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THE SOCIOLOGY OF SOCIAL NETWORKS

BERNICE A. PESCOSOLIDO
Indiana University

Social networks have come to take on prominence in sociology, other academic disciplines, many policy areas, and even in the public discourse in recent years. "Networking," "six degrees of separation," "social support," and "social capital" have been adopted in the business world, among poets and playwrights, and among friends. Yet the diffusion of the underlying terms and concepts from a social network perspective has produced both acceptance and confusion in academic and community circles. Simply stated, a social network is a "structure of relationships linking social actors" (Marsden 2000:2727) or "the set of actors and the ties among them" (Wasserman and Faust 1994). Relationships or ties are the basic building blocks of human experience, mapping the connections that individuals have to one another (Pescosolido 1991). As network theorists claim, the structure of these relationships among actors has important consequences for individuals and for whole systems (Knoke 1990).

Some sociologists see social networks as the essence of social structure (Burt 1980); others see social structure governing these networks (Blau 1974); still others see networks as the mechanism that connects micro and macro levels of social life (Coleman 1990; Pescosolido 1992). To many, the power of network explanations lies in changing the focus of social structure from static categories such as age, gender, and race to the actual nature of the social contacts that individuals have and their impact on life chances (White 1992; Wilson 1987, 1996). In any case, there is a clear link between networks and sociology's central concerns with social structures and social interaction.

THE ROOTS OF A SOCIAL NETWORK PERSPECTIVE IN SOCIOLOGY

Despite the many varieties of "sociology" in contemporary theory, the role of social interactions may be the single commonality (Pescosolido 1992). Social relationships have always been at the heart of sociological understandings of the world. Many sociologists trace the introduction of the structural approach to social interactions to Georg Simmel (1955) in *Conflict and the Web of Group Affiliations* (Pescosolido and Rubin 2000; White, Boorman, and Brieger 1976). In this work, Simmel (1955) began with the classic statement, "Society arises from the individual and the individual arises out of association" (p. 163). Like the founding sociologist, social interaction was the currency that set Simmel's work apart from other social sciences and philosophies. In Durkheim's (1951) *Suicide,* for example, two types of social interaction (integration and regulation) were seen as combining to create four distinct types of social structures (anomic, fatalistic, altruistic, and egoistic), which shaped the behavior of individuals who lived within them. To map these social structures, Durkheim referred to different kinds of "societies," social groups or institutions such as the family, polity, or religions. While consistent with a network approach, Durkheim's approach was more implicit than explicit on social ties (Pescosolido 1994).

Simmel suggested that it was the nature of *ties* themselves rather than the social group per se that lay at the center of many human behaviors. In his attempt to

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understand the transition from agrarian to industrial society, Simmel discussed two ideal configurations of social networks, commonly referred to as the "premodern" form of concentric social circles and the "modern" form of the intersection of social circles. For each, Simmel described and considered their effect on individuals, including the way personality and belief structures are formed. Briefly, social networks in premodern society were encapsulating and comforting but often intolerant of outsiders (Blau 1993; Giddens 1990). They provided a sense of security and solidarity, which minimized psychological "tensions" for the majority of individuals. Yet such a structure, as Simmel noted, limited freedom, individuality, and diversity. These networks were, as Suchman (1964) was later to call them, "parochial."

Modern society brought "cosmopolitan" networks characterized by intersecting circles. The transition to modern society allowed individuals to increasingly participate in a greater number of networks with more numerous, but fewer multistranded, ties (Blau 1977). Individuals craft unique personalities that stand at the intersection of all the social networks they have inherited and built (Burt 1976). Individuals are more unique and tolerant.[1] But with greater choices possible, individuals deal with greater uncertainty and less support (Giddens 1990; Maryanski and Turner 1992).

Sociological research continued to develop, making heavy use of Durkheim and referring less often to Simmel's network perspective. However, in the 1930s, J. L. Moreno (1934), a psychiatrist and a prolific writer, published *Who Shall Survive? Foundations of Sociometry, Group Psychotherapy, and Sociodrama.* This work marked the major reemergence of the social network metaphor into sociology and, equally important, across the social sciences and into social policy. Working within the context of a girls' school of the time, Moreno and his colleagues developed sociometric techniques that mapped the relationships among individuals (e.g., Jennings 1943; Moreno and Jennings 1938). The goal was not only scientific but pragmatic, with Moreno (1934) using network data to develop "interpersonal therapy," discussing its use with national leaders, including then president Franklin D. Roosevelt.

Moreno laid out a dictionary of network terms, many still used in the same way today (see the next section). More important, the sociogram, a visual technique that graphed the ties between social actors, became the main analytical tool of sociometry. For the first time, these pictures of social relationships made clear the structure of friendships, leadership, and classrooms (Jennings 1943; Northway 1940). Each individual was represented by a circle with lines showing connections and arrowheads indicating whether the tie was sent or received (see Figure 20.1).

As the number of cases increased, and the technique was applied to housing units and communities as well as individuals, the sociograms became increasingly difficult

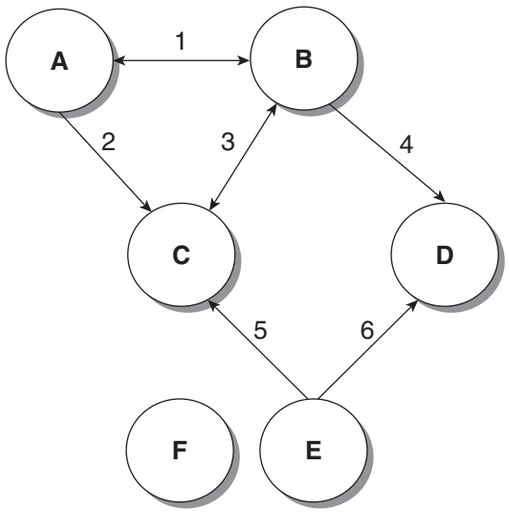

Figure 20.1 Representation of Network Ties in a Sociogram

to read and understand (e.g., see Barnland and Harlund 1963). This was complicated by attempts to introduce other factors, such as sociodemographics or tie intensity, into the graphs. While sociograms continued to appear, these limits saw the graphic approach fall into disuse, and with it, much of the intellectual force that the network approach had brought to sociology. The introduction of graph theory in the 1940s led to the development of mathematical techniques to deal with large networks (Harary, Norman, and Cartwright 1965) and forced Moreno to the sidelines. While Freeman (2004) refers to this period through the 1960s as the "Dark Ages," balance theory formalized the study of network influences and dramatically influenced theory and data collection in social psychology (e.g., Newcomb 1961).

The next important break came in the 1970s, when Harrison White and colleagues developed new principles to rethink the analysis of network data. Using matrix algebra and clustering techniques, block modeling (White et al. 1976), the essential insight of their approach, rested on five basic ideas.[2]

But the development of the Harvard School represented more than an answer to an analytical problem. It began a resurgence of theoretical interest in sociology that was limited to neither the kinds of data nor the analytical techniques developed by White and his colleagues. For example, both Granovetter's (1982) strength-of-weak-ties concept and Fischer's (1982) documentation that urban alienation was thwarted because people live their lives in small worlds, had roots in this environment. Such a review is not meant to imply that other important work across the social sciences was lacking or should be dismissed. In England, Bott's (1957) work on social networks in the family was seminal; in psychology, Milgram (1967) traced chains of connection in "small worlds"; in medical

sociology, Kadushin's (1966) "friends and supporters of psychotherapy," Suchman's (1965) "parochial versus cosmopolitan" network distinction, and Rogers's (1971) similar distinction between "localites" and "cosmopolities" became the mainstays of theoretical development and research agendas.

Nonetheless, the developments at Harvard under Harrison White revived interest in social networks, stemming from the realization that the magnitude of social structural problems could now be matched with adequate theoretical and analytical tools. Carrington, Scott, and Wasserman (2005) saw another recent but unexplained spike in network research and interest beginning in the 1990s. This resurgence captured not only the social sciences but also epidemiology, administrative science and management, physics, communications, and politics. Barabasi (2003) contends that the increased emphasis on networks reflects a broad-based realization that research, traditionally (and successfully) searching for "pieces" of social and physical life, could not consider these pieces in isolation. This recognition, he argues, comes in the wake of the emergence of the Internet with its focus on networks (see also Wasserman 2003; Wellman and Gulia 1999). Paralleling these efforts is the development of a wide range of network analytical techniques catalogued in *Network Analysis* (Wasserman and Faust 1994) and recent additions in *Models and Methods in Social Network Analysis* (Carrington et al. 2005).

MAIN CONTRIBUTIONS: PRINCIPLES UNDERLYING THE SOCIAL NETWORK PERSPECTIVE

There is no single network "theory"; in fact, Knoke (1990) sees this as unlikely and even inappropriate. The network approach is considered by most, who use it as more of a perspective or frame that can be used to develop specific theories. Yet sociologists share, across studies, basic principles that often underlie much research using a network frame and guide the development of specific investigations and analyses.[3]

1. Social actors, whether individuals, organizations, or nations, shape their everyday lives through consultation, information and resource sharing, suggestion, support, and nagging from others (White et al. 1976). Network interactions influence beliefs and attitudes as well as behavior, action, and outcomes.

2. Individuals are neither puppets of the social structure nor purely rational, calculating individuals. Individuals are "sociosyncratic," both acting and reacting to the social networks in their environment (Elder 1998a, 1998b; Pescosolido 1992). They are, however, always seen as interdependent rather than independent (Wasserman and Faust 1994). Some theorists (e.g., Coleman 1990) see networks in the purposive action, rational actor tradition, but this represents only one view that can be subsumed within a network perspective (Pescosolido 1992).

3. Important but often daunting and abstract influences such as "society," "institution," "culture," the "community," and the "system" can be understood by looking to the set of social interactions that occur within them (Tilly 1984). Networks set a context within groups, formal organizations, and institutions for those who work in or are served by them, which, in turn, affects what people do, how they feel, and what happens to them (Wright 1997).

4. Three characteristics of social networks are distinct—structure, content, and function. *Structure* targets the architectural aspect of network ties (e.g., size, density, or types of relationships). *Content* taps what flows across the network ties. They are "channels for transfers of material or non-material resources" (Wasserman and Faust 1994). That is, attitudes and opinions, as well as more tangible experiences and collective memory, are held within networks (Emirbayer and Goodwin 1994; Erikson 1996; Stryker 1980). Finally, networks serve a variety of *functions,* including emotional support, instrumental aid, appraisal, and monitoring (Pearlin and Aneshensel 1986).

5. Network influence requires the consideration of interactions among these three aspects. Structural elements (e.g., size) of a network may tap the amount of potential influence that can be exerted by the network (i.e., the "push"). However, only the content of the network can provide an indication of the direction of that influence (i.e., the "trajectory"). For example, large networks can influence individuals on the Upper West Side of Manhattan to seek out medical professionals (Kadushin 1966) while keeping individuals in Puerto Rico out of the medical system (Pescosolido, Wright, et al. 1998). The intersection of the structure and content of social networks together calibrates whether and how much individuals will be pushed toward or away from doctors and alternative healers or even rely only on family for assistance (Freidson 1970; Pescosolido 1991).

6. Networks may be in sync or in conflict with one another. Different contexts can circumscribe different sets of networks (Simmel 1955). Family, peer, and official school-based networks, for example, may reinforce messages or clash in priorities for teenagers. The level of discordance in the "culture" of networks and the *interface* of social circles may be critical to understanding the behavior of social actors (Pescosolido, Wright, and Sullivan 1995). They may also be different from the perspective of interacting parties in ways that provide insight into social action and outcomes (Pescosolido and Wright 2002).

7. Social interactions can be positive or negative, helpful or harmful. They can integrate individuals into a community and, just as powerfully, place stringent isolating regulations on behavior. The little research that has

explored negative ties in people's lives has found them to have powerful effects (Berkman 1986; Pagel, Erdly, and Becker 1987). Portes (1998), Rumbaut (1977), and Waldinger (1995) all document how tight social interactions within ethnic groups lead to restricted job opportunities for those inside and outside of the ethnic networks.

8. "More" is not necessarily better with regard to social ties. As Durkheim (1951) pointed out, too much oversight (regulation) or support (integration) can be stifling and repressive (Pescosolido 1994). Further, "strong" ties are not necessarily optimal because "weak" ties often act as a bridge to different information and resources (Granovetter 1982), and holes in network structures (Burt 1980) provide opportunities that can be exploited. The focus on social support, and now social capital, may have obfuscated the focus on the "dark" aspects of social networks (see below).

9. Networks across all levels are dynamic, not static, structures and processes.[4] The ability to form and maintain social ties may be just as important as their state at one point in time. There may be changes in the structure of networks or changes in membership. In fact, early work on this topic suggests that turnover rates may hover around 50%, while the structure (e.g., size) tends to remain stable (Perry 2005a). As Moody, McFarland, and Bender-deMoll (2005) note, "An apparently static network pattern *emerges* through a set of temporal interactions" (p. 1209). Further, the underlying reasons for changing networks may mark important insights into the influence of networks (Perry 2005a; Pescosolido and Wright 2004; Suitor, Wellman, and Morgan 1996; Wellman, Wong, Tindall, and Nazer 1996). This focus represents some of the newest work in sociology and some of the greatest theoretical, methodological, and analytical challenges (Bearman, Moody, and Stovel 2004; Snijders 1998). In fact, Carrington et al. (2005) refer to the analysis of social networks over time as the "Holy Grail" of network research. New analytical methods and visualization approaches are becoming available to see how social networks look and trace how they change (Bearman et al. 2004; Freeman 2004).

10. A network perspective allows for, and even calls for, multimethod approaches. Jinnett, Coulter, and Koegel (2002) conclude that quantitative research is powerful in documenting the effects of social networks but only when accompanied by qualitative research that describes why they operate and look the way they do. There is no standard way to chart network relationships—they may be derived from a list on a survey where individuals are asked to name people they trust, admire, or dislike or with whom they share information. Alternatively, the information may come from observing the behavior of individuals (e.g., who they talk to in their work group; Homans 1951, 1961). Network information can be collected through archival sources such as citation records (Hargens 2000) or by documenting the behavior of organizations or countries (e.g., trade agreements; Alderson and Beckfield 2004). Even simulated data can be and have been used to examine network processes (Cederman 2005; Eguiluz et al. 2005; Moss and Edmonds 2005).[5] In sum, deciding which kinds of social networks are of interest, how to elicit the ties, and how to track their dynamics remain critical issues (Berkman 1986; House, Robbins, and Metzner 1982; Leik and Chalkey 1996; O'Reilly 1998; Suitor et al. 1996; Wellman et al. 1996).

11. Sociodemographic characteristics are potential factors shaping the boundaries of social networks but provide, at best, poor measures of social interaction (Collins 1988; Morgan, Patrick, and Charlton 1984; White et al. 1976). Originally, networks were circumscribed by the place where people lived and their customs (Fischer 1982; Pescosolido and Rubin 2000; Simmel 1955; Wellman 1982). But a process of "disembedding" (Giddens 1990) from local places has been replaced by a "re-embedding" at the global level. While we may continue to see gross differences in, for example, the number of network ties by these "actor attributes" (Monge and Contractor 2003) or "composition variables" (Wasserman and Faust 1994), these static characteristics only indirectly tap the real underlying social forces at work—the content, structure, and function of social interactions.

Used in combination with social network factors, these characteristics offer two possibilities. First, complicated issues—for example, that men tend to report more networks but that women's networks are more intimate (Campbell and Rosenfeld 1985; Moore 1992)—can now be more readily examined with analytical techniques (Carrington et al. 2005; Freeman 2004; Koehly and Pattison 2005). Second, networks may operate differently for different groups. That is, considered as potential interactive factors, rather than simply shaping ones, attribute variables may provide insights into how social network processes create different pathways of beliefs and behaviors for social actors.

12. Individuals form ties under contextual constraints and interact given social psychological and neurological capacities. Thus, social networks exist in a multilevel environment. Some of these levels (e.g., organizations) may also be conceptualized in network terms. For example, an individual's network ties within the religious sphere exist within geographic areas that themselves have a structure of religious network types and a more general social capital profile (e.g., areas where the religion is dominant or in a minority; Pescosolido 1990). Such a view leads to additional research questions about whether network structures operate in the same way in different contexts (Pescosolido 1994). Similarly, other factors (e.g., laws) may set structural conditions on relationships (e.g., within organizational or business organization fields).

Further, individuals' social networks are not divorced from the body and the physical/mental capacities that individuals bring to them (Leventhal, Leventhal, and Contrada 1997; Orlinsky and Howard 1987; Rosenfield

and Wenzel 1997). As Fremont and Bird (2000) report, when social interactions are the source of social stress, the impact appears to be more devastating in magnitude (see also Perry 2005b). Social psychological characteristics (e.g., self-reliance) may also influence the effect of network ties. Biological challenges may lie at the heart of dramatic changes in individuals' social network systems both for those affected directly and for caregivers (Dozier 1993; Dozier, Cue, and Barnett 1994; Lysaker et al. 1994; Rosenfield and Wenzel 1997; Suitor and Pillemer 2002). It has long been known that children with physiological or neurological deficits have difficulties in establishing social relationships (Perry 2005b). Sociologists know that these early social relationships affect adult educational outcomes (Entwisle, Alexander, and Olson 2005).

Networks may also affect biology. In trying to understand why social networks matter—for example, in cardiac health—researchers have linked constellations of social networks to biological processes (e.g., plasma fibrinogen levels; Helminen et al. 1997). Furthermore, social support has been shown to influence the phenotypic expression of genetic predispositions (Caspi et al. 2002).

NETWORK BASICS

Even with some agreement on network foundations, a myriad of concepts and approaches confront the network approach with the necessity of clarifying terms (see also Monge and Contractor 2003). The most frequently referenced terms are briefly described below. This is neither an exhaustive nor a technical lexicon of network terminology; rather, the goal is to provide an orientation to network language and its basic variants.

• *Node, social atom, actor:* These terms refer to the central "units" that have networks. Social actors often refer to individuals; however, actors may also be families (Padgett and Ansell 1993), organizations (Galaskiewicz 1985), nations (Alderson and Beckfield 2004; Snyder and Kick 1979), or any other entity that can form or maintain formal (e.g., legal, economic) or informal (friendship, gossip) relationships (Figure 20.1: A, B, D through F represented as circles are "actors").

• *Ties, links, relationships, edges:* The network connections between and among actors are referred to as ties. Ties can be directed (sent or received) or not directed (joint organizational memberships). In Figure 20.1, a tie is sent from B to D (out-degree); D receives a tie from E (in-degree). A and B send and receive ties to each other. Double-headed arrows indicate "mutual," "bidirectional," "symmetrical," or "reciprocal" ties. They may map the existence of a relationship or have an intensity (ties in Figure 20.1 are lines 1 through 6). The two-actor connectors are dyads; three-actor connections are triads.

• *Subgroups:* When the focus is on some subset of actors and their linkages, the search is for subgroups.

• *Sociogram:* This is a picture of the relationships among members in a social network (Figure 20.1).

• *Sociomatrix/adjacency matrix:* Network ties can also be recorded and depicted as a set of numbers in a square table that consists of rows (recording ties sent) and columns (ties received) (see Figure 20.2).

• *Type of tie:* Networks can depict or illustrate different kinds of relationships called "types." For example, Padgett and Ansell's (1993) study of a Florentine family included both marriage and business ties.

• *Sociometric star:* In a social network, an actor(s) receiving a relatively high degree or number of ties is considered to be a "star." In Figure 20.1, C is a sociometric star with four in-degrees, more than any other actor.

• *Isolate:* An ego or node receiving no ties is an isolate (F in Figure 20.1, Actor 6 in Figure 20.2).

• *Network path:* Paths are determined by tracing ties to determine the number of degrees of separation between two actors. If two actors are directly connected, the value of the path is 1 (Figure 20.1, the path between A and B). The path value between E and A is 3 since E can be connected to A by tracing the path from E to C, C to B, and B to A.

• *Size:* In a network, the number of social actors constitutes the network size (in Figure 20.1, $n = 6$; in Figure 20.2, $N = 100$). In ego-based networks (see the next section), size refers to the number of ties listed for each social actor (e.g., How many confidants do you have?).

• *Density:* The "tightness" or "connectedness" of ties among actors in a network is calculated by the proportion of ties existing in a network divided by the possible number of ties that could be sent and received. Density

	1	2	3	4	5	6...	...100
1		1	1	0	0	0	1
2	1		1	1	0	0	1
3	0	1		0	0	0	0
4	0	0	1		0	0	0
5	0	0	1	1		0	0
6	0	0	0	0	0		0
⋮							
100	1	2	0	1	0	0	

Figure 20.2 Representation of Network Ties with a Sociomatrix

answers the question of how well all the members of a network are connected to one another (Figure 20.2: 30 possible ties, 9 ties sent, yielding a density of 9/30 or 0.33).

- *Content/function:* Both describe the meaning or nature of the tie.
  - *Strength:* This is a measure of intensity or potency of a tie. It may indicate frequency (e.g., how many trading agreements countries share), closeness (How close do you feel to X?), or another relevant quality that offers a value to the tie or defines a name generator (How many close business associates do you have in this firm?).
  - *Multiplexity:* When ties are based on more than one relationship, entail more than one type of social activity or social role, or serve more than one purpose, they are thought to be multiplex, "many stranded," or "multipurpose" (Barnes 1972). Multiplex ties tend to be more durable and deeper than those based on only one connection (Holschuh and Segal 2002; Morin and Seidman 1986; Tolsdorf 1976).
  - *Instrumental support:* Ties that offer practical resources or assistance are said to deliver instrumental support.
  - *Emotional support:* Ties that provide love, caring, and nurturing offer emotional support (Thoits 1995).
  - *Appraisal:* This targets network assistance in evaluating a problem or a source of aid (Pearlin and Aneshensel 1986).
  - *Monitoring:* When network ties watch, discipline, or regulate the behavior of other social actors, the monitoring function is fulfilled (Pearlin and Aneshensel 1986).

- *Latent versus activated ties:* Latent ties represent the number, structure, or resources of those ties on which actors expect to rely on a regular basis (Knoke 1990; Who can you rely on generally?). Activated ties represent a list of those persons, organizations, and so on that actors actually contacted in the face of a specific problem or task (e.g., Who did you consult?).

- *Network "holes"/network "bridges": Holes* refers to places in a network structure where social actors are unconnected (Burt 1992, 2001). These holes afford opportunities to build bridges where social actors can connect different subgroups or cliques, bringing new information to each (Granovetter 1982).

- *Binary/valued data:* These terms differentiate between the reporting of whether a tie exists or not and reporting ties where there is some sort of assessment (How close are you to X? Rate from 1 to 4).

- *Diffusion:* This type of network analysis focuses on the flow of information through a network—for example, why some social actors adopt a new idea and others do not (Deffuant, Huet, and Amblard 2005; Valente 2005).

FOUR TRADITIONS OR APPROACHES

Part of the complexity of understanding the contributions and future directions of social network research in sociology lies in the different ways in which the idea of network ties has been incorporated in research. The approaches have also been characterized by differences in theoretical starting points, data requirements, and methods of data collection. In this sense, they are not strictly different traditions but nonetheless represent different strands of research. They continue to use different terms and draw only sporadically from one another (Thoits 1995).

The first two represent quantitative traditions. The *complete or full* network approach attempts to describe and analyze whole network system. The *local or ego-centered approach* targets the ties surrounding particular individual actors. The *social support* perspective is more general and theory oriented, often using network imagery but tending to focus on the overall state of an individual's social relationships and summary measures of networks. The *social capital* perspective is the most recent, focusing on the "good" things that flow along network ties (i.e., trust, solidarity), which are complementary to the more economically focused human capital (e.g., education; Lin 2000).

As Wasserman and Faust (1994) note, the first question to ask and the one most relevant to distinguish many of these traditions is "What is your population?"

The Whole, Complete, or Full Network Approach

This tradition, in many ways, represents the "purest" approach. Here, all network ties among members of a population are considered. This allows for a mapping of the overall social network structure. And the most advanced techniques have been developed to determine and describe that structure. Full networks have been described in hospitals (Barley 1986), elite or ruling families (Padgett and Ansell 1993), laboratory groups and other scientific collaboration (Breiger 1976; Powell et al. 2005), business structures (Galaskiewicz et al. 1985), world trading partners and global economic systems (Alderson and Beckfield 2004; Snyder and Kick 1979), policy-making systems (Laumann and Knoke 1987; Laumann and Pappi 1976), and schools (Bearman et al. 2004).

In keeping with Wasserman and Faust's (1994) questions, this approach requires that the universe of network members can, in fact, be delineated. That is, it must first be possible to list all the members of the social structure in question and to elicit, in some way, the ties or bonds that exist among them. To make the analysis effective, data must be collected from all members of the population. While assumptions can be made to fill in missing data (e.g., assume that ties are reciprocal), this solution becomes more questionable as the response rate decreases even to levels considered acceptable for nonresponse in surveys. Furthermore, unlike regression techniques, there

are no well-established and tested options to deal with missing data. These requirements for defining the population and having nearly 100% response or completion rates make this approach unfeasible for many questions.

However, problems that can be matched to these stringent data requirements have at their disposal a rich range of possibilities for analysis. This analysis of complete network data begins with the construction of the sociomatrix or adjacency matrix of the type depicted in Figure 20.2, which lays out all ties. The data can be summarized across rows and columns in a number of ways, and individuals can be clustered together to examine clique structures or blocks. For example, in the block model approach (White et al. 1976), the assumption of structural equivalence is used to bring together columns of data that share *both* a similarity of ties and an absence of ties. As an illustration, in Figure 20.3, Panel A, an original matrix of zeros and ones for 100 actors has been clustered into four blocks of structurally equivalent social actors. Essentially, in this reordered matrix, the rows and columns have simply been reassigned from their original position in Figure 20.2 into blocks that reflect groupings (e.g., within the first block, the social actors with original IDs 1, 10, 11, 14, 77, and 81 have been grouped together based on the similarity of ties). Within each block of this new matrix, called the density matrix, the percentage or proportion of ones (indicating the presence of ties of the number possible) has been computed. So, for example, among the social actors in Block 1, 60% of the possible ties that can exist do exist. This indicates that this block may, in fact, be a clique or subgroup. However, only 10% of the ties that can exist between Block 1 and Block 3 have actually been recorded, indicating that those actors in Block 1 *do not* tend to be connected to those in Block 3.

The interpretation of the block structure begins with a conversion of the block proportions into ones and zeros. In the most stringent analysis, the cutting point between ties and no ties is a pure zero block (no ties). However, as can be seen in this more typical result, there are no such blocks (though Blocks 3 and 4 come close). The conversion from a density matrix to an image matrix, in most cases, requires a decision about an acceptable cutting point, which is often facilitated by having a good knowledge of the data collection setting. In the absence of that information (and often when the site is familiar), the conversion depends on the analyst's decision. Here, one choice might be to use a cutting point of 0.4 or above. A more stringent choice might be 0.6 or above. Figure 20.3, Panel B, uses the less stringent 0.4 criteria to represent the image matrix. There is no statistic that can determine either the proper number of blocks or the density cutting point, making the decision making relatively arbitrary.

To this point, then, actors were partitioned into structurally equivalent sets with the density of ties computed, and the structure of relationships was mapped into a set of images indicating whether subgroups exist and how they related to other blocks. To get a better sense of the

Panel A

	1 1 10 11 14 77 81	2	3	4
1 1 10 11 14 77 81	.60	.40	.10	.06
2	.80	.90	.14	.21
3	.65	.87	.11	.67
4	.18	.51	.01	.48

Panel B

	1	2	3	4
1	1	1	0	0
2	1	1	0	0
3	1	1	0	1
4	0	1	0	1

Panel C

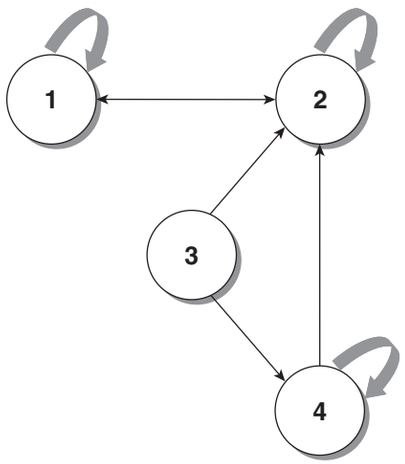

Figure 20.3 Hypothetical Density, Image, and Socio-Matrix from a Block Model Analysis of a Complete Network

structure of relationships, a sociogram can be constructed using the blocks, not actors, as nodes in the diagram (Figure 20.3, Panel C). The actors in Blocks 1, 2, and 4 appear to form subgroups because they send and receive ties to each other. Note, however, that the individuals in Block 4 are similar only in the patterns of their ties to other actors but do not in themselves form a subgroup. This also suggests that this group may be of lower prestige since they send ties to all other groups but do not receive ties in return (i.e., asymmetry). Furthermore, only the actors in Blocks 1 and 2 have a mutual relationship.

In sum, the complete network tradition is concerned with the structural properties of networks at a global or whole level (Doreian, Batagelj, and Ferligoj 2005). The primary issue in taking this approach is the identification of the boundaries of the network, which requires answering the question "Who are the relevant actors?" (Marsden 2005; Wasserman and Faust 1994).

The Local or Ego-Centered Approach

If the first approach is the purest, then this approach is the most typical. While data requirements may be less strict, there are more limits to what can be done analytically. Here, the focus is on a set of social actors who are defined as a sample. The effort centers on gathering information about the network from the standpoint of the social actors situated within it (Marsden 2005). Since it is impossible to include, for example, all individuals in a large community, each social actor is asked about his or her own ties. In Figure 20.4, each social actor (A, B, C through E of a small to very large *N*) was selected under some purposive sampling plan, whether a random sample, deliberate sample, or convenience sample. Here, each selected social actor (A through E) is typically asked to list other social actors in response to a name generator. This list may record all the individuals with whom a respondent is friends, loans money to, receives money from, and so on. The first case (Ego A) names three alters, Ego D names seven, and Ego B lists only one. In some cases, the individuals who are named may also be contacted using a snowball sampling technique (see Figure 20.4, Egos A or E). The original respondents may be called egos or focal respondents (FRs), while those they name, who are followed up, may be called alters or network respondents (NRs) (Figure 20.4).

The NRs may be asked about the networks that the original FR has, perhaps for corroboration or theoretical purposes (Pescosolido and Wright 2002). In this case, the dashed line indicates that Alter A1 does, in fact, have a relationship with the FR or ego, as does Alter A2. However, Alter 3 indicates no such tie to FR A. Finally, the alters may also be asked about their *own* ties. In caregiver research, it is a typical strategy to ask "Who cares for the caregivers?" Here, as indicated by the dotted lines, Ego E reports two network ties (Alters E2 and E1). They, in turn, have reported their ties. E1 mentions two actors, including the original person (Ego E). However, Alter E2 mentions five supporters but does not include Ego E among them. Such relationships have theoretical implications for both the stability and the durability of each ego's network support system as well as for the ability of each caregiver to experience "burnout" (e.g., Suitor and Pillemer 2002).

While more limited network mapping can be done compared with complete network data, factors such as the size

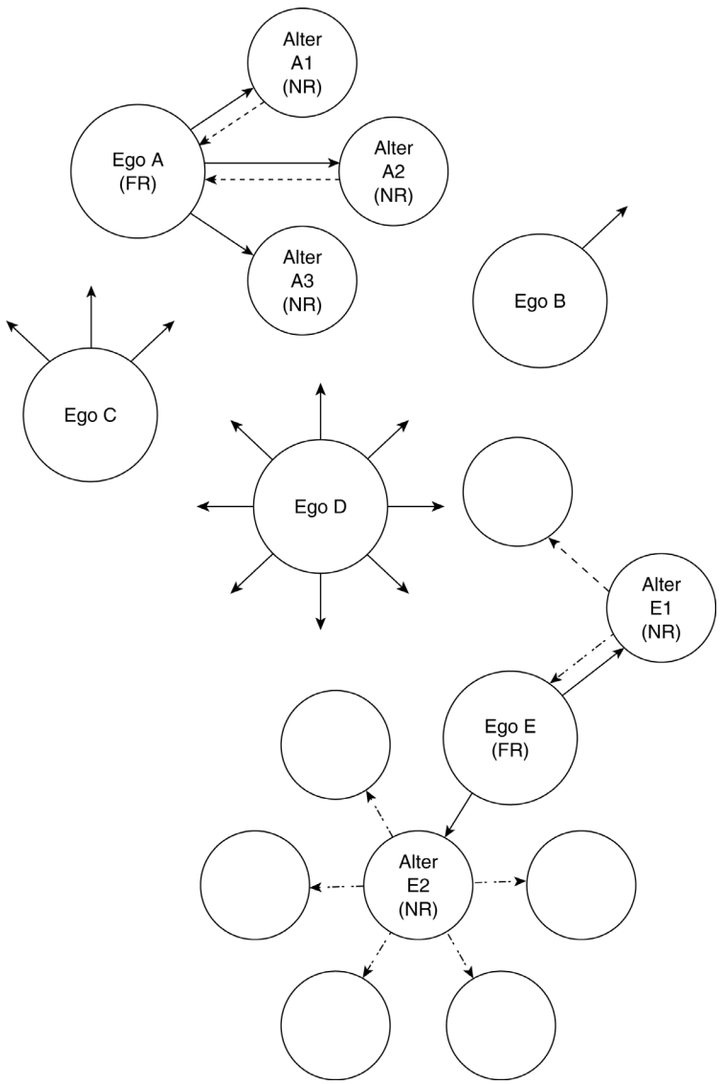

Figure 20.4 Local or Ego-Centered Structures

(as a count of mentions), density (by asking the FRs to indicate whether each NR they mention as a tie knows each other tie), or reciprocity (by asking the FRs if they also provide friendship, assistance, etc., or by asking the NRs in a first-stage snowball) can be constructed and used to test theoretical ideas about the influence of social networks. Attribute information can be collected on each tie (e.g., gender, age, ethnicity, attitudes), which can be used to examine, for example, the influence of network homogeneity on structural and context issues. Even the interaction of network size and content, noted earlier (Principle 5), can be operationalized, though recent methodological concerns surround the appropriate construction of such interactions (Allison 1978; Long 1997; for substantive examples of different approaches, see Pescosolido, Brooks-Gardner, and Lubell 1998; Pescosolido, Wright, et al. 1998).

The Social Support Approach

This tradition, unlike the two described above, comes primarily from a social psychological, rather than a structural, perspective. As Thoits (1995) notes, social support is the most frequently studied psychosocial resource and has been documented to be a powerful influence, for example, in occurrence of and recovery from life problems. While social support is seen similarly as resources available from family, friends, organizations, and other actors, researchers here tend to use a summary social integration strategy, looking less to network structures (Barrera 1986). Emanating from a concern with actors' responses to stressful situations, social support is considered a social reserve that may either prevent or buffer adverse events that occur in people's lives (Pearlin and Aneshensel 1986).

Social networks represent one component of social support (House, Landis, and Umberson 1988), in contrast to the structural perspective that tends to see social support, conversely, as a possible type of tie, a resource that flows over ties, or content that may or may not occur (Faber and Wasserman 2002; Wellman 1981). However, the social support tradition does not ignore structure altogether, noting that indicators of structural support (i.e., the organization of an individual's ties in terms of size, density, multiplexity) are important (Barrera 1986). Yet the focus in this approach is on the sustaining qualities of social relationships (Haines, Beggs, and Hurlbert 2002). Researchers tend to ask study respondents whether they have/had enough support in everyday life issues or critical events. Questions may target either perceived social support (i.e., the belief that love, caring, and assistance are potentially available from others; latent networks in the structural tradition) or received support (i.e., the actual use of others for caring, assistance, appraisal [Thoits 1995], activated networks in the structural tradition). In fact, social support research has documented that perceived support is more important than actual support received (House 1981; Turner and Marino 1994). Even more surprising, Cohen and Wills (1985) suggest that the simplest and most potent indicator is whether individuals report that they have a single intimate tie in which they can confide.

The Social Capital Tradition

According to Monge and Contractor (2003), the ideas underlying the investigation of social capital were introduced in the 1980s to refer to resources that accrue to social actors from individuals to nations as a result of networks (Bourdieu and Wacquant 1992; Coleman 1990; Lin 2000)—that is, because individuals participate in social groups, there are benefits to be had. Individuals invest in and use the resources embedded in social networks because they expect returns of some sort (Lin 2000). Resources are not equally available to all individuals but are differentially distributed across groups in society (Lin 2000). Thus, social capital in the form of trust, social norms of reciprocity, cooperation, and participation resides in relationships, not individuals, and therefore shares roots with many aspects of classical sociology and other network traditions (Paxton 2002; Portes 1998).

Although some contend that the social capital approach brings no novel ideas to network perspective, offering only a "more appealing conceptual garb" (Portes 1998; see also Etzioni 2001; Wilson 2001), three unique aspects of this approach are notable. First, more than the other traditions, social capital research has been popularized to describe the state of civil society (e.g., Putnam's [1995] concept of "bowling alone") or differing geographical areas (e.g., neighborhoods, Rahn 2004) and to relate to large public policy issues. For example, Wilson (2001) suggests that social networks constitute social capital to the extent that they contribute to civic engagement. As such, these resources can be measured at multiple levels (the individual, the neighborhood, the nation), a measurement task difficult under the other traditions. Social capital data have been collected in a variety of ways, from the number of positive networks or connections that individuals have to overall geographical characteristics (e.g., migration rates, voting rates). Second, social capital focuses attention on the positive qualities (though not necessarily consequences) of social ties, downplaying the potential "dark side" of networks. As Edwards and Foley (2001:230) note, social capital comes in three "flavors"—good, better, and best. From a social network perspective, this aspect is perhaps the most troubling. Like the social support tradition, this emphasis on positive contents limits the theoretical import of ties. Third, the social capital approach has broadened the appeal of a network perspective to those in other social science disciplines outside sociology. By providing sociability that is parallel to "human capital" and "fiscal capital," the introduction of social capital reinforced the sociological thesis that social interaction can have powerful effects on actors.

These unique contributions produce other curious corollaries. Because of its affiliation with other forms of

"capital," the social capital tradition has been more likely to adopt a rational choice foundation. Social capital theorists often talk about the costs and benefits of establishing ties, as well as how and why actors deliberately construct or maintain ties in the service of creating opportunities and resources. This discussion of "investment strategies" or "fungibility," "opportunity costs" or "resources to pursue interests" (Baker 1990), does not question the self-interested and antisocial nature of individuals, a debate in sociology still not settled by those who see an inherent sociability. By basing the perspective in the notion of purposive action (Lin 1999), the roles of "habitus" and emotions are underplayed, if not absent, in the rational choice perspective that undergirds most social capital research (Pescosolido 1992).

THE FUTURE OF SOCIAL NETWORKS: CHALLENGES AND OPPORTUNITIES

The network perspective poses many challenges to routine ways of doing sociological research. Two seem to be most pressing. The first entails questions about social networks themselves, their dynamics, and how the network approach might be integrated into the life-course approach. Such questions include the following: To what extent do ties persist? Why do some persist more than others? How do changes affect actors' networks and intersect with larger changes in society? How are network dynamics intertwined with change in other life arenas? (Pescosolido and Wright 2002; Suitor et al. 1996). The second topic addresses the interplay of social and biological forces. The biological and social network interaction across the life course represents some of the most recent considerations that have been posited (Elder 1998b; Giele 2002; Klovdahl, Graviss, and Musser 2002; Shonkoff and Phillips 2000). Relevant questions include the following: How are social networks shaped by and shape lives through psychological and biological processes? Can we understand what happens in social life by reference to the limits that social networks, genetics, personality, and biology set for one another?

Patterns, Pathways, and Trajectories of Networks and Their Influence

The life-course perspective views lives as organized socially across both biological and historical time (Elder 1998b; see also Werner 2002). The social network perspective suggests that what links the lives of individuals to the time and place in which they live are their connections to others (Kahn and Antonucci 1980). However, these interactions can exist at many levels—individuals interacting with other individuals, individuals interacting within large social groups or organizations, and individuals interacting in larger climates or contexts that may differentially affect outcomes. Simultaneously embracing the dynamics and multiple levels of the life course—that is, understanding social networks as attached to time and place—reveals a complex interplay of forces to be examined. If social networks mark the social interdependence that continuously shapes and redirects lives, then exploring how they play a role in pathways, trajectories, and transitions becomes critical (Elder 1985; Moen, Robison, and Dempster-McClain 1995; Pavalko 1997; Werner 2002).

The Multidisciplinary Evolution and Prominence of Social Networks

From its beginning, the network approach has been embraced by a variety of social science disciplines, particularly anthropology (e.g., Barnes 1954; Bott 1957; Mitchell 1969). The network approach has come to be a major force in the areas of health and medicine (Levy and Pescosolido 2002); communications research (Monge and Contractor 2003); mathematics, physics, and other sciences (Barabasi 2003; Watts 2003); and political science (Fowler and Smirnov 2005; Huckfeldt and Sprague 1987; Rahn 2004). Yet these areas remain unconnected. Taking seriously the life-course perspective's principle of "linked lives" (Elder and Pellerin 1998; Werner 2002), the network perspective offers a way to synthesize disciplinary insights.

While network theory may reject focusing on individuals alone, mental events, cognitive maps, or technological determinism (White 1992), identity, cognition, technology, and biology may be intertwined in complex ways. Agenda-setting reports on health and medicine, for example, have embraced this possibility. In an Institute of Medicine report, *From Neurons to Neighborhoods* (Shonkoff and Phillips 2000), social network relationships are viewed as the "fundamental mediators of human adaptations" and the "active ingredients of environmental influence." Yet the response of sociology in leading the theoretical agenda has been slow. If we see, as Castells (2000) suggests, that social structure is made up of networks in interactions that are constantly on the move, similar to self-generating process images in molecular biology, sociologists' familiarity with conceptualizing multilevel, dynamic processes becomes essential to understanding social life.