FIFTH EDITION

THE STRUCTURE OF SOCIOLOGICAL THEORY

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1991

WADSWORTH PUBLISHING COMPANY
Belmont, California
A Division of Wadsworth, Inc.

PART 5

Structural Theorizing

CHAPTER 27

Network Analysis*

Over the last 20 years, work within anthropology, social psychology, sociology, communications, psychology, geography, and political science has converged on the conceptualization of "structure" in terms of "social networks." During this period, rather metaphorical and intuitive ideas about networks have been reconceptualized in variable types of algebra, graph theory, and probability theory. This convergence has, in some ways, been a mixed blessing. On the one hand, the grounding of concepts in mathematics can give them greater precision and provide a common language for pulling together a common conceptual core of the various overlapping metaphors of different disciplines. On the other hand, the extensive use of mathematics and computer algorithms far exceeds the technical skills of most social scientists; and, more importantly, the use and application of quantitative techniques, per se, have become a preoccupation among many who seem less and less interested in explaining how the actual social world operates.

Nonetheless, despite these drawbacks, the potential for network analysis as a theoretical approach is great because it captures an important property of social structure—patterns of relations among social units, whether people, collectivities, or positions. For, as Georg Simmel emphasized, at the core of any conceptualization of social structure is the notion that structure consists of relations and links among entities. Network analysis forces us to conceptualize carefully the nature of the entities and relations, as well as the properties and dynamics that inhere in these relations.[1]

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*This chapter is coauthored with Alexandra Maryanski.

[1]For some readable overviews on network analysis, see Barry Wellman, "Network Analysis: Some Basic Principles," *Sociological Theory* (1983), pp. 155–200; Jeremy F. Boisevain and J. Clyde Mitchell, eds., *Network Analysis* (The Hague: Mouton, 1973) and *Social Networks in Urban Situations* (Manchester: Manchester University Press, 1969); J. A. Barnes, "Social Networks" (Addison-Wesley Module, no. 26, 1972); Barry S. Wellman and S. D. Berkowitz, *Social Structures: A Network Approach* (Cambridge, England: Cambridge University Press, 1988). Somewhat more technical summaries of recent network research can be found in Samuel Leinhardt, ed., *Social Networks: A Developing Paradigm* (New York: Academic Press, 1977); Paul Holland and Samuel

to describe rather than explain these processes. In fact, descriptions of events are what Giddens and many others mean by explanation.

His view of explanation is misguided, although I must confess that Giddens has produced an important contribution with it (I can only imagine how much better it would be if he dropped this extreme anti-science viewpoint). There are several reasons for this assertion, which, I should emphasize again, many others do not share. First, Giddens' work contradicts his belief that there are no invariant properties of the social world. If there are not basic and fundamental processes, what good is his conceptual scheme? Will it not be outdated as soon as lay actors incorporate it? My answer is no, and so is Giddens', at least implicitly. Giddens has isolated some of the basic properties and processes of the universe; just because lay actors know about them and lock them into their discursive and practical consciousness, these properties will not change. Second—and this is related to the above point—Giddens has a very narrow view of what a law is. For Giddens a law is an empirical generalization—a statement of covariance among empirical events. If this is your vision of law, then it is easy to assert that there are no universal laws, since indeed empirical events change (in accord, I should add, with many of the invariant processes in Giddens' conceptual scheme). Third, I think there are several examples of laws in Giddens' scheme, and it is at just these points where he articulates a law that the scheme takes on more clarity and (for me at least) more interest. Here is one example of a law that Giddens articulates but that he would deny as universal: "The level of anxiety experienced at the level of discursive and practical levels of consciousness is a positive function of the degree of disruption in the daily routines for an actor." There is also a similar proposition about anxiety and unconscious trust and ontological security, but I will for the present ignore this. There are many propositions like this one in Giddens' scheme, and these are universal. If they were not, then his scheme would not make any sense. And, most importantly, the law is not obviated by our knowledge of it, for an actor will not feel less anxiety if day-to-day routines are disrupted. One might even use the law to diagnose the problem and create new, or restore the old, routines, but in the process the law has not been obviated. For, when one's routines are disrupted, the individual will experience anxiety.

I have not extracted these and many other propositions from Giddens, since doing so would violate the essence of his approach. But herein resides the great flaw, and I hope that others working with Giddens' concept are not so antipositivistic as he. For there is too much insight into the basic properties and dynamics of human action, interaction, and organization to use the scheme as a mere "sensitizing device." It has far more potential than Giddens would admit for helping develop a natural science of society—that is, for developing abstract laws of the social universe.

THE DIVERSE ORIGINS OF NETWORK SOCIOLOGY

The rationale for network analysis can be found in several of sociology's early masters. For example, Georg Simmel's emphasis on "formal sociology" as an examination of the basic patterns of social relations, irrespective of their content or substance, captures the central thrust of network analysis.[2] For the core task of the network approach is to examine, at least initially, the underlying structure of social relations. Émile Durkheim's[3] analysis of "social morphology," an idea he took from Montesquieu,[4] can also be viewed as an early precursor to the network strategy. For Durkheim, morphological analysis involves "the number, nature, size, arrangement, and interrelations" of parts, and this general idea captures much of the flavor of the network agenda.

Yet it is closer to the present that we must seek the more important sources of inspiration for network concepts. Although a number of diverse scholars can be seen as the early founders of this approach, several figures stand out. Each of their contributions is briefly examined below.

Jacob Moreno and Sociometric Techniques

Jacob Moreno was an eclectic thinker, and we have already encountered his ideas on role and role playing in Chapter 18. But perhaps his more enduring contribution to sociology was the development of *sociograms*.[5] Moreno was interested in the processes of attraction and repulsion in groups, and so he sought a way to conceptualize and measure these processes. What Moreno and subsequent researchers did was to ask group members about their preferences for associating with others in the group. Typically, group members would be asked questions about whom they liked and with whom they would want to spend time or engage in activity. Often subjects were asked to give their first, second, third, etc., choices on these and related issues. The results could then be arrayed in a matrix (this was not always done) in which each person's rating of others in a group is recorded (see Figure 27-1 for a simplified example). The construction of such matrices was to become an important part of network analysis, but equally significant was the development of a sociogram in which

Leinhardt, eds., *Perspectives on Social Network Research* (New York: Academic Press, 1979); Ronald S. Burt, "Models of Network Structure," *Annual Review of Sociology* 6 (1980), pp. 79–141; Peter Marsden and Nan Lin, eds., *Social Structure and Network Analysis* (Newbury Park, CA.: Sage, 1982). See also the journal *Social Networks*.

[2]Georg Simmel, *Sociology: Studies in Forms of Sociation* (1908, but incompletely translated; see Jonathan H. Turner, Leonard Beeghley, and Charles Powers, *The Emergence of Sociological Theory* (Belmont, CA: Wadsworth, 1989), for a list of references where portions of this work are translated).

[3]Émile Durkheim, *The Division of Labor in Society* (New York: Free Press, 1947; originally published in 1893), *The Rules of the Sociological Method* (New York: Free Press, 1938; originally published in 1895).

[4]Charles Montesquieu, *The Spirit of the Laws*, 2 vols. (London: Colonial Press, 1900; originally published in 1748).

[5]Jacob L. Moreno, *Who Shall Survive?* (Washington, DC: Nervous and Mental Diseases Publishing Co., 1934; republished in revised form by Beacon House, New York, 1953).

FIGURE 27–1 An Example of an Early Matrix. (*Source:* Constructed from sociogram in J. Moreno, *Who Shall Survive?*, rev. ed., New York: Beacon House, 1953, p. 171.)

Matrix of Friendship Choices in a School Fraternity

Choosers \ Chosen	1	2	3	4	5	6	7	8	9	10	11
1			X								
2			X	X						X	
3	X	X						X		X	
4		X								X	
5			X								
6			X								
7											X
8									X	X	X
9			X					X			X
10			X					X			X
11							X	X	X		

group members were arrayed in a visual space, with their relative juxtaposition and connective lines representing the pattern of choices (those closest and connected being attracted in the direction of the arrows, and those distant and unconnected being less attracted to each other). Figure 27-2 illustrates the nature of Moreno's sociograms.

This visual representation of choices, as pulled from a matrix, captures the "structure" of preferences or, in Moreno's terms, the patterns of attraction and repulsion in groups. The visual array can be viewed as a network, because the "connections" among each individual are what is most significant. Moreover, in looking at the network, structural features emerge that can be observed.

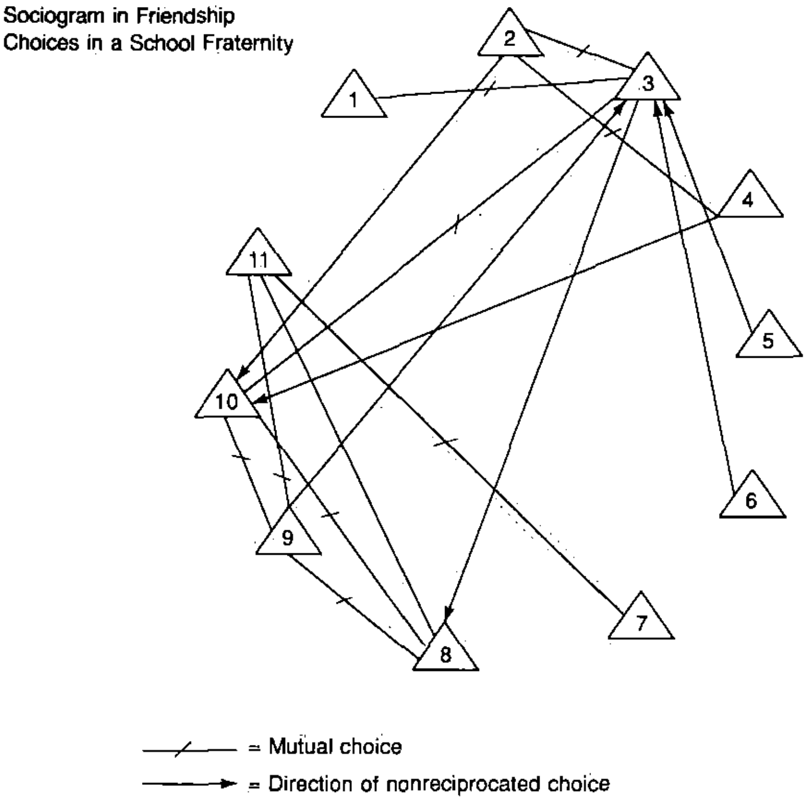
Moreno thus introduced some of the key conceptual ingredients of contemporary network analysis: the mapping of relations among actors in visual space in order to represent the *structure of these relations*. Yet, alongside Moreno's sociograms, other research and theoretical traditions were developing and pointing toward the same kind of structural analysis.

Studies of Communications in Groups: Alex Bavelas and Harold Leavitt

Alex Bavelas[6] was one of the first to study how the structure of a network influenced the flow of communication in experimental groups. Others such as

[6]Alex Bavelas, "A Mathematical Model for Group Structures," *Applied Anthropology* 7 (3) (1948), pp. 16–30.

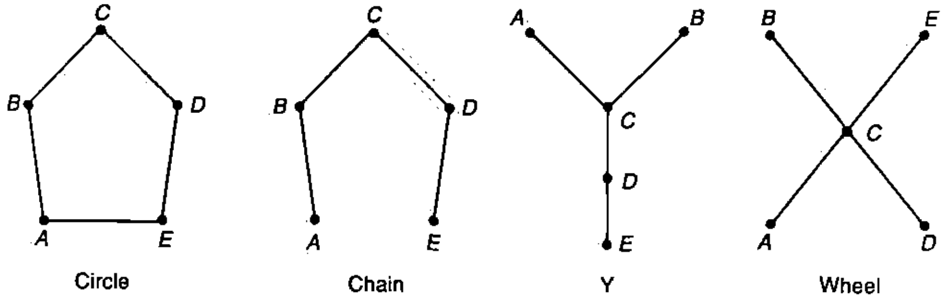
FIGURE 27–2 An Example of a Sociogram. (*Source:* J. Moreno, *Who Shall Survive?*, rev. ed., p. 171.)



Harold Leavitt[7] followed Bavelas' lead and also began to study how communication patterns influence the task performances of people in experimental groups. The network structure in these experiments usually involved artificially partitioning groups in such a way that messages could flow only in certain directions and through particular persons. Emerging from Bavelas' original study was the notion of *centrality*, which was evident when positions lie between other positions in a network. When communications had to flow through this central position, certain styles and levels of task performance prevailed, whereas other patterns of information flow produced different results. Figure 27–3 outlines some of the chains of communication flow that Bavelas originally isolated and that Leavitt later improved upon.

[7]Harold J. Leavitt, "Some Effects of Certain Communication Patterns on Group Performance," *Journal of Abnormal and Social Psychology* 46 (1951), pp. 38–50; Harold J. Leavitt and Kenneth E. Knight, "Most 'Efficient' Solution to Communication Networks: Empirical versus Analytical Search," *Sociometry* 26 (1963), pp. 260–67.

FIGURE 27–3 Types of Communication Structures in Experimental Groups. (*Source:* Harold J. Leavitt, "Some Effects of Certain Communication Patterns on Group Performance," *The Journal of Abnormal and Social Psychology* 56 [1951], p. 40.)



The results of these experiments are perhaps less important than the image of structure that is offered, although we should note in passing that occupying central positions, such as *C* in Figure 27-3, exerted the most influence on the emergence of leadership, task performance, and effective communication. These diagrams in Figure 27–3 resemble the sociograms, but there are some important differences that were to become critical in modern network analysis. First, the network is conceptualized in the communication studies as consisting of positions rather than persons, with the result that the pattern of relations among positions was viewed as a basic or generic type of structure. Indeed, different people could occupy the positions and the experimental results would be the same. Thus there is a real sense that structure constitutes an emergent reality, above and beyond the individuals involved. Second, the idea that the links among positions involve flows of resources—in these studies, information and messages—anticipates the thrust of much network analysis. Of course, we could also see Moreno's sociograms as involving flows of affect and preferences among people, but the idea is less explicit and less embedded in a conception of networks as relations among positions.

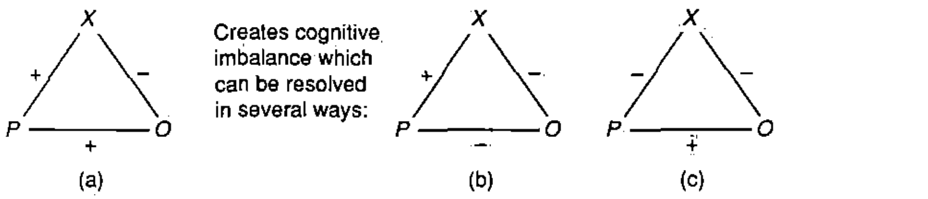
Thus these early experimental studies on communication created a new conceptualization of networks as (1) composed of positions, (2) connected together by relations, and (3) involving the flows of resources.

Early Gestalt and Balance Approaches: Heider, Newcomb, Cartwright, and Harary

Fritz Heider,[8] who is often considered the founder of Gestalt psychology, developed some of the initial concepts in various theories of "balance" and "equi-

[8]Fritz Heider, "Attitudes and Cognitive Organization," *Journal of Psychology* 2 (1946), pp. 107–12. For the best review of his thought as it accumulated over four decades, see his *The Psychology of Interpersonal Relations* (New York: John Wiley, 1958).

FIGURE 27–4 The Dynamics of Cognitive Balance. (*Source:* Adapted from Fritz Heider with (+) and (−) used instead of Heider's notation.)



librium" in cognitive perceptions. In Heider's view, individuals seek to balance[9] their cognitive conceptions; in his famous *P,O,X* model, Heider argued that a person (*P*) will attempt to balance cognitions toward an object or entity (*X*) with those of another person (*O*). If a person (*P*) has positive sentiments toward an object (*X*) and another person (*O*), but *O* has negative sentiments toward *X*, then a state of cognitive imbalance exists. A person has two options if the imbalance is to be resolved: (1) to change sentiments toward *X* or (2) to alter sentiments toward *O*. By altering sentiments to *X* toward the negative, cognitive balance is achieved, because *P* and *O* now reveal a negative orientation toward *X*, thereby affirming their positive feelings toward each other. Or, by altering sentiments directed to *O* toward the negative, cognitive balance is achieved because *P* has a positive attitude toward *X* and negative feelings for *O*, who has a negative orientation to *X*.

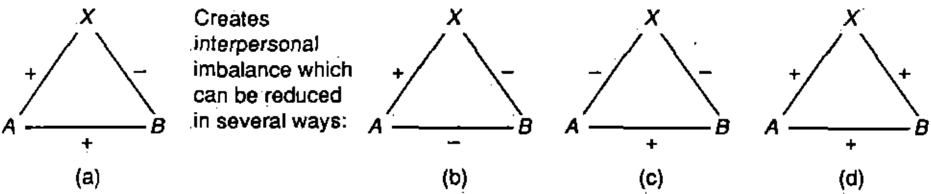
Although Heider did not explicitly do so, this conception of balance can be expressed in algebraic terms, as is done in Figure 27-4 by multiplying the cognitive links in Figure 27–4(a): $(+) \times (-) \times (+) = (-)$ or imbalance. This imbalance can be resolved by changing the sign of the links toward a (−) or a (+), as is done for Figures 27–4(b) and 27–4(c). By multiplying the signs for the lines in 27–4(b) or 27–4(c), a (+) product is achieved, indicating that the relation is now in balance.

Theodore Newcomb[10] extrapolated Heider's logic to the analysis of interpersonal communication. Newcomb argued that this tendency to seek balance applies equally to *inter*personal as well as the *intra*personal situations represented by the *P,O,X* model, and he constructed an *A,B,X* model to emphasize this conclusion. A person (*A*) and another (*B*) who communicate and develop positive sentiments will, in an effort to maintain balance with each other, develop similar sentiments toward a third entity (*X*), which can be an object, an idea, or a third person. However, if *A*'s orientation to *X* is very strong in either a positive or a negative sense and *B*'s orientation is just the opposite,

[9]The process of "attribution" was, along with the notion of "balance," the cornerstones of Heider's Gestalt approach.

[10]Theodore M. Newcomb, "An Approach to the Study of Communicative Acts," *Psychological Review* 60 (1953), pp. 393–404. See his earlier work where these ideas took form: *Personality and Social Change* (New York: Dryden Press, 1943).

FIGURE 27–5 The Dynamics of Interpersonal Balance. (*Source:* Adapted from Theodore Newcomb with alterations to Newcomb's system of notion.)



several options are available: (1) *A* can convince *B* to change its orientation toward *X*, and vice versa, or (2) *A* can change its orientation to *B*, and vice versa. Figure 27-5 represents this interpersonal situation for *A,B,X* in the same manner as Heider's *P,O,X* model in Figure 27-4. Situation 27-5(a) is in interpersonal imbalance, as can be determined by multiplying the signs $(+) \times (+) \times (-) = (-)$ or imbalance. Figures 27-5(b), (c), and (d) represent three options that restore balance to the relations among *A*, *B*, and *X*. (In 27-5(a), (b), and (c), the product of multiplying the signs now equals a (+), or balance.)

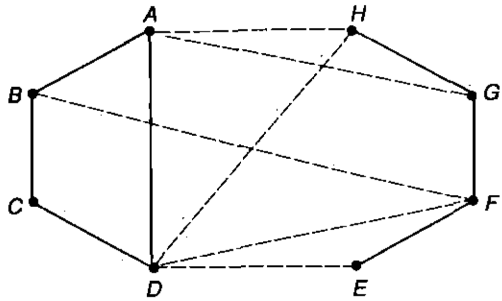
Heider's and Newcomb's approach was to stimulate research that would more explicitly employ mathematics as a way to conceptualize the links in interpersonal networks. The key breakthrough had come earlier[11] in the use of the mathematical theory of linear graphs. Somewhat later, in the mid-1950s, Dorin Cartwright and Frank Harary[12] similarly employed the logic of signed-digraph theory to examine balance in larger groups consisting of more than three persons. Figure 27-6 presents a model developed by Cartwright and Harary for a larger set of actors.

The basic idea is much the same as in the *P,O,X* and *A,B,X* models, but now the nature of sentiments is specified by dotted (negative) and solid (positive) lines. By multiplying the signs (+) = solid line; (−) = dotted line across all of the lines, points of imbalance and balance can be identified. For Cartwright and Harary, one way to assess balance is to multiply the various *cycles*

[11]For example, D. König, *Theorie der Endlichen und Undlichen Graphen* (Leipzig, 1936 but reissued, New York: Chelsea, 1950), is, as best we can tell, the first work on graph theory. Again, from our reading, it appears that the first important application of this theory to the social sciences came with R. Duncan Luce and A. D. Perry, "A Method of Matrix Analysis of Group Structure," *Psychometrika* 14 (1949), pp. 94–116, followed by R. Duncan Luce, "Connectivity and Generalized Cliques in Sociometric Group Structure," *Psychometrika* 15 (1950), pp. 169-90. Frank Harary's *Graph Theory* (Reading, MA: Addison-Wesley, 1969) later became a standard reference, which had been preceded by Frank Harary and R. Z. Norman, *Graph Theory as a Mathematical Model in Social Science* (Ann Arbor: University of Michigan Institute for Social Research, 1953), and Frank Harary, R. Z. Norman, and Dorin Cartwright, *Structural Models: An Introduction to the Theory of Directed Graphs* (New York: John Wiley, 1965).

[12]Dorin Cartwright and Frank Harary, "Structural Balance: A Generalization of Heider's Theory," *The Psychological Review* 63 (1956), pp. 277-93. For more recent work, see their "Balance and Clusterability: An Overview," in Holland and Leinhardt, eds., *Perspectives on Social Network Research.*

FIGURE 27-6 An *S*-graph of Eight Points. (*Source:* D. Cartwright and F. Harary, "Structural Balance: A Generalization of Heider's Theory," *Psychological Review* 63 (5), 1956, p. 286.)



on the graph—for example, *ABCD*, *ABCDEFGH*, *HDFG*, *DFE*, and so on. If multiplying the signs for each connection yields a positive outcome, then this structure is in balance. Another procedure is specified by a theorem:[13] "An *S*-graph is balanced if and only if all paths joining the same pair of points have the same sign."

The significance of introducing graph theory into balance models is that it facilitated the representation of social relations with mathematical conventions—something that Moreno, Heider, and Newcomb failed to do. But the basic thrust of earlier analysis was retained: graph theory could represent directions of links between actors (this is done by simply placing arrows on the lines as they intersect with a point); graph theory could represent two different types of relations between points to be specified by double lines and arrows;[14] it could represent different positive or negative states (the sign being denoted by solid or dotted lines); it offered a better procedure for analyzing more complex social structures; and, unlike the matrices behind Moreno's and others' sociograms, graph theory would make them more amenable to mathematical and statistical manipulation. Thus, although the conventions of graph theory have not remained exactly the same, especially as adopted for network use, the logic of the analysis that graph theory facilitated was essential for the development of the network approach beyond crude matrices and sociograms or simple triadic relations to more complex networks involving the flows of multiple resources in varying directions.

S. F. Nadel and Anthropological Influences on Network Analysis

Several early pioneers[15] in network analysis were anthropologists trying to capture the nature of "structure" in traditional societies. A. R. Radcliffe-

[13]Ibid., p. 286.

[14]Early conventional notation would make these lines different colors, but this convention is not always followed since publications are usually in black and white.

[15]For example, Boisevain and Mitchell, eds., *Social Networks in Urban Situations*; Barnes,

Brown's[16] effort to develop a method for analyzing kinship was certainly one line of influence, especially his emphasis on patterns of social relations as the critical element of structure. Yet, in this years between World Wars I and II, Radcliffe-Brown and other anthropologists were still welded to functional analysis, allowing notions of the functions of a structure to distort or short-circuit purely structural analysis (see pp. 42-45 in Chapter 2). Whereas hints of a network approach can be found in a number of anthropological works,[17] S. F. Nadel's *The Theory of Social Structure*[18] was decisive for many anthropologist in separating "structure" and "function"; in so doing, Nadel proposed a mode of analysis compatible with contemporary network analysis. And, since his approach was intended to facilitate the understanding of "structure" in larger populations in natural settings (as opposed to small, contrived experimental groups), Nadel's work encouraged movement out of the psychologist's and sociologist's laboratories into the real world.

Nadel began his argument with the assertion that conceptions of structure in the social sciences are too vague. Indeed, we should begin with a more precise, and yet general, notion of all structure: "structure indicates an ordered arrangement of parts which can be treated as transposable, being relations invariant, while the parts themselves are variable."[19] Thus structure must concentrate on the properties of relations rather than actors, especially on those properties of relations that are invariant and always occur.

From this general conception of all structure, Nadel proposed that "we arrive at the structure of a society through abstracting from the concrete population and its behavior the pattern or network (or system) of relationships obtaining between actors in their capacity of playing roles relative to one another."[20] Within structures exist embedded "subgroups" characterized by certain types of relationships that hold people together. Thus, social structure is to be viewed as layers and clusters of networks—from the total network of a society to varying congeries of subnetworks. The key to discerning structure is to avoid what he termed "the distribution of relations on the grounds of their similarity and dissimilarity" and concentrate, instead, on the "interlocking of relationships whereby interactions implicit in one determine those occurring in others." That is, one should examine specific configurations of link-

"Social Networks." See also Jeremy F. Boisevain, "Network Analysis: A Reappraisal," *Current Anthropology* 20 (1979), pp. 392–94; Norman E. Whitten and Alvin W. Wolfe, "Network Analysis," in J. J. Honigmon, ed., *The Handbook of Social and Cultural Anthropology* (Chicago: Rand McNally, 1974); and Alvin Wolfe, "The Rise of Network Thinking in Anthropology," *Social Networks* 1 (1978), pp. 53–64.

[16]A. R. Radcliffe-Brown, "On Social Structure," *Journal of the Royal Anthropological Institute* 70 (1940), pp. 1–2; "Structure and Function in Primitive Society," *American Anthropologist* 37 (1935), pp. 58–72; and *Structure and Function in Primitive Society* (New York: Free Press, 1952).

[17]For examples, see Raymond Firth, *Elements of Social Organization* (London: Watts, 1952); E. E. Evans-Pritchard, *The Nuer* (London: Oxford University Press, 1940); and Meyer Fortes, *The Web of Kinship among the Tallensi* (London: Oxford University Press, 1949).

[18]S. F. Nadel, *The Study of Social Structure* (London: Cohen and West, 1957).

[19]Ibid., p. 8.

[20]Ibid., p. 21.

ages among actors playing roles rather than the statistical distributions of actors in this or that type of role.

From these general ideas, several anthropologists, most notably J. Clyde Mitchell[21] and J. A. Barnes,[22] welded the metaphorical imagery of work like Nadel's to the more specific techniques for conceptualizing the properties of networks. Coupled with path-breaking empirical studies,[23] the anthropological tradition began to merge with work in sociology and social psychology. And in the 1970s, as the use of mathematical approaches and computer algorithms accelerated from the modest beginnings in the late 1940s and early 1950s, network analysis achieved greater distinctiveness as a conceptual orientation and developed a number of basic theoretical concepts.

BASIC THEORETICAL CONCEPTS IN NETWORK ANALYSIS

Emerging from early work is a corpus of concepts that now guide network analysis. Taken together, these concepts provide a new framework for developing theories about social structure. I will now briefly review the most important of these concepts.

Points and Nodes: Persons, Positions, and Actors

Because network analysis is interdisciplinary, the units embedded in the network can be persons, positions, corporate actors, or other entities. In graph theory, as we saw in Figure 27-6, these are conceptualized as points or nodes and symbolized by either letters or numbers—for example, *A*, *B*, *C*, *D*, etc., or 1, 2, 3, 4, etc. The positions and nodes are then arrayed in visual space so as to depict the pattern of relations among them. In a mathematical sense it makes little difference *what* the points or nodes are, and this fact can be a great virtue because it provides a common set of analytical tools for analyzing very diverse phenomena. But, from a theoretical viewpoint, it may make a big difference as to whether the points are individual people, positions (statuses in an organization), or corporate actors (composed of collections of either positions or people). Depending on the nature of the point, very different dynamics may ensue, although it is possible that in some cases the same dynamics operate.[24] If the latter is the case, then network analysis offers a powerful tool for obviating

[21]J. Clyde Mitchell, "The Concept and Use of Social Networks" in Boisevain and Mitchell, eds., *Social Networks in Urban Situations.*

[22]J. A. Barnes, "Social Networks." See also his "Network and Political Processes" in Boisevain and Mitchell, eds., *Social Networks in Urban Situations.*

[23]Perhaps the most significant was Elizabeth Bott, *Family and Social Network: Roles, Norms, and External Relationships in Ordinary Urban Families* (London: Tavistock, 1957, 1971). Her basic finding might be expressed as a network "law," which goes something like this: *The flow of resources between actors is reduced to the extent that they are members of dense, but nonoverlapping networks, or to the extent that they occupy distant positions in the same dense network.*

[24]This was, of course, the goal of Simmel's "formal sociology."

micro-vs.-macro debates (since interaction between people and collective actors would reveal the same network dynamics) and for analyzing widely diverse phenomena in the same terms.

Links, Ties, Connections

As Figure 27–6 indicates, points are only one basic element of a network. These points need to be "connected' in some way, as is indicated by lines. These connections were originally viewed as *links*,[25] but more recently, in sociology, they have come to be seen as *ties*. But the question immediately arises as to *what* this tie or link is. Again, in the mathematics of graph theory it does not make much difference, but in the substantive concerns of sociologists it probably does make a difference. If one looks at the large literature, these lines can represent such diverse forces as information, liking, preferences, control, influence, honor/prestige, material things, and ideas. For example, early sociograms by Moreno saw individuals (the nodes, as currently conceptualized) as connected by *emotions* such as friendship, preference, and liking. Similarly, early work by Gestalt sociologists, such as Heider, Newcomb, and Cartwright, connected actors in terms of sentiments. Other early work by such experimental psychologists as Bavelas and Leavitt examined the flow of messages or information among actors who were assigned by the experimenters to particular positions. More recent work has examined the flows of material resources like money and goods in market networks. For example, "world systems theory" is, in a sense, a network approach to the flow of material resources among nation/states, and terms like "core," "periphery," and "semiperiphery"[26] refer to the position of nations in a world network.

One way to rise above the diversity of resources examined in network analysis is to visualize resource flows in networks in terms of three generic types: materials, symbols, and emotions. That is, what connects persons, positions, and corporate actors in the social world is the flow of (1) symbols (information, ideas, values, norms, messages, etc.), (2) materials (physical things and perhaps symbols, such as money, that give access to physical things), and (3) emotions (approval, respect, liking, pleasure, etc). In nonsociological uses of networks the ties or links may be other types of phenomena, but, when the ties are social, they exist along material, symbolic, and emotional dimensions.

As noted, these ties are represented as lines connecting those positions or nodes represented by letters or numbers, and the lines can constitute a directed graph (or digraph) when the movement of resources is specified by arrows. Moreover, if multiple resources are connecting positions in the graph, multiple lines (and arrows specifying direction) will be used.

The configuration of ties can also be represented as a matrix, as we saw in Figure 27–1. Such matrices are useful for various statistical procedures and

[25] For example, see Mitchell, "The Concept and Use of Social Networks."

[26] Immanuel Wallerstein, *The Modern World-System*, Vol. 1 (New York: Academic Press, 1974).

computer algorithms, and they can become very complicated because different ties involving multiple resources are represented in the cells of the matrix. The construction of matrices is generally preliminary for the development of network diagrams like the one in Figure 27–2. And, as we saw, it has been a part of early work, such as sociometry, from the very beginning. Today the matrices are ever more essential for discovering with computer algorithms the patterns and configurations of ties among positions that are of most interest to network analysts. Indeed, network analysis often confines itself exclusively to matrices, avoiding the construction of graphs that would become too complicated and, in essence, unreadable (indeed, many of Moreno's early sociograms were too complicated to be easily discerned).

Patterns and Configurations of Ties

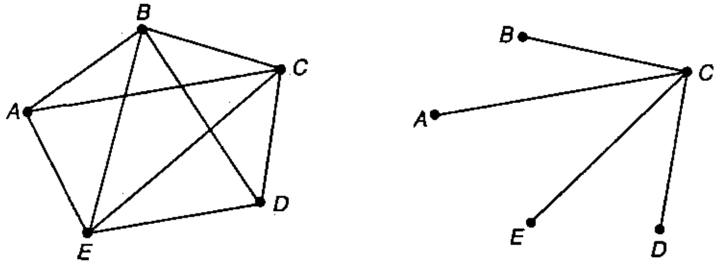
From a network perspective, social structure is conceptualized as the form of ties among positions or nodes. That is, what is the pattern or configuration among what resources flowing among what sets of nodes or points in a graph? To answer questions like this, network sociology addresses a number of properties of networks. The most important of these are number of ties, directedness, reciprocity of ties, transitivity of ties, density of ties, strength of ties, bridges, brokerage, centrality, and equivalence.

Number of ties An important piece of information in performing network analysis is the total number of ties among all points and nodes. Naturally, the number of potential ties depends upon the number of points in a graph and the number of resources involved in connecting the points. Yet, for any given number of points and resources, it is important to calculate both the actual and potential number of ties that are (and can be) generated. This information can then be used to calculate other dimensions of a network structure.

Directedness It is important to know the direction in which resources flow through a network; so, as indicated earlier, arrows are often placed on the lines of a graph, making it a digraph. As a consequence, a better sense of the structure of the network emerges. For example, if the lines denote information, we would have a better understanding of how the ties in the network are constructed and maintained, since we could see the direction and sequence of the information flow.

Reciprocity of ties Another significant feature of networks is the reciprocity of ties among positions. That is, is the flow of resources one way, or is it reciprocated for any two positions? If the flow of resources is reciprocated, then it is conventional to have double lines with arrows pointing in the direction of the resource flow (recall from Moreno's sociogram in Figure 27–2 that he represented reciprocity with a slash across the line). Moreover, if different resources flow back and forth, then this too can be represented. Surprisingly,

FIGURE 27–7 High- and Low-Density Networks



(a)
High-density five-point network

(b)
Low-density five-point network

conventions on how to represent this multiplicity of resource flows are not fully developed. One way to denote the flow of different resources is to use varying-colored lines or numbered lines; another is to label the points with the same letter subscripted (i.e., A_1, A_2, A_3, etc.) if similar resources flow and with varying letters (i.e., A, B, C, D) if the resources connecting actors are different. But, whatever the notation, the extent and nature of reciprocity in ties become an important property of a social network.

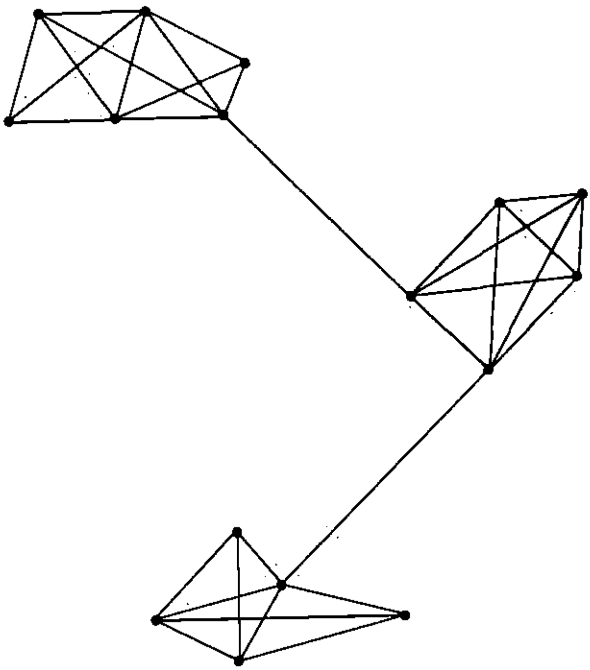
Transitivity of ties A critical dimension of networks is the level of transitivity among sets of positions. Transitivity refers to the degree to which there is a "transfer" of a relation among subsets of positions. For example, if nodes A_1 and A_2 are connected with positive affect, and positions A_2 and A_3 are similarly connected, we can ask: will positions A_1 and A_3 also be tied together with positive affect? If the answer to this question is "yes," then the relations among A_1, A_2, and A_3 are transitive (hence Heider and Newcomb were, in essence, examining transitivity). Discovering patterns of transitivity in a network can be important because it helps explain other critical properties of a network, such as density and the formation of cliques.

Density of ties A significant property of a network is its degree of connectedness, or the extent to which nodes reveal the maximum possible number of ties. The more the actual number of ties among nodes approaches the total possible number among a set of nodes, the greater is *the overall density* of a network.[27] Figure 27–7 compares the same five-node network under conditions of high and low density of ties.

Of even greater interest are subdensities of ties within a larger network structure. Such subdensities, which are sometimes referred to as *cliques*, reveal

[27]There are other ways to measure density; this definition is meant to be illustrative of the general idea.

FIGURE 27–8 A Network with Three Distinct Cliques



strong, reciprocated, and transitive ties among a particular subset of positions within the overall network.[28] For example, in Figure 27–2, persons 8, 9, and 10 (and perhaps 11) reveal a reciprocity in their friendship choices (high density) and thereby form separate cliques within the overall system of ties that constitute the network. Figure 27–8 also illustrates clique formation.

Strength of ties Yet another crucial aspect of a network is the volume and level of resources that flow among positions. A weak tie is one where few or sporadic amounts of resources flow among positions, whereas a strong tie evidences a high level of resource flow. The overall structure of a network is significantly influenced by clusters and configurations of strong and weak ties. For example, if the ties in the cliques in Figure 27–8 are strong, the network is composed of cohesive subgroupings that have relatively sparse ties to one another. On the other hand, if the ties in these subdensities are weak, then

[28]The terminology on subdensities varies. "Clique" is still the most prominent term, but "alliances" (Linton Freeman, "Alliances: A New Formalism for Primary Groups and Its Relationship to Cliques and to Structural Equivalences," working paper, 1987) has recently been offered as an alternative. Moreover, the old sociological standbys "group" and "subgroup" seem to have made a comeback in network analysis.

the subgroupings will involve less intense linkages,[29] with the result that the structure of the whole network will be very different than would be the case if these ties were strong.

Bridges When networks reveal subdensities, it is always interesting to know which positions connect the subdensities, or cliques, to one another. For example, in Figure 27-8, those ties connecting subdensities are bridges and are crucial in maintaining the overall connectedness of the network. Indeed, if one removed one of these positions or severed the tie, the structure of the network would be very different; in fact, it would now become three separate networks. These bridging ties are typically weak,[30] since each position in the bridge is more embedded in the flow of resources of a particular subdensity or clique. But, nonetheless, such ties are often crucial to the maintenance of a larger social structure; thus it is not surprising that the number and nature of bridges within a network structure are highlighted in network analysis.

Brokerage At times a particular position is outside subsets of positions but is crucial to the flow of resources to and from these subsets. This position is often in a brokerage situation because its activities determine the nature and level of resources that flow to and from subsets of positions.[31] In Figure 27-9, position A_6 is potentially a broker for the flow of resources from subsets consisting of positions A_1, A_2, A_3, A_4, and A_5 to B_1, B_2, B_3, B_4, B_5, and B_6. Position A_6 can become a broker if (1) the distinctive resources that pass to, and from, these two subsets are needed or valued by at least one of these subsets and (2) direct ties, or bridges, between the two subsets do not exist. Indeed, a person or actor in a brokerage position often seeks to prevent the development of bridges (as in Figure 27-8) and to manipulate the flow of resources such that at least one, and if possible both, subsets are highly dependent upon its activities.

Centrality An extremely important property of a network is *centrality*, as was noted for Bavelas' and Leavitt's studies of communication in experimental groups. There are several ways to calculate centrality:[32] (1) the number

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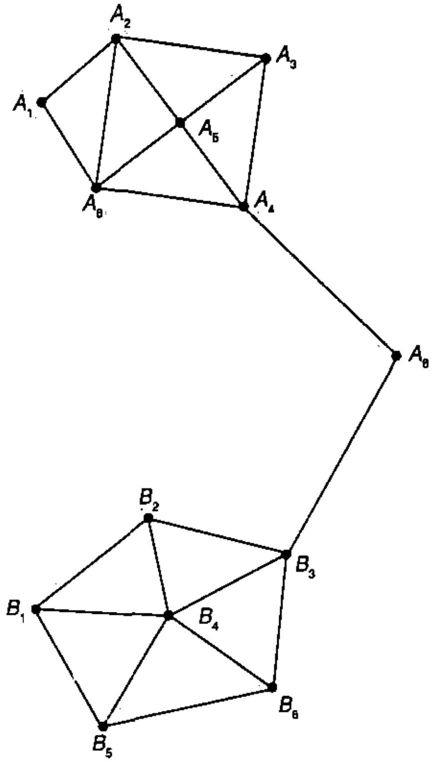
[29]At one time, "intensity" appears to have been used in preference to "strength." See Mitchell, "The Concept and Use of Social Networks." It appears that Granovetter's classic article shifted usage in favor of "strength" and "weakness." See footnote 30.

[30]See Mark Granovetter, "The Strength of Weak Ties," *American Journal of Sociology* 78 (1973), pp. 1360–80; and "The Strength of Weak Ties: A Network Theory Revisited," *Sociological Theory* (1983), pp. 201–33. The basic network "law" from Granovetter's original study can be expressed as follows: *The degree of integration of a network composed of highly dense subcliques is a positive function of the extensiveness of bridges, involving weak ties, among these subcliques.*

[31]Ronald S. Burt has, perhaps, done the most interesting work here. See, for example, his *Toward a Structural Theory of Action* (New York: Academic Press, 1982) and "A Structural Theory of Interlocking Corporate Directorships," *Social Networks* 1 (1978–79), pp. 415–35.

[32]The definitive work here is Linton C. Freeman, "Centrality in Social Networks: Conceptual Clarification," *Social Networks* 1 (1979), pp. 215–39; and Linton C. Freeman, Douglas Boeder, and Robert R. Mulholland, "Centrality in Social Networks: 11. Experimental Results," *Social Networks* 2 (1979), pp. 119–41. See also Linton C. Freeman, "Centered Graphs and the Structure of Ego Networks," *Mathematical Social Sciences* 3 (1982), pp. 291–304.

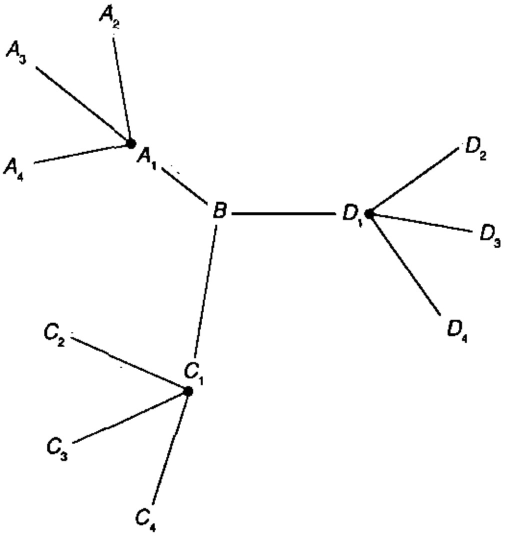
FIGURE 27-9 A Network with Brokerage Potential



of other positions with which a particular position is connected, (2) the number of points between which a position falls, and (3) the closeness of a position to others in a network. Although these three measures might denote somewhat different points as central, the theoretical idea is fairly straightforward: some positions in a network mediate the flow of resources by virtue of their patterns of ties to other points. For example, in Figure 27-7(b), point *C* is central in a network consisting of positions *A*, *B*, *C*, *D*, and *E*; or, to take another example, points A_5 and B_4 in Figure 27-9 are more central than other positions because they are directly connected to all, or to the most, positions and because a higher proportion of resources will tend to pass through these positions. A network can also reveal several nodes of centrality, as is evident in Figure 27-10. Moreover, as we will see shortly, the patterns of centrality may shift over time. Thus the dynamics of network structure revolve around the nature and pattern of centrality.

Equivalence When positions stand in the same relation to another position, they are considered *equivalent*. When this idea was first introduced into network analysis, it was termed *structural equivalence* and restricted to

FIGURE 27–10 Equivalence in Social Networks



situations in which a set of positions is connected to another position or set of positions in exactly the same way.[33] For example, positions *B*, *A*, *E*, and *D* in Figure 27-7 are structurally equivalent because they reveal the same relation to position *C*. Figure 27-10 provides another illustration of structural equivalence. A_2, A_3, and A_4 are structurally equivalent to A_1; similarly, C_2, C_3, and C_4 are structurally equivalent to C_1; D_2, D_3, and D_4 are equivalent to D_1; and A_1, C_1, and D_1 are structurally equivalent to *B*.

This original formulation of equivalence was limited, however, in that positions could be equivalent only when *actually connected to the same position.* We might also want to consider all positions as equivalent when they are connected to different positions but in the same form, pattern, or manner. For instance, in Figure 27-10, A_2, A_3, A_4, D_2, D_3, D_4, C_2, C_3, and C_4 can all be seen as equivalent because they bear the *same type* of relation to another position—that is $A_{,1}$, D_1, and C_1, respectively. This way of conceptualizing equivalence is termed *regular equivalence*[34] and, in a sense, subsumes the original notion of *structural equivalence*. That is, structural equivalence, wherein the equivalent *positions must actually be connected to the same position in the same way,* is a particular type of a more general equivalence phenomenon. These terms, "structural" and "regular," are awkward, but they have become con-

[33] Francois Lorrain and Harrison C. White, "Structural Equivalence of Individuals in Social Networks," *Journal of Mathematical Sociology* 1 (1971), pp. 49–80; Harrison C. White, Scott A. Boorman, and Ronald L. Breiger, "Social Structure from Multiple Networks: I. Block Models of Roles and Positions," *American Journal of Sociology* 8 (1976), pp. 730–80.

[34] Lee Douglas Sailer, "Structural Equivalence," *Social Networks* 1 (1978), pp. 73–90.

ventional in network analysis and so we are stuck with them. The critical idea is that the number and nature of equivalent positions in a network have important influences on the dynamics of the network.[36] The general hypothesis is that actors in structurally equivalent or regularly equivalent positions will behave or act in similar ways.

The mathematics of network analysis can become quite complicated, as can the computer algorithms used to analyze data sets in terms of the processes outlined above. This listing of concepts is somewhat metaphorical, because it eliminates the formal and quantitative thrust of much network analysis. Indeed, as we mentioned earlier, much network analysis bypasses the conversion of matrices into graphs like those in the various figures presented thus far and, instead, performs mathematical and statistical operations on just the matrices themselves. Yet, if network analysis is to realize its full theoretical (as opposed to methodological) potential, it may be wise to use concepts, at least initially, in a more verbal and intuitive sense. Let us now assess the theoretical potential of network analysis and examine some of the theoretical programs that have used the concepts discussed here.

THE THEORETICAL POTENTIAL OF NETWORK SOCIOLOGY

Few would disagree with the notion that social structure is composed of relations among positions. But is this all that social structure is? Can the concepts denoting nodes, ties, and patterns of ties (number, strength, reciprocity, transitivity, bridges, brokerage, centrality, and equivalence) capture all of the critical properties of social structure?

The answer to these questions is probably "no." Social structure probably involves other crucial processes that are not captured by these concepts. Yet a major property of social structure *is* its network characteristics, as Georg Simmel was perhaps the first to really appreciate. For, whatever other dimensions social structure may be seen to reveal—cultural, behavioral, ecological, temporal, psychological, etc.—its backbone is a system of interconnections among actors who occupy positions vis-à-vis one another and who exchange resources. And, so, network analysis has great potential for theories of social structure. Has this potential been realized? Probably not, for several reasons.

First, as just noted, network analysis is overly methodological and concerned with generating quantitative techniques for arraying data in matrices and then converting the matrices into descriptions of particular networks (whether as graphs or as equations). As long as this is the case, network sociology will remain primarily a tool for empirical description.

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[36]In many ways Karl Marx's idea that those who stand in a common relationship to the means of production have common interests is an equivalence agreement. Thus the idea of equivalence is not new to sociology—just the formalism used to express it.

Second, there has been little effort to develop principles of network dynamics, per se. Few[36] seem to ask theoretical questions within the network tradition itself. For example, how does the degree of density, centrality, equivalence, bridging, and brokerage influence the nature of the network and the flow of relations among positions in the network? There are many *empirical* descriptions of events that touch on this question but few actual theoretical laws or principles.[37]

Third, network sociology has yet to translate traditional theoretical concerns and concepts into network terminology in a way that highlights the superiority, or at least the viability, of using network theoretical constructs for mainstream theory in sociology. For example, power, hierarchy, differentiation, integration, stratification, conflict, and many other concerns of sociological theory have not been adequately reconceptualized in network terms, and hence it is unlikely that sociological theory will adopt or incorporate a network approach until this translation of traditional questions occurs.

All of these points, however, need to be qualified by the fact that numerous sociologists have actually sought to develop laws of network processes and to address traditional theoretical concerns with network concepts. Although these efforts are far from constituting a coherent theory of network dynamics, they do illustrate the potential utility of network sociology. Let us examine some of these adaptations of network ideas.

EXCHANGE THEORY AND NETWORK ANALYSIS: THE EMERSON–COOK PROGRAM

Since networks involve the flow of resources among positions that reveal ties, it should not be surprising that exchange theorists have gravitated toward network concepts. Although there are several creative efforts to adopt network concepts to exchange theory,[38] this merger can best be illustrated with the work of the late Richard Emerson[39] and his collaborator, Karen S. Cook.[40]

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[36]There are, of course, some notable exceptions to this statement. For examples of what we see as the kinds of laws that need to be formulated, see our formal statements on Granovetter's and Bott's work in footnotes 30 and 23, respectively.

[37]Mark Granovetter, "The Theory-Gap in Social Network Analysis" in P. Holland and S. Leinhardt, eds., *Perspectives on Social Network Research.*

[38]See, in particular, David Willer, "The Basic Concepts of the Elementary Theory," in D. Willer and B. Anderson, eds., *Networks, Exchange and Coercion* (New York: Elsevier, 1981); "Property and Social Exchange," *Advances in Group Processes* 2 (1985, pp. 123–42; and *Theory and the Experimental Investigation of Social Structures* (New York: Gordon and Breach, 1986).

[39]Emerson's perspective is best stated in his "Exchange Theory, Part I: A Psychological Basis for Social Exchange" and "Exchange Theory, Part II: Exchange Relations and Network Structures," in *Sociological Theories in Progress*, ed. J. Berger, M. Zelditch, and B. Anderson (New York: Houghton Mifflin, 1972), pp. 38–87. Earlier empirical work that provided the initial impetus to, or the empirical support of, this theoretical perspective includes: "Power-Dependence Relations," *American Sociological Review* 17 (February 1962), pp. 31–41; "Power-Dependence Relations: Two Experiments," *Sociometry* 27 (September 1964), pp. 282–98; John F. Stolte and Richard M. Emerson, "Structural Inequality: Position and Power in Network Structures," in *Behavioral Theory in Sociology*, ed. R. Hamblin (New Brunswick, NJ: Trans-action Books, 1977). Other more

The Overall Strategy

Emerson began by enumerating the basic propositions of operant psychology. Then, through the development of corollaries, he extended these propositions and made them more relevant to human social organization. Finally, he derived from these propositions and their corollaries a series of theorems to account for the operation of different social patterns. At various points in the development of his system of propositions, corollaries, and theorems, new concepts that would be incorporated into the corollaries and theorems were added.

Emerson never did perform the logical operations in deriving corollaries from the basic operant propositions and in developing theorems from these propositions and corollaries. Yet, in contrast to most theory in sociology, Emerson's work is extremely rigorous.[41] Concepts are precisely defined and represented by symbolic notation. Propositions, corollaries, and theorems are stated in terms of covariance among these clearly defined concepts. Thus considerable attention is devoted to concept formation and then to the use of these concepts in a system of propositions, corollaries, and theorems.

Emerson followed the substantive strategy of other exchange theorists by moving from micro processes in simple structures to processes in more complex structures. As the structures under investigation become more complex, additional corollaries and theorems are developed. But the most important difference between Emerson's substantive approach and that of other perspectives is his concern with the *forms* of exchange relations. The theorems delineate the processes inherent in a given form of exchange relationship. The nature of the units in this relationship can be either micro or macro—individual persons or corporate units such as groups, organizations, or nations. Much as Georg Simmel focused on the "forms of sociation" and their underlying exchange basis, so Emerson sought to develop a set of theoretical principles that explains generic social forms. In this way the distinction between micro- and macroanalysis is rendered less obstructive, because it is the *form of the relationship* rather than the properties of the units that is being explained. And

conceptual works include "Operant Psychology and Exchange Theory," in *Behavioral Sociology*, eds. R. Burgess and D. Bushell (New York: Columbia University Press, 1969) and "Social Exchange Theory," in *Annual Review of Sociology*, eds. A. Inkeles and N. Smelser, 2 (1976), pp. 335–62.

[40]For example, see Karen S. Cook and Richard Emerson, "Power, Equity and Commitment in Exchange Networks," *American Sociological Review* 43 (1978), pp. 712–39; Karen S. Cook, Richard M. Emerson, Mary R. Gillmore, and Toshio Yamagishi, "The Distribution of Power in Exchange Networks," *American Journal of Sociology* 89 (1983), pp. 275–305; Karen S. Cook and Richard M. Emerson, "Exchange Networks and the Analysis of Complex Organizations," *Research in the Sociology of Organizations* 3 (1984), pp. 1–30. See also Karen S. Cook, "Exchange and Power in Networks of Interorganizational Relations," *Sociological Quarterly* 18 (Winter 1977), pp. 66–82; "Network Structures from an Exchange Perspective," in *Social Structure and Network Analysis*, eds. P. Marsden and N. Lin; and Karen S. Cook and Karen A. Hegtvedt, "Distributive Justice, Equity, and Equality," *American Sociological Review* 9 (1983), pp. 217–41.

[41]There are, of course, notable exceptions to this statement. See, for examples, Alfred Kuhn, *Unified Social Science* (Homewood, IL: Dorsey Press, 1975), and the articles in Berger, Zelditch, and Anderson, eds., *Sociological Theories in Progress* as well as in Willer and Anderson, eds., *Networks, Exchange and Coercion.*

it is this point of emphasis that would make his perspective compatible with network analysis.

Emerson's strategy involves many problems of exposition, however. His concern with rigorous concept formation involves the creation of a new language. Acquiring a familiarity with this language requires considerable time and effort. Moreover, the system of definitions, concepts, propositions, corollaries, and theorems soon becomes exceedingly complex, even though Emerson explores only a few basic types, or forms, of social relations. This analysis of Emerson's work therefore translates terms into more discursive language and omits discussion of certain corollaries and theorems.

The Basic Exchange Concepts

The following is an incomplete list of key concepts in Emerson's exchange perspective:

Actor: An individual or collective unit that is capable of receiving reinforcement from its environment.

Reinforcement: Features of the environment that are capable of bestowing gratification upon an actor.

Behaviors: Actions or movements of actors in their environment.

Exchange: Behaviors by actors that yield environmental reinforcement.

Value: The strength of reinforcers to evoke and reinforce behavioral initiations by an actor, relative to other reinforcers and holding deprivation constant and greater than zero.

Reward: The degree of value attached to a given type of reinforcement.

Alternatives: The number of sources in the environment of an actor that can bestow a given type of reinforcer.

Cost: The magnitude and number of rewards of one type foregone to receive rewards of another type.

Exchange relation: Opportunities across time for an actor to initiate behaviors that lead to relatively enduring exchange transactions with other actors in the environment.

Dependence: A situation in which an actor's reinforcement is contingent upon behaviors on the part of another actor, with the degree of dependence being a dual function of the strength of reinforcement associated with behavior and the number of alternatives for rewards.

Balance: The degree to which the dependency of one actor, *A*, for rewards from actor *B* is equal to the dependency of actor *B* for rewards from actor *A*.

Power: The degree to which one actor can force another actor to incur costs in an exchange relation.

Resources: Any reward that an actor can use in an exchange relation with other actors.

Several points about this list of concepts should be emphasized. First, Emerson analyzes only the exchange *relation* between actors. This approach bypasses the problem of tautology so evident in much exchange theory by viewing an established relation—not the actors in the relation—as the smallest unit of analysis. In this way questions about each actor's values become less central because attention is focused on the relationship between actors who exchange resources. This line of argument, of course, abandons explanation in terms of an individual actor's values.[42] The emphasis is on the ratio of rewards exchanged among actors and on how this ratio shifts or stabilizes over the course of the exchange relationship. Propositions thus focus on explaining the variables outside the actors in the broader context of the social relationship that might influence the ratio of rewards in a given social relationship. Thus behavior is no longer the dependent variable in propositions; rather, the exchange relationship becomes the variable to be explained. The goal is to discover laws that help account for particular patterns of exchange relations. This approach is contrary to traditional exchange theory, which seeks to explain why a person enters into an exchange relationship in terms of that person's values. But, if the relationship is the unit of analysis, then the question of why the individual enters the relationship is no longer of prime concern. The fact is that the individual has entered a relationship and is willing to exchange rewards with another. When this exchange relationship among actors becomes the unit of analysis, Emerson argued, theory seeks to discover what events could effect variations in the entire relational unit, not in the individual behaviors of actors. For example, in a hypothetical exchange, person *A* gives esteem and respect to person *B* in return for advice. With the *A*, *B* relationship as the unit of analysis, the question is not what made either *A* or *B* enter the relationship—answers to which would take theory into *A*'s and *B*'s cognitive structure and thereby increase the probability of tautologous propositions. Rather, since the *A*,*B* unit already exists as an entity, theoretical questions should focus on what events would influence the ratio of esteem and advice exchanged in the *A*,*B* unit.

Second, as can be seen from the list of definitions above, the concepts of actor, reinforcement, exchange, value, reward, cost, and resource are all defined in terms of one another; but, since they are not analyzed independently of the exchange relation, the problem of tautology is bypassed. These concepts are the givens of any existing exchange relation. Thus, in contrast to most exchange approaches, social structure is not a theoretical given. Instead, behavioral dispositions are the givens, and it is social structure that is to be explained.

Third, in accordance with the emphasis on the structure of the exchange relation, as opposed to the characteristics of the actors, the concepts of (*a*) dependence, (*b*) power, and (*c*) balance in exchange relations become central. The key questions in Emerson's scheme thus revolve around how dependence,

[42]Yet, curiously, Emerson returned to this question in his last article. See Richard M. Emerson, "Toward a Theory of Value in Social Exchange," in Karen S. Cook, ed., *Social Exchange Theory* (Newbury Park, CA: Sage, 1987), pp. 11–46. See, in this same volume, Jonathan H. Turner's critique of this shift in Emerson's thought: "Social Exchange Theory: Future Directions," pp. 223–39.

power, and balance in exchange relations help explain the operation of more complex social patterns.

Fourth, actors are viewed as either individuals or collective units. The same processes in exchange relations are presumed to apply to both individuals and collectivities of individuals, thus obviating many problems in the micro-vs.-macro schism in sociological theorizing. This emphasis is possible when attention is shifted away from the attributes of actors to the *form* of their exchange relationship.

Thus, although this partial list of Emerson's concepts appears to be similar to that developed by George Homans (see Chapter 15) and other behavioristically oriented exchange theorists, there is an important shift in emphasis from concern with the values and other cognitive properties of actors to a concern with the structure of an exchange relation. This concern with structure takes as a given the flow of valued resources among those involved in the exchange. Theoretical attention then focuses on the structural attributes of the exchange relation and on the processes that maintain or change the structural form of an ongoing exchange relationship.

The Basic Exchange Processes

In Emerson's scheme, analysis begins with an existing exchange relation between at least two actors. This relationship has been formed from (1) perceived opportunities by at least one actor, (2) the initiation of behaviors, and (3) the consummation of a transaction between actors mutually reinforcing each other. If initiations go unreinforced, then an exchange relation will not develop. And, unless the exchange transaction between actors endures for at least some period of time, it is theoretically uninteresting.

Emerson's approach thus starts with an established exchange relation and then asks: to what basic processes is this relationship subject? His answer: (1) the use of power and (2) balancing. If exchange relations reveal high dependency of one actor, *B*, on another actor, *A*, for reinforcement, then *A* has what Emerson termed a *power advantage* over *B*. This conceptualization of power is similar to Peter Blau's formulation (see Chapter 16), although Emerson developed a different set of propositions for explaining its dynamics. To have a power advantage is to use it, with the result that actor *A* forces increasing costs on actor *B* within the exchange relationship.

In Emerson's view, a power advantage represents an imbalanced exchange relation. A basic proposition in Emerson's scheme is that, over time, imbalanced exchange relations tend toward balance.[43] He visualized this process as occurring through a number of "balancing operations":

1. A decrease in the value for actor *B* of reinforcers, or rewards, from actor *A*.

[43]Note here the emphasis on balance, an idea introduced into network analysis by Gestalt psychology.

2. An increase in the number of alternative sources for the reinforcers, or rewards, provided to B by A.
3. An increase in the value of reinforcers provided by B for A.
4. A reduction in the alternative sources for the rewards provided by B for A.

These balancing operations are somewhat similar to the propositions enumerated by Blau on the conditions for differentiation of power (see Table 16–2 on page 334). But in contrast to Blau's emphasis on the inherent and incessant dialectic for change resulting from power imbalances, Emerson stressed that, through at least one of these four balancing operations, the dependency of B and A on each other for rewards will reach an equilibrium. Thus exchange transactions reveal differences in power that, over time, tend toward balance. Naturally, in complex exchange relations involving many actors, A, B, C, D, . . . , n, the basic processes of dependence, power, and balance will ebb and flow as new actors and new reinforcers or resources enter the exchange relations.

The Basic Exchange Propositions

In Table 27–1 the initial propositions that Emerson developed to explain exchange relations are selectively summarized. The general strategy was to begin with behaviorist principles and then to derive theorems from these that explain the basic exchange processes, use of power, and balancing. In turn, corollaries to these theorems can be developed to account for the structural forms of exchange relations. Thus the propositions in Table 27–1 represent only a starting point.

The crucial next step is to derive theorems from these behaviorist principles that pertain to the dynamics of power and balancing. In Table 27–2, Emerson's initial set of theorems is summarized. These theorems describe the dynamics of power as a function of one actor's dependency on another for valued resources (Theorem 4), whereas balance is conceptualized as a process whereby dependency is reduced over time (see definition of balance and Theorem 5). Thus power (P) is a positive function of the dependency (D) of actor B on the resources of actor A, or $P_{AB} = D_{BA}$. Balance is a situation in which B's dependency for resources from A is equal to A's dependency for resources from B, or $D_{BA} = D_{AB}$.

Thus far Emerson has derived some basic theorems on power and balance from a long list of behaviorist principles. This list of behaviorist assumptions now recedes, and the main task is to introduce corollaries and new theorems to account for the structural form of an ongoing exchange relation. It is at this point that Emerson introduced ideas from network analysis.

Structure, Networks, and Exchange

Emerson's portrayal of social networks will be simplified, since for our purposes here the full details of his network terminology need not be addressed. Although

TABLE 27–1 The Operant Propositions and Initial Corollaries

Proposition 1:	The greater the behavioral repertoire of actor *A* in a situation and the greater the variations in rewards for behaviors, the more likely is *A* to emit those behaviors yielding the greatest rewards.	
	Corollary 1.1:	The greater the decrease in rewards for *A* in an established exchange relation, the greater the variation in *A*'s behavior.
	Corollary 1.2:	The more rewards in an established exchange relation approach a zero level of reinforcement, the fewer the initiations by *A*.
	Corollary 1.3:	The greater the power advantage of *A* over *B* in an exchange relation, the more *A* will use its power advantage across continuing transactions.
	Corollary 1.4:	The more power is balanced in an exchange relation between *A* and *B*, and the more *A* increases its use of power, the more *B* will increase its use of power.
Proposition 2:	The more frequent and valuable the rewards received by actor *A* for a given behavior in a situation, the less likely is actor *A* to emit similar behaviors immediately.	
	Corollary 2.1:	The more rewards of a given type received by *A*, the less frequent *A*'s initiations for rewards of this type.
Proposition 3:	The more actor *A* must emit a given behavior for a given type of reward, and the greater the *strength* and number of rewards of this type in a situation, the more likely is actor *A* to emit behaviors *of a given* type in that situation.	
	Corollary 3.1:	The greater the number of alternatives available to *A* for a given reward, the less dependent is *A* upon that situation.
	Corollary 3.2:	The more a situation provides multiple sources of reward for *A*, the more dependent is *A* on that situation.
	Corollary 3.3:	The greater the value of rewards received by *A* in a given situation, the greater is the dependency of *A* on that situation.
	Corollary 3.4:	The greater the uncertainty of *A*'s ever receiving a given reward in a given situation, and the fewer alternative situations for receiving this reward, the greater is the dependency of *A* on that situation.
	Corollary 3.5:	The less the value of a reward for *A* in an *A,B* exchange relation, and the greater the alternative sources of that reward for *A*, the less cohesive is the exchange relation between *A* and *B*; or, conversely, the more the value of a reward for *A*, and the fewer alternative sources of that reward for *A*, the more cohesive is the relationship between *A* and *B*.
	Corollary 3.6:	The more an *A,B* exchange relationship at one point in time is transformed to an *A,B,C* relationship, the greater the dependency of *B* upon *A*; also, the fewer the alternatives for *B* in the *A,B* relationship, the more *B*'s dependency upon *A* will be greater than *B*'s dependency upon *C*.
Proposition 4:	The more uncertain is an actor *A* of receiving a given type of reward in recent transactions, the more valuable is that reward for actor *A*.	
	Corollary 4.1:	In a set of potential exchange relations, the more maintenance of one transaction precludes other transactions in this set, the greater the initial costs of this one transaction but the less the costs across continuing transactions.

TABLE 27–2 The Initial Theorems

Theorem 1:	The greater the value of rewards to *A* in a situation, the more initiations by *A* reveal a curvilinear pattern, with initiations increasing over early transactions and then decreasing over time. (From Corollaries 1.2 and 2.1.)
Theorem 2:	The greater the dependency of *A* on a set of exchange relations, the more likely is *A* to initiate behaviors in this set of relations. (From Propositions 1 and 3.)
Theorem 3:	The more the uncertainty of *A* increases in an exchange relation, the more the dependency of *A* on that situation increases, and vice versa. (From Corollary 3.3 and Proposition 4.)
Theorem 4:	The greater the dependency of *B* on *A* for rewards in an *A,B* exchange relationship, the greater is the power of *A* over *B* and the more imbalanced is the relationship between *A* and *B*. (From Propositions 1 and 3 and definitions of cost, dependence, and power.)
Theorem 5:	The greater the imbalance of an *A,B* exchange relation at one point in time, the more likely it is to be balanced at a subsequent point in time. (From Corollaries 1.1, 1.3, 3.1, 3.3, and Proposition 4.)

Emerson followed the conventions of graph theory and developed a number of definitions, only two definitions are critical:

Actors: Points *A*, *B*, *C*, . . . , *n* in a network of relations. Different letters represent actors with different resources to exchange. The same letters—that is, A_1, A_2, A_3, and so forth—represent different actors exchanging similar resources.

Exchange relations: *A*——*B*, *A*——*B*——*C*, A_1——A_2, and other patterns of ties that can connect different actors to each other, forming a network of relations.[44]

The next conceptual task is to visualize the forms of networks that can be represented with these two definitions. For each basic form, new corollaries and theorems are added as Emerson documented the way in which the basic processes of dependence, power, and balance operate. His discussion is only preliminary, but it does illustrate the perspective's potential.

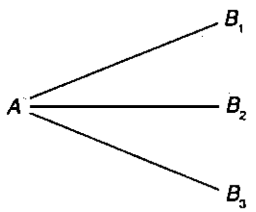
Several basic social forms are given special treatment: (*a*) unilateral monopoly, (*b*) division of labor, (*c*) social circles, (*d*) stratification, and, along with Karen Cook, (*e*) centrality in networks. Each of these network forms is discussed below.

Unilateral monopoly In the network illustrated in Figure 27–11, actor *A* is a source of valuable resources for actors B_1, B_2, and B_3. Actors B_1, B_2, and B_3 provide rewards for *A*, but, since *A* has multiple sources for rewards and the *B*s have only *A* as a source for their rewards, the situation is a unilateral monopoly.

Such a structure often typifies interpersonal as well as intercorporate units. For example, *A* could be a female date for three different men, B_1, B_2, and B_3.

[44] Emerson usually specified direction in his graphs, but we will keep it simple.

FIGURE 27–11



Or A could be a corporation that is the sole supplier of raw resources for three other manufacturing corporations, B_1, B_2, and B_3. Or A could be a governmental body and the Bs dependent agencies. Thus it is immediately evident that, by focusing on the structure of the exchange relationship, many of the micro-vs.-macro problems of exchange analysis, as well as of sociological theory in general, are reduced.

Another important feature of the unilateral monopoly is that, in terms of Emerson's definitions, it is imbalanced and thus its structure is subject to change. Previous propositions and corollaries listed in Table 27-1 provide an initial clue as to what might occur. Corollary 1.3 argues that A will use its power advantage and increase costs for each B. Corollary 1.1 indicates that, with each increment in costs for the Bs, their behaviors will vary and they will seek alternative rewards from $A_2, A_3, \ldots, A_n$. If another A can be found, then the structure of the network would change.

Emerson developed additional corollaries and theorems to account for the various ways this unilateral monopoly can become balanced. For instance, if no $A_2, A_3, \ldots, A_n$ exist and the Bs cannot communicate with each other, the following corollary would apply (termed by Emerson *Exploitation Type I*):

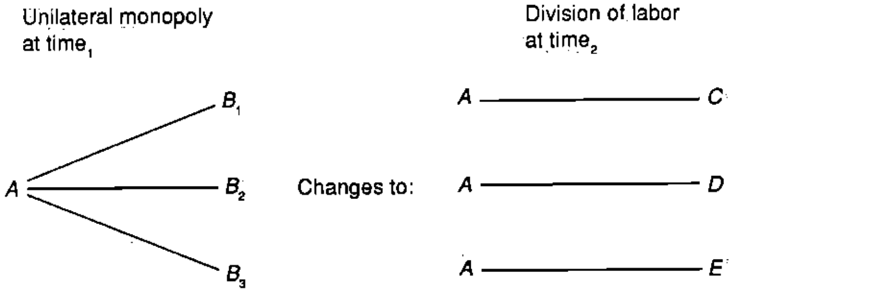
> *Corollary 1.3.1*: The more an exchange relation between A and multiple Bs approximates a unilateral monopoly, the more additional resources each B will introduce into the exchange relation, with A's resource utilization remaining constant or decreasing.

Emerson saw this adaptation as short-lived, since the network will become even more unbalanced. Assuming that the Bs can survive as an entity without resources from A, then Theorem 8 applies (termed by Emerson *Exploitation Type II*):

> *Theorem 8*: The more an exchange relation between A and multiple Bs approximates a unilateral monopoly, the less valuable to Bs the resources provided by A across continuing transactions. (From Corollary 1.3, Theorem 4, and Corollary 4.1.)

This theorem thus predicts that balancing operation 1—a decrease in the value of the reward for those at a power disadvantage—will operate to balance a unilateral monopoly where no alternative sources of rewards exist and where Bs cannot effectively communicate.

FIGURE 27–12



Other balancing operations are possible, if other conditions exist. If *B*s can communicate, they might form a coalition (balancing operation 4) and require *A* to balance exchanges with a united coalition of *B*s. If one *B* can provide a resource not possessed by the other *B*s, then a division of labor among *B*s (operations 3 and 4) would emerge. Or if another source of resources, A_2, can be found (operation 2), then the power advantage of A_1 is decreased. Each of these possible changes will occur under varying conditions, but Corollary 1.3.1 and Theorem 8 provide a reason for the initiation of changes—a reason derived from basic principles of operant psychology.

Division of labor The emergence of a division of labor is one of many ways to balance exchange relations in a unilateral monopoly. If each of the *B*s can provide different resources for *A*, then they are likely to use these in the exchange with *A* and to specialize in providing *A* with these resources. This decreases the power of *A* and establishes a new type of network. For example, in Figure 27–12, the unilateral monopoly at the left is transformed to the division of labor form at the right, with B_1 becoming a new type of actor, *C*, with its own resources; with B_2 also specializing and becoming a new actor, *D*; and with B_3 doing the same and becoming actor *E*.

Emerson developed an additional theorem to describe this kind of change, in which each *B* has its unique resources:

> *Theorem 9*: The more resources are distributed *non*uniformly across *B*s in a unilateral monopoly with *A*, the more likely is each *B* to specialize and establish a separate exchange relation with *A*. (From theorems not discussed here and Corollaries 1.1 and 1.3.1.)

Several points should be emphasized. First, the units in this transformation can be individual or collective actors. Second, the change in the structure or form of the network is described in terms of a theorem systematically derived from operant principles, corollaries, and other theorems. The theorem can thus apply to a wide variety of micro and macro contexts. For example, the theorem could apply to workers in an office who specialize and provide *A* with resources not available from others. It could also apply to a division in a corporation

FIGURE 27-13

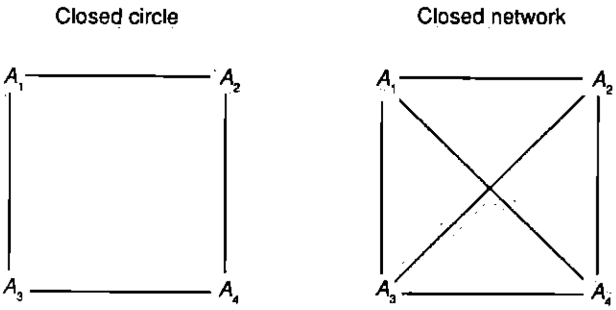
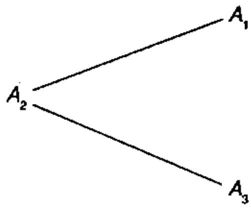


FIGURE 27-14



that seeks to balance its relations with the central authority by reorganizing itself in ways that distinguish it, and the services it can provide, from other divisions. Or it could apply to relations between a colonial power (A) and its colonized nations (B_1, B_2, B_3), which specialize (become C, D, and E) in their predominant economic activities in order to establish a less dependent relationship with A.

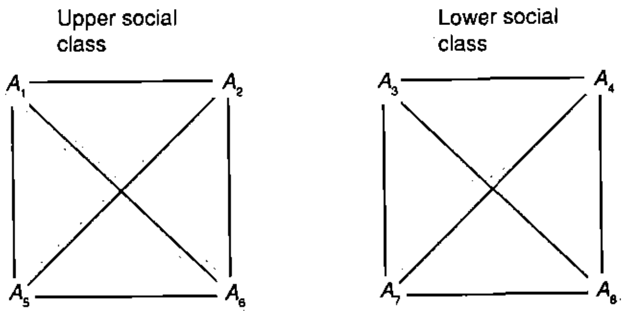
Social circles Emerson emphasized that some exchanges are intercategory and others intracategory. An intercategory exchange is one in which one type of resource is exchanged for another type—money for goods, advice for esteem, tobacco for steel knives, and so on. The networks discussed thus far have involved *inter*category exchanges between actors with different resources (A, B, C, D, E). An *intra*category is one in which the same resources are being exchanged—affection for affection, advice for advice, goods for goods, and so on. As indicated earlier, such exchanges are symbolized in Emerson's graph approach by using the same letter—A_1, A_2, A_3, and so forth—to represent actors with similar resources. Emerson then developed another theorem to describe what will occur in these intracategory exchanges.

> *Theorem 10*: The more an exchange approximates an intracategory exchange, the more likely are exchange relations to become closed. (From Theorem 5 and Corollaries 1.3 and 1.1.)

Emerson defines "closed" either as a circle of relations (diagramed on the left in Figure 27-13) or as a balanced network in which all actors exchange with one another (diagramed on the right in Figure 27-13). Emerson offered the example of tennis networks to illustrate this balancing process. If two tennis players of equal ability, A_1 and A_2, play together regularly, this is a balanced intracategory exchange—tennis for tennis. However, if A_3 enters and plays with A_2, then A_2 now enjoys a power advantage, as is diagramed in Figure 27-14.

This is a unilateral monopoly, but, unlike those discussed earlier, it is an intracategory monopoly. A_1 and A_3 are dependent upon A_2 for tennis. This relation is unbalanced and sets into motion processes of balance. A_4 may be

FIGURE 27-15



found, creating either the circle or balanced network diagramed in Figure 27-13. Once this kind of closed and balanced network is achieved, it resists entry by others, A_5, A_6, A_7, . . . , A_n, because, as each additional actor enters, the network becomes unbalanced. Such a network, of course, is not confined to individuals; it can apply to nations forming a military alliance or common market, to cartels of corporations, and to other collective units.

Stratified networks The discussion on how intracategory exchanges often achieve balance through closure can help us understand processes of stratification. If, for example, tennis players A_1, A_2, A_3, and A_4 are unequal in ability, with A_1 and A_2 having more ability than A_3 and A_4, an initial circle may form among A_1, A_2, A_3, and A_4; but, over time, A_1 and A_2 will find more gratification in playing each other, and A_3 and A_4 may have to incur too many costs in initiating invitations to A_1 and A_2. For an A_1 and A_3 tennis match is unbalanced; A_3 will have to provide additional resources—the tennis balls, praise, esteem, self-deprecation. The result will be for two classes to develop:

Upper social class A_1——A_2
Lower social class A_3——A_4

Moreover, A_1 and A_2 may enter into new exchanges with A_5 and A_6 at their ability level, forming a new social circle or network. Similarly, A_3 and A_4 may form new tennis relations with A_7 and A_8, creating social circles and networks with players at their ability level. The result is for stratification to reveal the pattern in Figure 27-15.

Emerson's discussion of stratification processes was tentative, but he developed a theorem to describe these stratifying tendencies:

Theorem II: The more resources are equally valued and the more resources are unequally distributed across a number of actors, the more likely is the network to stratify in terms of resource magnitudes and the more likely are actors with a given level of resources to form closed exchange networks. (From Theorem 5 and Propositions 1 and 4.)

Again, this theorem can apply to corporate units as well as to individuals. Nations become stratified and form social circles, as is the case with the distinctions between the developed and underdeveloped nations and the alliances among countries within these two classes. Or it can apply to traditional sociological definitions of class, since closed networks tend to form among members within, rather than across, social classes.

The dynamics of centrality As noted earlier, an important concept in network analysis is *centrality*. Indeed, it is considered one of the most critical properties of a network. Centrality is determined by a variety of measures, as mentioned earlier.[45] Most network analyses simply describe centrality, but Karen Cook has tried to use Emerson's theoretical ideas to explain its dynamics.[46] Her argument will be simplified and also rephrased a bit, but the essential logic is the same. We can begin by creating a theorem that summarizes her hypothesis.[47]

> *Theorem 12*: Over time, the distribution of power in complex intracategory networks decentralizes around those actors (points) who possess the highest relative degree of direct access to resources. (From Corollary 1.3.1 and Theorems 4 and 5.)

Using Figure 27–16 as an illustration of this theorem, Cook would predict that power will become increasingly concentrated in A_3, A_4, and A_1. A_2 will become less powerful and, in a more sociological sense, less central. In fact, the entire network will, over time, collapse around A_3, A_4, and A_1. Why should this be so? The basic argument that follows from the dynamics of power and dependence is this: A_3, A_4, and A_1 reveal regular equivalence in that they each have a unilateral monopoly with at least three other *A*s (for example, A_3 has a monopoly exchange relation with A_{11}, A_{12}, and A_{13}). Thus, to get resources, A_2 must bargain with structurally equivalent *A*s—that is, A_1, A_3, and A_4—who can extract more resources from those *A*s over which they possess a monopoly. And so, A_1, A_3, and A_4 will increase exchanges with their monopolized partners and decrease exchanges with A_2, who, in all likelihood, will become like the monopolized *A*s. Hence the network will decentralize around A_1, A_3, and A_4, who possess the highest relative access to resources (by virtue of their respective unilateral monopolies). However, if A_2 provides a unique and highly valued resource—thereby making the exchange intercategory and changing the designation of A_2 to *B*—then the network may stay centralized around *B*. For example, if *B* is a king in a feudal system and provides the organizational know-how to coordinate military defense for all of the *A*s in a hostile environment,

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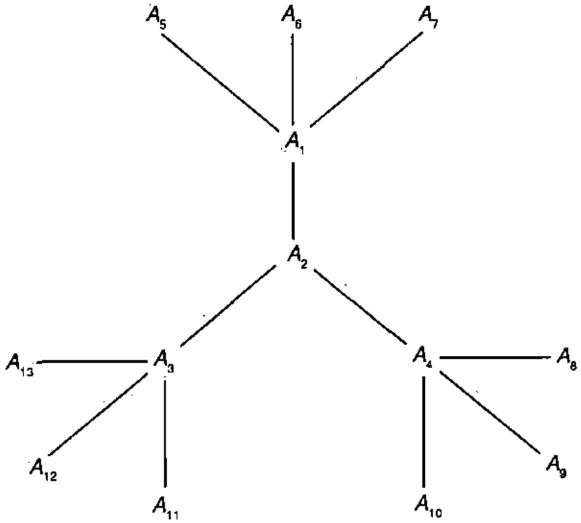
[45] Linton C. Freeman, "Centrality in Social Networks: Conceptual Clarification."

[46] Karen S. Cook et al., "The Distribution of Power in Exchange Networks."

[47] This is our wording of a more complex argument presented by Cook, Emerson, and others. See ibid.

FIGURE 27-16



then the structure portrayed in Figure 27-16 would remain in tact. Thus Theorem 12 is most relevant to *intra*category exchanges.[48]

The critical point here is that Cook and her associates are trying to use the basic principles developed by Emerson to address more complex network systems. In so doing, they can explain the process of centrality, and perhaps other network properties, in terms of theoretical deductions. Up to this point, network analysis has typically described centrality using various measures, whereas the Emerson-Cook approach allows these network properties to be explained in terms of an abstract theoretical proposition.

CONCLUSION

There is a curious division between mainstream sociological theory and network analysis. Although the heavily quantitative portions of network sociology are difficult for many social theorists to understand, this fact alone cannot explain the division. For network sociology is doing the very thing that early sociologists and anthropologists saw as crucial—the mapping of the relations that create social structures; and, as we have seen, network analysis can be phrased in nonquantitative terms.

The real reason for the split of network sociology from mainstream theory is that *neither* is very theoretical. Network analysis is a bag of computer algorithms and mathematical formulations whose relevance to the real world or

[48]Recall Figure 27-10 on page 556. The prediction here would also be that this network would be decentralized around A_1, C_1, and D_1, *unless* the resources provided by B were highly valued and could not be gotten elsewhere—from a B_1, B_2, B_3, etc.

to traditional theoretical questions in sociology is, at best, tenuous; much mainstream "theory" is now so philosophical and antiscientific that any approach that is too "scientific looking" will be rejected. What is required, then, is for network analysis and much "theory" in sociology to become theoretical in the sense of developing testable laws and models of human organization.

On the network side of this proscription, several tacks are possible. One is to develop formal laws in terms of network concepts—that is, laws on the dynamics of centrality, equivalence, brokerage, bridging, density, clique formation/dissipation, and the like. Another is to translate, much as the Emerson-Cook project has begun to do, traditional sociological concerns—power and stratification, for instance—into network concepts. For either tack it is essential that the tendency to develop "formalisms" for their own sake or their ascetic appeal needs to be tempered by a willingness to communicate the theoretical message in less arcane terms.

Is this likely? It is not clear that it is. Network sociology is part of an interdisciplinary movement that constitutes a world in itself—a big clique, in network terms. Its members talk to one another more than to anyone else, and they appear to be content with this situation. For their part, mainstream theorists have retreated into a variety of camps and perspectives—some soft, others hard and formal—whose members also talk to one another and ignore "outsiders." Thus it is questionable whether mainstream theory can reveal even a central current, or even trickle, in the future, and it is also questionable that network analysis will be widely influential in theory circles in the near future.

Such a scenario would, of course, be unfortunate, since network analysis offers a set of useful tools for examining a critical property of the social universe: social structure. More than any of the "structural perspectives" examined in this section of chapters, network analysis offers the most potential for developing scientific sociology.