoning (as in White, 1965; Lorrain and White, 1971). Steeped in quantitative traditions, many sociologists have sought to describe the structure of networks as precisely as possible. They have gathered survey and observational data from a variety of settings, using graph-theoretic and matrix-algebraic techniques to analyze social structures.

Sociological network analysts have had two distinct orientations. Some have been *formalists*. They concentrate on studying the form of network patterns rather than their content, sharing a Simmelian sensibility that similar forms may have similar behavioral consequences in a wide range of substantive contexts. Many formalists take a bottom-up approach, treating interpersonal triads as the building blocks of social structure. They wonder about the empirical distribution of different types of triads ("the enemy of my enemy is my friend"), the fit of these distributions with theoretical predictions, and how the clustering of triads structures large-scale social systems (see many of the papers in Holland and Leinhardt, 1979b). Other formalists prefer a top-down approach, arguing that they can study local structures only within the context of overall structures. They want to use network analysis to map the overall role structure of a social system (as in Boorman and White, 1976; Light and Mullins, 1979; White, 1981).

The second orientation has been a broad *structuralism*—that is, using a variety of network-analytic concepts and techniques to address the substantive research questions that preoccupy most sociologists. Some researchers analyze *whole networks*—all the ties of a certain kind among all the members of a population—to study the underlying structural patterns of links between large corporations (Levine, 1972; Levine and Roy, 1979; Scott, 1979; Miller, 1980; Carrington, 1981; Berkowitz, 1982). Others analyze *personal networks*—defined from the standpoints of focal individuals—to study how the composition, content, and configuration of ties affect the flow of resources to these persons (Gottlieb, 1981; Hirsch, 1981; Wellman, 1981a). Many scholars have been concerned with the effects of network properties on the integration of large-scale social systems, a sociological preoccupation since Durkheim ([1893], 1933):

- The conditions under which triads of ties concatenate into certain forms of larger networks (Davis and Leinhardt, 1972; Davis, 1979; Holland and Leinhardt, 1979a)
- The addition of new members to networks through ramifying ties (Rapoport, 1979)
- The likelihood of network ties between members of large-scale social systems (Milgram, 1967; White, 1970b; Bernard and Killworth, 1978; Pool and Kochen, 1978)
- The impact of network patterns on the integration of large-scale social systems (Kemper, 1972; Granovetter, 1973; Laumann, 1973; Breiger, 1974)

Questions of resource access are closely associated with questions of network form. How does one go about reaching another node in a network? Studies of searches for abortionists (Lee, 1969) and jobs (Granovetter, 1974; Boorman, 1975; Delaney, forthcoming) have demonstrated the effects of different network patterns on access to resources.

Structural Explanations of Political Processes. A third research tradition contends that political processes result from the position of interest groups and nation-states in large-scale structures of exchange and dependency. Members of this tradition rarely use network-analytic terms or techniques, and few see themselves as network analysts. Yet they share the network analysts' claim that the most important characteristic of individual units is their position in social networks and their emphasis on studying the ways in which the pattern of ties in a social system allocates resources unevenly (Friedmann, forthcoming-a).

Some scholars in this research tradition analyze the ways in which networks and coalitions structure contentions for power within states. Their work juxtaposes neatly with recent historical research into the demography and structure of families and communities (Anderson, 1971; Laslett, 1971; Katz, 1975; Tilly and Scott, 1978; Johnson, 1979; Maynes, 1981). They are reacting against psychologistic "relative deprivation" studies that explain political behavior in terms of the personal attributes and internalized norms of individuals (Davies, 1962). In contrast, the structuralists emphasize the pattern of links between interest groups, the linkage of these groups to resources through networks, the extent to which contending groups mobilize, and the structural possibilities for coalitions and competitive relations (Oberschall, 1978; Tilly, 1978, 1979, 1980).

Another group of scholars uses network concepts to explain the internal structure of a state in terms of transnational links of dependency *between* states or interest groups. Their work has attacked single-state analyses that explain a state's development solely in terms of the social structure, norms, and values of that state (McClelland, 1961; Hagen, 1962; Pye, 1962; Moore, 1979). The structuralists argue that asymmetric linkages between the core and periphery of the *world system* affect socioeconomic development more than does internal backwardness or modernity. A number of research groups have made contributions to this work: analyses emphasizing the association between international terms of trade and the internal structures of dependent countries (originally called *dependency theory*; see Frank, 1969; Delacroix and Ragin, 1981); analyses of underdevelopment in terms of the production and trade of primary resources (originally called *staples theory*; see Innis, 1956; Curtis and Edginton, 1979); and analyses of imperial relations, capital formation, and class structure (see Friedmann, 1978, forthcoming-b; Skocpol, 1979).

The Network Alternative

Norms and Structures. Network analysts want to study regularities in how people and collectivities behave rather than regularities in beliefs about how they ought to behave. Hence network analysts try to avoid normative explanations of social behavior. They dismiss as non-structural any explanation that treats social processes as the sum of individual actors' personal attributes and internalized norms (see Mullins, 1973). Such explanations find sociological regularities when people in the same social categories (having similar attributes) behave similarly in response to shared norms. Since they are concerned with individual motives for action, they are ultimately psychological and not sociological. Based on assumptions of shared attitudes, they inherently treat social integration as the normal state. They define "the relation of people to society and to social change in terms of shared consciousness, commitments, normative orientations, values, systems of expectation" (Howard, 1974, p. 5).

The network critique suggests that normative explanations overlook the ways in which structured access to scarce resources determines opportunities and constraints for behavior. True, many sociologists do refer to the structural location of individuals to explain the

acquisition of norms. Yet their explanations still treat persons as individuals moving like compasses in response to internalized norms.

Are norms cause or effect? Network analysts tend to treat them as effects of structural location. They argue that accounting for individual motives is a job better left to psychologists. They suggest that sociologists should explain behavior by analyzing the social distribution of possibilities: the unequal availability of resources such as information, wealth, and influence as well as the structures through which people may have access to these resources. They study the processes through which resources are gained or mobilized—such as exchange, dependency, competition, and coalition—and the social systems that develop through these processes.

If norms are treated as effects, then how do network analysts explain why people behave the way they do? Network analysts deal with matters of normative motivation in four ways. The first type of analysis excludes questions of human motivation and concentrates on describing and explaining social systems only in system terms. One study, for example, modeled systems of social mobility in the American Episcopal church (White, 1970a). The Episcopal ministers' motives for changing positions were irrelevant to their regular movements through linked *vacancy chains*.

The second type of analysis treats social structures as providing constraints and opportunities for social behavior (Mayer, 1966; Burt, 1980a). This work does not deny the existence of normatively guided behavior but concentrates on analyzing the structurally determined limits of the behavior. As Harrison White (1968) argues:

My personal *values* are voluntaristic individualism. I wish for myself, and others, as much freedom as possible, i.e., as much dignity as possible. This value becomes a mockery without facing the constraints of social structure. Much better a twig of genuine freedom wrung from a tree of constraint than an artificial tinsel forest of freedom. . . .

Most sociology and social science, especially in the U.S., takes the *view* [of] voluntaristic individualism: basic reality is in individuals' values and choices, social structure, being derived therefrom, being merely epiphenomenal. . . .

The fruit of much sociological theory is this deception: social structure must be the sum of individual values so you can define it *a priori* out of your head. Or in recent versions, you can find it by pooling responses of populations to questionnaires. . . .

The third type of analysis suggests that structural constraints and opportunities explain social behavior more fully than does normative motivation. "Most studies find little or no correlation between an individual's attitudes or normative beliefs and his behavior" (Cancian, 1975, p. 112; see also Deutscher, 1973). In one experiment, many persons obeyed orders to shock others "lethally":

[Many were] against what they did . . . and many protested even while they obeyed. But between thoughts, words, and the critical step of disobeying a malevolent authority lies another ingredient, the capacity for transforming beliefs and values into action. Some subjects were totally convinced of the wrongness of what they were doing but could not bring themselves to make an open break with authority. Some derived satisfaction from their thoughts and felt that—within themselves, at least—they had been on the side of the angels. What they failed to realize is that subjective feelings are largely irrelevant to the moral issue at hand so long as they are not transformed into action. [Milgram, 1974, p. 10]

The difference between normative and structural analyses is clearly apparent in their studies of modernization. Normative studies argue that rural Third World inhabitants become modern in their attitudes before they participate actively in urban industrial social systems (Inkeles and Smith, 1974). Structural studies, on the other hand, argue that villagers do not migrate to an industrial city because of newly adopted modern norms and values but because previously migrated kin, friends, and neighbors have promised to help them find homes and jobs. They find that migration is rarely a once-and-for-all, uprooting, and isolating experience. Rather, migrants travel and communicate back and forth between their new residence and ancestral homeland (Jacobson, 1973; Mitchell, 1973a; Roberts, 1973; Howard, 1974; Mayer and Mayer, 1974).

The fourth type of analysis explains the uneven distribution of norms as a structural phenomenon. These analyses point out that “people do not form their attitudes in direct response to their attributes, which in themselves have no causal force” (Erickson, forthcoming). Rather people acquire norms, as they do other pieces of information: through their ties structured in social networks. Information flows between network clusters through shared members (Fischer, 1975; Fine and Kleinman, 1979). Where these clusters have few links to other parts of the network, distinctive subcultures form. (See Cohen’s 1969 and Schildkraut’s 1974 accounts of West African minorities and Brym’s 1978 account of Russian Jewish socialist intellectuals in late Czarist Russia.) Thus not only is normatively guided behavior constrained by the structure of networks but the inculcation of these norms is differentially reproduced through these networks.

Aggregated Categories and Relational Structures. Sociologists have long relied on categorical analyses that treat social processes as the sum of individual actors’ personal attributes and internalized norms. They “have been largely content to aggregate in only two ways: either by positing categorical aggregates (such as ‘functional subsystems,’ ‘classes’) whose relation to concrete social structure has been tenuous; or by cross-tabulating individuals according to their attributes (such as lower-middle-class white Protestants who live in inner city areas and vote Democrat)” (White, Boorman, and Breiger, 1976, p. 733).

Such analyses lump persons with similar attributes and norms into social categories (“women,” “alienated”) without regard to the structure of relationships among them. Hence they interpret social behavior as the result of individuals’ common possession of attributes and norms rather than as the result of their involvement in structured social relationships. This methodological individualism has led in a number of ways to the “neglect of social structure and of the relations among individuals” (Coleman, 1958, p. 28):⁵

1. Categorical analyses treat each social system member as an astructural, independent unit of analysis. Since these analyses assume random linkages, they cannot take into account the members’ structural connections. “But of course individuals do not act randomly with respect to one another. They form attachments to certain persons, they group together in cliques, they

establish institutions" (Coleman, 1964, p. 88). Hence aggregating each member's characteristics independently destroys structural information just as centrifuging genes destroys structure while providing information about composition.

2. Categorical analyses concentrate on the attributes of discrete individuals. For example, they treat an inherently structural phenomenon, social class, as a personal attribute: socioeconomic status. Yet "it is as useful to tell me that 'power' is localized in the X club of New York as it is to tell me that my soul resides in my pineal gland; the premise is false . . . social vitalism" (Levine and Roy, 1979, pp. 360–361).
3. Many analyses compare distributions and correlations of aggregated categories of attributes. They focus on the causes and correlates of internal variation within a social category—relating socioeconomic status to voting behavior, for example. At best, such analyses use categorical memberships as proxy measures of structured relationships (see Friedmann, 1979, on Weber).
4. When analysts treat a category as truly relevant rather than as a proxy, they expect members of that category to behave similarly. However, coordinating ties among category members may be responsible for the similar behavior. How these ties function is still an open question. Thus the artisans of the Vendée did not all rise up spontaneously as the aggregated indignation of thousands of individuals; rather, ties between local communities and occupational groups structured political activity (Tilly, 1967).
5. By treating only categories and groups as the relevant organizational units of analysis, analysts affect the ways in which they study ties that cut across category and group boundaries. They must treat such ties as marginal when in fact the category or group may be truly irrelevant to the ties' functioning. Terming migrants *marginal*, for example, may well ignore their concrete urban relationships while unduly positing attachments back to ancestral villages.
6. Aggregating individual attributes encourages analysts to interpret social behavior as normatively guided. The aggregation process usually destroys information about structural linkages but retains information about internalized norms. Analysts often seize upon these norms to explain social behavior. This tendency can easily

lead to blaming the victim—as when analysts attribute lower-class shiftlessness to normative forces rather than to structural constraints (see Ryan's 1971 critique).

7. Normative interpretations lead analysts to look for behavior that is prescribed or common among category members. Either they do not recognize other kinds of behavior or they consider them deviant. Yet analysts may be calling behavior deviant only because they are classifying it in terms of categorical reference groups and not in terms of the social networks in which the behavior fits (Heinlein, 1961; Lee, 1978).

Hence some network analysts wonder whether “the stuff of social action is, in fact, waiting to be discovered in the network of interstices that exist outside the normative constructs and the attribute breakdowns of our very categories.” They urge sociologists to aggregate social regularities “in a fashion consistent with their inherent nature as networks”—that is, aggregate them by equivalent structural location rather than by equivalent categorical membership (White, Boorman, and Breiger, 1976, p. 734).

People belong to networks as well as to categories. Network analysts treat categorical memberships as reflecting underlying structural relationships—that is, patterned differences in the kinds of resources with which they are linked. They do not treat social class, for example, as a set of statuses occupied by a population but as a summary label for economic relations of power and dependency: “This shift in perspective markedly affects analysis: Once we assume that the unit of analysis is . . . a ‘world system’ and not the ‘state’ or the ‘nation’ or the ‘people’. . . , we shift from a concern with the attributive characteristics of states to concern with the relational characteristics of states. We shift from seeing classes (and status groups) as groups within a state to seeing them as groups within a world economy” (Wallerstein, 1974, p. xi).

Dyads and Structures. Many sociological approaches treat dyadic (two-person) interaction as the basic relational unit of analysis (see Homans, 1961; Berscheid and Walster, 1978). They disregard structural form, making an implicit bet that they can analyze ties in structural isolation without reference to the nature of other ties in the network or how they fit together.

In contrast, network analysts argue that structural form affects the flow of resources through specific ties. "To discover how A, who is in touch with B and C, is affected by the relation between B and C . . . demands the use of the network concept" (Barnes, 1972, p. 3). Network analysts suggest that structural properties, such as the extent to which two network members have mutual ties to others, strongly affect dyadic ties. They point out that sociologists cannot discover such emergent structural properties as coalition formation or network density from the study of dyads. Nor can they study structural effects, such as the impact of densely knit kin groups on marital relationships (Bott, 1971) or the effect of interlocking corporate ties on corporate profit levels (Carrington, 1981). This focus on structural form distinguishes network analysts from other transactional approaches, such as exchange theory or sociometry, which look at structural patterns primarily as they condition dyadic ties (see Kapferer, 1976; Burgess and Huston, 1979).

Even nonhuman social systems have emergent structural properties. Neither individual characteristics nor success in isolated pairwise dominance relationships explain hierarchies in chicken flocks, for example. It is the triadic (three-way) relationships among chickens that lead to these hierarchies, making the barnyard pecking order a complex structural phenomenon (see Landau, 1965; Chase, 1974, 1980).

Not only does network structure affect dyadic ties, but there are times when the larger network itself is the focus of attention. The ties between two individuals are important not only in themselves but also as parts of the social networks in which they are embedded. Each tie gives participants potential indirect access to all those with whom other dyad members are connected. These compound chains transmit and allocate scarce resources, fitting network members into larger social systems.

Groups and Networks. Network analysts try not to impose prior assumptions about the "groupiness" of the world. They suspect that few social structures are, in fact, sociometrically bounded. Hence they avoid treating discrete groups and categories as the fundamental building blocks of large-scale social systems. Instead they see the social system as a network of networks, overlapping and interacting in various ways.

This approach facilitates the study of ties that are not organized into discrete groups while permitting the discovery of those networks that are, in fact, sufficiently bounded and densely knit to be termed groups (see the discussions in Barnes, 1954, and Boissevain, 1974). For example, it allows the discovery of complex hierarchies of power rather than simple discrete strata (see Walton, 1976; Breiger, 1979). It leaves open the possibility of discovering ramified, spatially dispersed networks of community ties even when these ties do not fit within bounded neighborhood, kinship, or disciplinary solidarities (Tilly, 1970; Chubin, 1976; Fischer, 1976, 1981; Fischer and others, 1977; Verbrugge, 1977; Wellman, 1979, 1981b; Wellman and Leighton, 1979; Blau, 1980). It provides a structural basis for assessing the Durkheimian ([1893], 1933) thesis on the integration of social systems through complex divisions of labor.

Individualistic Statistics and Structural Methods. Statistical methods in sociology have grown increasingly sophisticated in multivariate capability. Yet the most widely used methods treat individuals as independent units of analysis. Their very assumption of statistical independence, which makes them so powerful in categorical analysis, detaches individuals from social structures and forces analysts to treat them as disconnected masses. Researchers can only measure social structure indirectly by organizing and summarizing numerous individual covariations. This limitation has led researchers, often unconsciously, to neglect social properties that are more than the sum of individual acts. Thus SPSS methods (Nie and others, 1975) become a world view. As one review of social indicator research noted:

Social structure, social process, social institutions—all that . . . goes into a social scientific understanding of society—are all nearly absent. The society whose conditions we are to be informed about is one of atomistic individuals, grouped immutably by sex, race, and birth cohort. Their well-being comes in discrete little packages of disconnected benefits. . . . It is a world of work without dirty work, where there are unions and strikes, but no industrial conflict. It is an economy virtually without corporations, a politics without either political parties or political power. [Seidman, 1978, p. 718].

Network analysts have criticized other sociological methods more thoroughly than they have created their own structural methods.

Their shift away from methodological individualism to structural analysis calls for the development of relational methods and the redefinition of units of analysis:

The unit is [now] a relation, for example, the kinship relation among persons, the communication links among officers of an organization, the friendship structure within a small group. The interesting feature of a relation is its pattern: It has neither age, sex, religion, nor income, nor attitudes, although these may be attributes of the individuals among whom the relation exists. These fundamental definitions prevent structuralists from adopting measurement techniques and methodologies available to other sociologists (for example, you cannot interview a friendship). A structuralist may ask whether and to what degree friendship is transitive or clustered. He may examine the logical consistency of a set of kin rules, the circularity of hierarchy of communication, or the cliquishness of friendship. We have, as yet, few tools for these tasks and almost none upon which there is universal agreement. Simply defining such terms as degree of transitivity has proven difficult! [Levine and Mullins, 1978, p. 17]

Network analysts have worked in three ways to develop methods for studying social structures directly: defining populations and samples relationally rather than categorically; shifting from categorical to relational methods of description; and developing statistical and determinate mathematical techniques of relational analysis to replace individualistic statistical techniques.

Network analysts often use the concepts and methods of graph theory—the mathematical analysis of nodes and links (Burt, 1980b; Frank, 1981). In the early days, many analysts drew graphs, but these had severe limitations in the scale of the social systems they could represent and the complexity of the sociological analyses they would permit. Hence most network analysts now use matrices in which each cell represents a potential tie from one network member to another.

Some matrix representations take into account the number of ties connecting two nodes or the amount of resources flowing between them. However, there are analysts who argue that the only essential information concerns the binary condition of whether any sort of tie connects the two nodes. They suggest that, given the lack of connectiv-

ity in most social systems, the crucial phenomenon is the presence of any sort of link to flows of resources and clusters of ties within the system (White, 1966; White, Boorman, and Breiger, 1976).

Many network analysts continue to use standard statistical methods, supplementing them with such measures of network properties as the density of ties and the centrality of members (Sonquist, 1980). Several analysts are working to develop relational, statistical methods for analyzing ties and networks (Fienberg and Wasserman, 1981; Holland and Leinhardt, 1981; Marsden, 1981). Others are developing procedures to make inferences from sampled network properties to large-scale structural phenomena (Granovetter, 1976; Erickson, 1978; Frank, 1978). One scholar, arguing that probabilistic judgments are intrinsic parts of social structures, is developing stochastic techniques to study serial judgments about resource flows (Padgett, 1980, 1981).

Many network analysts now use determinate mathematics to model and describe networks (Burt, 1980b; Erickson, forthcoming). *Clustering* techniques identify regions of high density in complex networks. Analysts have used them to describe network clusters and social closeness among large corporations, state authorities, and elite groups (Laumann, Galaskiewicz, and Marsden, 1978; Laumann and Marsden, 1979; Soref, 1979; Berkowitz, 1980; Alba, 1981a).

Whereas clustering tries to find clusters of individuals who have many ties among each other and few other ties, *blockmodeling* aggregates individuals who are in structurally equivalent positions because of their "similarity in ties to third parties rather than by choices of one another" (White, Boorman, and Breiger, 1976, p. 736). This determinate technique has helped researchers to discover basic social structures and to compare actual networks with hypothesized structures (Boorman and White, 1976; Arabie, Boorman, and Levitt, 1978; Levine and Mullins, 1978; Sailer, 1978; Breiger, 1979; Carrington, Heil, and Berkowitz, 1980; Light and Mullins, 1979; Snyder and Kick, 1979; Pattison, 1980).

The development of quantitative methods such as blockmodeling has been at the cutting edge of many recent analytic advances (Shepard and Arabie, 1979; Hubert, 1980; White, 1980; Mulherin, Kawabata and Sonquist, 1981). Other analysts, however, are developing ways of using fieldwork and archival methods to study network structures (Roberts, 1973; Tilly, 1975; Bodemann, 1980). The essence

of the network approach remains not in the method used but in posing questions and searching for answers in terms of structured connectivity.

Analytic Principles

The following principles, in the working kits of many network analysts, are a mixture of definitions, assumptions, partially tested hypotheses, and empirical generalizations.

Principle 1: Ties often are asymmetrically reciprocal, differing in content and intensity. The kinds of resources that flow through ties and networks include more than material goods. They can include such resources as information about one's environment and resources that are themselves part of the ties—such as affective gratification obtained through being liked.

Ties between two persons are usually asymmetric in the amount and kinds of resources that flow from each to the other. Few ties resemble the link between Damon and Pythias—intense, comprehensive, and symmetric. Most are asymmetric in content and intensity. There is rarely a one-to-one correspondence between what two persons give to each other; indeed, the overall relationship is often asymmetric (see Emerson, 1962; Cook, 1981).

One study found, for example, that only 36 percent of those named as close friends and kin feel symmetrically close in return to the persons who had named them. Their own close ties are with others; they have weaker asymmetric ties to those who name them (Shulman, 1972, 1976). Many people deliberately limit their claims for assistance from close ties in order to maintain the link (Wellman, 1981a). Yet such asymmetric ties still crucially connect network members to each other, and each is indirectly connected through the other's additional ties to larger social networks.

While ties are rarely symmetric, they are usually reciprocated in a generalized way. Not only do clients send resources to patrons, for example, but patrons usually send clients such resources as goods, information, or protection in order to maintain the ties. Furthermore, the power of patrons is to some extent based on their ties with clients, as the ties themselves are a scarce resource. The ties are clearly not symmetric; nevertheless they are often stable parts of a social system

(Wolf, 1956). Among the Ibadan Hausa, for example, reciprocal, asymmetric patron-client ties maintain complex trading networks over great distances (Cohen, 1969). Indeed, even the most totalitarian social systems have not been able to function solely through one-way, coercive relations. Reciprocal ties between guards and prisoners permeate prisons in order to ensure compliance (Solzhenitsyn, 1968; Charrière, 1970).

Principle 2: Ties link network members indirectly as well as directly; hence ties must be analyzed within the context of larger network structures. The prevalence of asymmetric ties calls into question the voluntaristic assumption that ties exist because two members of a dyad *want* to interact with one another (Berscheid and Walster, 1978; Evans and Northwood, 1979). The very nature of a tie is defined by the larger networks in which it fits; close friends relate quite differently in small, densely knit solidarities than in large, ramifying networks (Bott, 1971; Caulkins, 1981; Fischer, 1981).

In practice, many ties are with network members whom one does not like and with whom one would not voluntarily form a two-some. Such ties come as an involuntary part of the network membership package. They may be ties to persons who must be dealt with at work or in the neighborhood. They may be part of a solidary kinship group or friendship circle. They may be patron-client ties. Despite their involuntary nature, such ties are often important in terms of the time spent on them, the resources that flow through them, the ways in which they constrain other network members' activities, and the indirect access they give to the resources of third parties.

The possibilities for indirect ties are abundant because each direct tie links two individuals and not just two roles. Jack and Jill are linked by more than a single pail of water. While the role relationship between two members affects expectations for behavior, indirect ties are not necessarily restricted to a single role system. Network members use a wide variety of direct and indirect ties to search for resources, often traversing several role relationships (see Milgram, 1967; Lee, 1969; Travers and Milgram, 1969; Granovetter, 1974; Lin and Dayton, 1976). For instance, one neighbor often asks another to approach a local politician friend for help in dealing with City Hall. It is the overall structural context of network members that defines the specific ties (Burt, 1976, 1980b). Hence such phenomena as patron-client ties must

be treated as local manifestations of larger class structures (Bodemann, 1980).

Principle 3: The structuring of social ties creates nonrandom networks; hence network clusters, boundaries, and cross-linkages arise. We start with two weak assumptions. First, ties in networks are often *transitive*. If there is a tie between A and B and a tie between B and C, then there is an increased probability of a direct tie between A and C. For example, friends of friends are more than randomly likely to be friends and not to be enemies or not directly linked (Davis, 1970; Holland and Leinhardt, 1977). This transitivity assumption applies to all networks and not just to friendship ties. If there are transfer (or *brokerage*) costs so that each node in a chain of ties consumes some of the resource flow, then network members often find it more efficient to maintain direct ties.

Our second assumption is that there are *finite limits* to the amount and intensity of ties an individual can maintain (and that most individuals are near these limits). Consequently, most cannot add many new ties (or add new strands to existing ties) without giving up all or part of their existing ties.

Because of transitivity and reciprocity, two linked network members often draw others with whom they are linked into a cluster of ties in which most members are directly linked with each other (Abelson, 1979; Cartwright and Harary, 1979). Finite limits operate so that involvement in such densely knit clusters entails the loss of other ties. Jointly these structural processes encourage many ties within a cluster's boundary and few ties across its boundary. Such a clustered network contrasts markedly with a *random network*, in which each member is equally likely to be linked with each other member, or with a clusterless *even network*, in which each member has the same number of links (see Erdős and Spencer, 1974; Holland and Leinhardt, 1979a; Rapoport, 1979).

Transitivity is only a weak assumption or else the world might well resemble one giant network cluster (see Milgram, 1967). Network members often avoid certain direct ties in order to maintain structural autonomy, as when prodigal sons retain parental links through their siblings. Some direct ties, such as friendships with feuding coworkers, are structurally difficult to maintain. *Intransitivity* helps to separate

individuals from each other and to perpetuate discrete network clusters (White, 1966; Bernard and Killworth, 1973; Killworth, 1974).

Clustered networks have paradoxical implications for social system integration: "At the level of the individual, the system is highly connected, for he lies at the center of a dense network of direct and indirect social relationships. At the level of the total system it is highly disconnected, for there are many pairs who have neither direct nor indirect relationships" (Davis, 1967, p. 186). This sort of network pattern may have been the principal structural reason for the inability of the Italian-American residents of Boston's West End to form coalitions to defeat the massive slum clearance activities that destroyed their neighborhood. (The original account is in Gans, 1962; see also Granovetter's 1973 analysis.)

Many network ties are not bound up in clusters, however, as both finite limits and reciprocity are weak assumptions also. Individuals are usually members of multiple social networks and their ties can connect clusters. Such cross-linkages give clusters access to external resources and provide the structural basis for coalitions. At the same time, internal linkages allocate resources within a cluster and provide the structural basis for solidarity.

Principle 4: Cross-linkages connect clusters as well as individuals. The nodes of a network do not have to be individual persons. They can be clusters of ties, groups, nation-states, or other discrete units. Ties between such nodes may occur because some persons are members of several clusters or because certain persons have "foreign relations" with other portions of the network. While the physical ties may be between individuals, their structural importance is as links between clusters (Breiger, 1974).

When analysts focus on clusters and the links between them, they often are less interested in the internal ties within a cluster. They assume that if a tie between two clusters exists at all, then all members of one cluster are linked with all members of the other cluster because of internal ties within the clusters. Consider the case of interlocking corporate directorates. It is usually more significant that a director links two corporations than it is that common board membership links two directors personally. If officials of property development companies are also board members of a public housing agency, for example, the links may enable the companies to acquire inside infor-

mation about public housing activities. When most of the major companies are represented on the public housing board, the links are likely to aid the class interests of the industry rather than aid any particular companies. According to Craven and Wellman (1973, p. 81): "The ties give the managers of the public agency easy access to a number of 'trusted' private firms to which it can subcontract its work. Here, the relevant links are clearly between the corporate entities, both public and private—although the specific linkages are people, who hold directorships on the boards of both."

In many cases, analysts study the consequences of links between clusters for the structure of ties within clusters. *Cosmopolitans*, for example, have influence within communities because of their direct access to outside resources (Gouldner, 1957; Merton, 1957). Thus in many peripheral states, certain clusters of the local elites have privileged access to the social, economic, and political resources of core states. Their active use of these links to the core significantly structures the internal class relations of their own states and hinders the development of more autonomous elites (Frank, 1969; Delacroix and Ragin, 1981). Hence treating a cluster of ties as a node is an abstraction at one analytic level that does not necessarily imply ignoring the structure of relations within that cluster.

Principle 5: Asymmetric ties and complex networks distribute scarce resources differentially. Resources do not flow evenly or randomly in a social system with its asymmetric ties and bounded network clusters. The density of clusters, the tightness of cluster boundaries, and the patterns of ties within and between clusters all structure resource flows. Because of their structural location, members of a social system differ greatly in their access to these resources. Indeed, unequal access to scarce resources may in turn increase the asymmetry of ties.

Asymmetric ties and clusters concatenate into hierarchical networks with cumulative differences in access to scarce resources (Davis, 1970). These networks are not perfect one-way hierarchies (as are organizational trees): They contain both reciprocal ties transmitting resources in two directions and complex structures with multiple and cyclical paths. However imperfectly hierarchical, the cumulative effect of these networks is to distribute resources unevenly.

Researchers have used hierarchical network concepts to study the political and economic development of nation-states. They have

argued the importance of asymmetric ties *between* states, regions, and multinational interest groups to explain the nature of social structures *within* these states. Some researchers have suggested that the supposed backwardness of Third World social systems is less a matter of their internal rigidities and more a matter of their independent ties with other social systems (Wayne, 1975; Friedmann and Wayne, 1977). Others have shown the central importance of hierarchical networks in the formation of European nation-states (Skocpol, 1979; Wallerstein, 1974) and the operation of international commodity markets (Friedmann, 1978, forthcoming).

The incumbency of a structural position is itself a scarce resource, as it determines access to other resources. Many social system members profit from their structural positions as gatekeepers or brokers, for example. A gatekeeper, controlling access to an organization leader, often gains wealth, flattery, influence, use of organization resources, and personal pleasure in exercising control. A broker, linking two network clusters, takes a share of the resources passing through that position. Indeed, a canny broker may impede transitivity by working to prevent the formation of other direct links between these clusters. Brokers, by their very structural position, cannot be full members of any network cluster. Often their marginal nature means they are not fully trusted because no single cluster can exercise total social control over them (Goffman, 1963).

People as well as resources flow through networks as they change structural positions. The flows of people through positions and positions through people are *dual* flows (Breiger, 1974). Indeed, positions themselves may be subject to social mobility as people with different resources occupy them. Individual moves are part of linked *vacancy chains* (White, 1970a) as old incumbents create vacant positions by moving to new positions. (Thus vacancies also flow through systems.) Several network analysts have used the flows of persons through positions to analyze mobility in occupations, organizations, and housing (see White's 1970a study of the Episcopal church; Mullins's 1972 study of scientific advisers; White, 1971) and demographic constraints on the flow of cohorts through social systems (see Tepperman's 1977 study of Canadian elites and Howell's 1979 study of the !Kung).

Principle 6: Networks structure collaborative and competitive activities to secure scarce resources. Structured competition for scarce resources is inherent in a social system. In a system with finite resources, interest groups compete for access to them. In a nonrandom hierarchical network with asymmetric ties, members must use collaborative or complementary ties to gain access to these resources. Clustering within a network organizes these ties into more or less bounded factions and coalitions.

Network analysts have worked to show the structural basis of collective political activity. They have demonstrated how such acts of collective violence as food riots and rebellions are integral parts of broad contentions for power by competing interest groups. Those engaged in collective violence are not the uprooted, disconnected individuals whose putative existence has fascinated mass society theorists (see Davies, 1962; Kornhauser, 1968; Gurr, 1969). To the contrary: Those more deeply rooted and more densely knit into contending groups are more likely to be politically active—violently as well as nonviolently (see Tilly, 1967, 1975, 1979; Feagin, 1973; Shorter and Tilly, 1974; Oberschall, 1978; Snyder, 1978).

Competition for resources may lead to social structural change. Coalitions and factions shift in time, and network realignments can have broad systemic consequences. When local leaders in India transfer allegiance from one regional patron to another (in itself an outcome of alternative sources of rewards available in a network), this causes profound shifts in the social interactions of all the clients of this local leader as these clients themselves form and relinquish network ties (Mayer, 1966; Pettigrew, 1975).

Although such network realignments redistribute access to resources, they do not create thoroughgoing changes in a social system's division of labor. Social scientists have had difficulty explaining the conditions for comprehensive transformations of large-scale social systems either within single states or in larger social units (such as the development of the capitalist world system described by Wallerstein, 1974). While many since Marx have argued that structured competition for scarce resources creates conditions for large-scale social change, they have had difficulty specifying the transformational mechanisms.

Network modeling procedures may well provide a useful approach to the study of structural change. Blockmodeling, for example, can provide a set of rules for the transformation of one social system image—a simplified set of role relationships—into another (Pattison, 1980). If analysts can integrate such rules with more strictly historical work which models the conditions under which system members mobilize to claim scarce resources (see Tilly, 1978), the combination should improve our understanding of large-scale structural change.

Prospects

While network analysts have not yet produced a general theory, they have already developed a coherent set of characteristics and principles backed up by a sizable body of empirical work. To a great extent, network analysts have not competed directly with other sociologists to explain the same phenomena but have worked to reformulate basic issues. Their most significant achievements have been in posing new intellectual questions and showing new ways to describe social structures. Network analysts have proposed the substitution of world systems analysis for single-state modernization theories, political networks for psychological interpretations of collective violence, and vacancy chains for categorical social mobility analyses. They have mapped the interlocking ties of corporations and states in useful ways, and they have found abundant community ties by looking for them in networks rather than in neighborhoods. They are starting to develop relational methods to supplant explanations that have too often relied upon descriptive techniques, verbal persuasiveness, and esthetic appeal for acceptance.

The current state of network analysis probably is just a waystation to more comprehensive structural formulations. In this review I have reasoned upwards—working from the characteristics of individual ties to that of larger networks. In contrast, thoroughgoing structural formulation would reason downwards—working from large-scale network properties to the nature of ties and clusters.

Sociologists are just beginning to advance beyond intuitive ways of doing such top-down reasoning. One approach has been to model—specifying mathematically the characteristics of social struc-

tures (Boorman and White, 1976; Howell, 1979; Fararo, 1981; Seidman and Foster, 1981; White, 1981). Another approach has been to develop top-down structural analyses—discovering, for example, the nature of the family within the constraints of capitalist social systems (Foster, 1974; Friedmann, 1980; Wayne, 1980). Yet this latter work has also depended greatly on the persuasiveness of verbal descriptions. Here too the capacity of network analysis to pose questions would profit from an enhanced capacity to provide answers.

Notes

1. An alternative structural approach analyzes social systems primarily in terms of the distributions of the characteristics of their component units (such as differentiation and inequality) and secondarily derives linkage properties from these distributions (see Mayhew and Levinger, 1976; Blau, 1977). Mayhew (1980) argues the similarity of this approach with network analysis, contrasting their structuralism with individualism.

2. These structural approaches include the structural anthropology of cultural systems (as in Lévi-Strauss, 1969), structural linguistics (as in Jakobson and Halle, 1971), structural psychology (as in Piaget, 1970), and structuralist political economy (as in *Insurgent Sociologist*, 1979).

3. Wellman and Whitaker (1974), Freeman (1976, 1981), Klov Dahl (1977), Feger and others (1978), and Rice (1981) have all compiled bibliographies. *Connections* (the bulletin of the International Network for Social Network Analysis, founded in 1977) and *Social Networks* (a journal founded in 1978) provide contemporary coverage.

For reviews of network research see Bott (1971), Barnes (1972), Mullins (1973), Mitchell (1974, 1979), Whitten and Wolfe (1974), Leinhardt (1977), Burt (1980b), Alba (1981b), and Berkowitz (1982). Moreover, Srinvas and Bêteille (1964), Mitchell (1969a, 1969b, 1973b), Boissevain (1974, 1979), and Wolfe (1978) have discussed network analysis from an anthropological perspective. Their work complements my review here, as do the remarks from a sociological perspective of Howard (1974, chap. 1), White, Boorman, and Breiger (1976), Laumann (1979), Berkowitz and Heil (1980), Burt (1980b), Laumann, Marsden, and Prensky (1980), Pattison (1980), and Berkowitz (1982).

4. See the reviews and analyses in Wolf (1966), Mitchell (1969a, 1969b, 1969c), Wayne (1971, pp. 51–52), Boissevan and Mitchell (1973), Pèil (1978, 1981), Roberts (1978), and Peattie and Rein (1979). Numerous case studies exist—see, for example, Mitchell (1956, 1961), Gutkind (1965), Liebow (1967), Epstein (1969), Parkin (1969), Kapferer (1972), Jacobson (1973), Roberts (1973), Howard (1974, 1977), Mayer and Mayer (1974), and Boswell (1975).

5. These seven points are based, in part, on Howard (1974, chap. 1).

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