

*Ethnography and Network Analysis: The Study of Social Context in Cultures and Societies*¹

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INTRODUCTION

People consistently reflect their primary values and beliefs through the people they associate with and the people they avoid or are in conflict with. The immediate social world is made up of family and friends, work partners, and acquaintances. It then extends outward in a web of relationships through the organizations and communities that form the more distant structures in people's lives. The social structure in human culture reduces problems by producing predictability in relationships. The process is not perfect, and there are other purposes for cultural systems, but at least three elements of culture allow humans to live together and interact comfortably. One is cultural knowledge. This is the information, such as language, knowledge, values, and beliefs, that allows people to communicate and share both emotion and experience. Without this symbolic portion of culture, predictable behavior would be impossible and life would be incomprehensible. A second element of culture that produces predictability is the interaction between cultural knowledge and the environment. This element produces technology and lifestyles adapted to available resources. The third area is the human need for structure and organization in interpersonal and community relationships. Humans live their lives by interacting with small groups that are the organizational fabric of their existence. These groups include family and kinship groups, friends and work acquaintances, the political and power groups they associate with, and all of the other

relationships and organizations that have an impact on them. This element of culture focuses on the people's interactions within the context of their cultural knowledge and their environment.

While anthropologists have used the idea of social networks both as a metaphor and as a theory for analysis (Johnson 1994: 125), this chapter explores the specific approaches, and the findings, that come from the techniques available through formal social network studies of human behavior. These studies allow anthropologists to find and define cultural differences in the ways that humans organize themselves into the small groups that handle the issues of daily life. Social network analysis is an attempt to identify the structure and meaning of relationships, explain their impact, and predict how they will affect the future of individuals, organizations, and societies. The social network approach allows anthropologists to ask and to answer very different questions than the ones that are focused on individual knowledge, behavior, or personal values. This approach allows us to move out into the broader important structures of society and to understand the forces beyond the individual level that shape the lives of people.

SOCIAL NETWORK APPROACHES TO HUMAN CULTURE

Early in the history of anthropology, researchers found that the cultures they encountered orga-

nized critical relationships differently. Cross-cultural studies identified unexpected differences that led to the first studies of kinship groups, marriage patterns, and social and political organizations in small societies. These were critical findings, and are still a part of the overall information that is important for understanding cultural differences in people's daily lives.

As ethnographic research progressed, two different approaches to understanding cultural networks were explored. Pasternak (1976) summarized the initial systematic approaches to the exploration of kinship groups, and Elizabeth Bott (1971) produced an ethnographic exploration of social networks in England. These works represent two theoretical and methodological anchor points for anthropologically driven social network analysis. Pasternak describes methods for collecting and then comparing the ways that different cultures identify, label, and understand the genealogical relationships that are part of their culture. The Bott study provides an in-depth exploration of the intimate support networks that most people use to survive in their culture, and provides a model for exploring these relationships across cultures. Following these studies, anthropologists conducted and systematically refined their examinations of informal and formal human groups and associations, in conjunction with work going on in sociology, social psychology, and political science (Galaskiewicz and Wasserman 1993; Johnson 1994; Wasserman and Faust 1994). The combined approaches expand our knowledge of the effects and dynamics of both kinship and nonkin networks in all parts of human culture. This research ranges from purely qualitative descriptions of groups and associations, to quantitative social network schemas that create network descriptions based on the algorithms of both graph theory and matrix algebra. Each approach provides valuable insights into human cultures. In combination, they provide powerful explanations for the ways that humans think, act, and organize their daily lives within their personal cultural context.

Social network research describes relationships. These relationships include physical contact with other people (sex, violence, supportive touch, healing), social contact (friendship, work relations, social events), symbolic contact (communication, emotional impact, e-mail), or even imaginary interactions. Different types of relationships produce different cultural contexts in people's lives. Social network analysis defines specific relationships (such as kinship or friendship, power or influence, communication, physical contact, or social support), and then determines how those relationships are orga-

nized or structured, and how that structure has an impact on individual lives. They describe the structural environment of individuals, organizations, and societies.

There are three primary anthropological approaches to network studies. These are ethnographic descriptions of social networks (Bernard and Killworth 1973; Morrill 1991), personal network studies or ego-centered networks (Hammer 1983; Shelley 1992), and the analysis of whole networks (e.g., Hage and Harary 1991).²

The social network approach has changed rapidly during the last ten years, due to the development of sophisticated data collection and analysis techniques, especially the development of new statistical approaches to understanding complex relationships.³ Wasserman and Faust (1994) provide an excellent introduction to both the descriptive and the probabilistic statistical methods used to analyze social relationships. All of these techniques are based on an attempt to find order in the relationships that people create. The variety of important questions asked in different social science research paradigms (anthropology, sociology, geography, political science, and psychology) have resulted in the social network approaches described in this chapter. The authors provide examples of a wide range of fruitful research questions answered by a social network approach, including studies of occupational mobility, the impact of urbanization on individual well-being, world political and economic systems, community elite power and decision making, social support research, group problem solving, the diffusion and adoption of innovations, interlocking corporate directorates, cognition and social representation, markets, exchange relationships, social influence, and the formation of coalitions, among others (Wasserman and Faust 1994: 5-6).

There are three levels of analysis that can be simultaneously applied to social networks. These are analyses of the individual, the subgroup, and the whole system characteristics. At the individual level, the analysis consists of describing the relationships, position, and roles of the individual in relation to other people in the network. Each individual can be described in terms of how his relationships connect him with other people, how information and influence can flow to or from him (or through him to others), and how his place in the network affects his life by making him similar to, or different from, others in similar or different kinds of roles and positions in his own or other networks. Individuals can also be described in terms of their membership in subgroups in the network, and their closeness or distance to other individuals. Analysis of the subgroup structure of the network consists of discovering, describing, and analyzing the effect of

subgroups in the network and the connection of those subgroups to other groups and individuals. In larger networks, people tend to cluster into smaller groups. An example would be an extended family. Kinship ties connect the entire family to each other. Each nuclear family would tend to have the closest ties in our culture, but would still maintain contact with other nuclear families. The adults would tend to have the most direct connections and the most frequent direct contacts, while their children would be connected to the rest of the group through indirect ties (their mother lets them know what is happening to their cousins, aunts, and uncles) with much less frequent direct contact (family reunions). Network analysis allows researchers to identify these subgroups within larger connected networks, and to analyze the impact that these groups have on people's lives. Finally, a network can be characterized as a whole and compared with other networks. Network density (the number of connections between people compared with the number of potential connections), network centrality measures, and transitivity measures (a measure of whether the connections of one individual are also connected with each other) are some of the technical measures of total network conditions.

APPROACHES TO STUDYING RELATIONSHIPS

Social network theory has commonly developed from the analysis of relationships, rather than an *a priori* theory of relationships. Anthropologists noted differences in family structure in different cultures, and developed theory to account for those differences, rather than having the theory first, and finding the difference afterwards. The same condition applies to many network approaches, where researchers first focused on describing relationships, and then created methods and theories to make those descriptions and analyses stronger over time.

This observation-based approach to social relationships has produced different but complementary methodological approaches that are used in network analysis. These are the exploration of personal networks, egocentric networks, chained or snowball network studies, and the analysis of whole networks. These approaches are summarized in Table 1.

Each of these types of study has its own theory, methods, and appropriate research instruments attached to it. The basic approaches are described in the following sections.

Table Approaches, foci, and methods of network analysis

Approach	Focus	Methods, Instruments
	Questions about personal networks and relationships from the perspective of the informant (Burt and Minor 1983)	Standard questions about relationships (McCallister and Fischer 1983)
Egocentric	Description of individuals in personal networks and the relationships of both ego and the individuals named by them to each other (Sarason et al. 1983)	Name generators and questions about interactions of those named (Burt, 1984; Marsden 1990, 1993)
Chained or snowball	Descriptions of linked and overlapping personal networks and the relationships between individuals and the whole population drawn from snowball samples, random walk designs (Klovdahl 1989)	Survey instruments and name generators tied to chained sampling designs (Palmore 1967)
Full network	Identification of relationships in a bounded community (Knoke and Kuklinski, 1982)	Relationship matrix, membership lists, questions about relationships between all members of the community (Wasserman and Faust, 1994)

Personal Networks

The personal network approach focuses on individual informants and their personal relationships. The focus of this type of study is to identify similarities and differences in individual relationship environments. This is often called ego-centered network analysis. Each individual is assumed to exist in a structured social context. That context may have very similar effects for individuals who have the same type of contextual environment, and be very different for individuals who have significant differences in their personal networks. Anthropologists (Bott 1971; Kapferer 1973; and other British social anthropologists) who were studying urban systems pioneered this approach. The approaches used in personal network analysis fit very nicely into the small community, ethnographic interview, key informant format of ethnographic research designs (Johnson 1994: 135), and it works well with participant observation conditions. This approach allows the ethnographer to collect personal network data both through interviews and by directly observing the behavior of individuals in key social settings.

Personal network analysis concentrates on asking questions or recording observations about individual behaviors, attitudes, and beliefs. It is an attempt to introduce information about the context of individual lives into survey approaches to understanding culture and society. Early on, the theoretical underpinning of this approach came from the rational choice theory or structural functionalism, or a combination of both these approaches (Galaskiewicz and Wasserman 1993). These approaches assume that humans are actors in a larger social setting, and that the actors can be assumed to have autonomy and independence. Individuals are also treated as solitary or relatively solitary in these situations. This means that individual relationships are discounted as having an important impact on behavior or culture. However, research on personal relationships and interactions showed these approaches to be far too limited in describing and predicting patterns in peoples lives. The personal network approach was expanded to encompass influence patterns in addition to autonomy, multiple and multiplex relations in addition to solitary conditions, and influenced actions, in addition to independence of action.

Personal network research approaches have relied on asking two types of questions about relationships. One type of question asks the person to describe her personal networks, just as she would describe other personal characteristics such as gender, age, preferences, or knowledge. The second approach, the egocentric question-

naire, collects additional information from the informant's perspective about the relationships between the other people mentioned by the informant, as part of the informant's personal network. These two approaches, combined or singly, answer many important questions about cultural conditions beyond the individual level.

Personal Network Questions

One of the easiest and most productive ways of finding out about the social context of an informant is to ask a series of questions about his relationships with the people around him (McCallister and Fischer 1983). Personal network analysis provides information from the perspective of the person providing the information. This creates an important strength to this approach and a weakness. Two people who are in a relationship may have widely different views of the relationship. One may be in love with the other, while the other may merely like the first person. Based on their perceptions, the assumptions that each one makes and the decisions they make about ways to follow through with the relationship can be very different. The strength in the personal network approach is that the questions asked allow the researcher to discover the individual perspective of each person interviewed. However, the weakness is that this method cannot resolve differences of opinion about a relationship. It can only identify those differences because it is focused on individual perceptions and how those perceptions are related to behavior, life events, or the predictability of some type of social interaction, for the individual. Within this limitation, the approach can produce very important insights into individual lives.

Personal network questions identify an informant's social context from a structural perspective and a role or meaning perspective. The structural questions focus on the size, shape, and organizing principles of the person's relationships. These include information about the size of the person's personal network, the strength of her relationship to other individuals, the closeness or intimacy of the relationships, and the overall shape of her connections to different kinds of people as well as different individuals. The role or meaning questions ask about the cultural labels and meanings of the relationships, such as kinship roles, gender roles, status questions, and the like. The combined questions are analyzed to produce a description of each informant's personal network. This information can then be aggregated to determine if there are patterns to personal networks that are closely related to the critical questions that the

researcher is trying to uncover. For example, does the size of an individual's personal network have an important impact on his influence or power in a community? Do people in different cultures have different average size networks or different networks on the basis of their composition (roles, demographics)? Are personal networks made up mostly of family members more supportive than ones that are made up exclusively of friends and acquaintances? If someone wanted to get a job, what is the best kind of personal network to have? Do the structure and the role relationships in a personal network determine the success of an individual in business, love, or longevity of life? Each of these questions can be answered by asking people about their personal networks and then comparing those network answers to answers about the critical life experiences of the informant.

Egocentric Network Questions

The egocentric approach collects judgements about relationships among the people in ego's personal network, from the informant's perspective. This changes the data from a view of how the informant sees her relationship to each person she identifies in her network, to her perceptions of other people's relationships to one another and to herself. Some of the questions that could be answered with this approach include the following. Do networks where everyone knows everyone else provide better social support for ego than networks where the only connection among members is directly to ego, not to anyone else? What effect does dividing up your social life into several different tight subgroups (cliques) have on a person's success in business, compared with having one homogeneous network? If the people in ego's network are in conflict with each other, how does that affect the strength or the longevity of their relationship with ego? Are members of ego's network more likely to be connected with each other if they are the same gender, ethnicity, social status, or religion, and if so, what impact does that have on ego's success, happiness, or future health? How do personal networks form and how stable are they over time?

Asking informants about their relationships without the cross check of asking the people named about the same relationship raised a critical question for anthropologists engaged in personal network analysis. The primary question, if this approach is used for any type of critical decisions, is: 'are informants accurate when they provide information about their relationships?' One potential problem with this

approach arises from the ways people remember things. Memory is sometimes affected by emotion, bias, and biological processes (injury, aging). Reporting is affected by all of these issues plus social pressures to hide embarrassing or harmful information or to lie about relationships by bragging or exaggerating. Asking a person who has had a traumatic experience to remember that experience may produce only partially accurate memory, and asking a person who is married to name all of his sex partners may produce an incorrect list, due to lying. Yet, there are times when this information is the only information that can be collected about important relationships.

This issue produced a very powerful discussion and analysis of elements of informant accuracy (Johnson 1994: 122-7). The early experimental research (Bernard and Killworth 1973, 1977; Killworth and Bernard 1976, 1979-80) called into question the general accuracy of self-report data when people's reports about their contacts were compared with actual observations (also Bernard et al. 1980, 1982a, 1982b, 1984). As other scholars conducted further analysis on the original data sets, or conducted further experiments, it became clear that this complex question of accuracy had a number of answers, ranging from conditions that produce very little accurate information, through conditions that produce accurate information if certain biases are taken into account, to situations in which the aggregated information from informants produces very accurate data (cf. Johnson and Miller 1983; Romney and Faust 1983; Romney and Weller 1984). These studies found that the accuracy of an informant depends on the level or intensity of the informant's participation in a group. It also showed that informants who have similar backgrounds and experiences tend to exhibit regular or predictable biases in accuracy depending on the characteristics of the informant (Freeman et al. 1987a, 1987b). It also found a range of accuracy in any group of informants which correlated with the informant's ability to describe a consensual model of the relationships being studied (Romney and Weller 1984; Romney et al. 1986). Finally, researchers discovered that the ability of individuals to describe some social interactions, compared with behavioral observations, produced the most accurate picture when it was analyzed by aggregating individual reports, rather than looking at the reports singly (Bernard et al. 1982a, 1982b; Freeman et al. 1988). This indicates that the most accurate pictures of social interactions often come from an aggregate group view, rather than from an individual perspective. The related question of how people remember, not just what they report,

was also explored (Boster 1986a 1986b; Killworth and Bernard 1976), followed by explorations of the impact of an individual's social positions on his recall and reporting of social relationships (Boster et al. 1987; Michaelson and Contractor 1992). These studies on the relation between social position in a network and reporting indicate that there are regularities in perception of networks and interactions based on similarities in the roles that people have in a community. People's position in social networks influences the accuracy of their reports. Personal network data also show that the networks reported by individuals, whether they are accurately measured against another form of data or not, are a key condition for understanding the social world of any given informant, from that informant's perspective. These portrayals are useful in both understanding and predicting the behavior of individuals beyond the information that an informant gives us about herself alone.

Personal and Egocentric Data Collection

Personal or ego-centered network data is collected in the form of questionnaires or interviews. Individuals are asked a series of questions about the structure, composition, and relationships they have with a defined personal network. The most common way that data are collected is to ask a set of questions about the size and composition of a personal network, to ask the person to list the names of the people in that network, and to answer questions about the person's relationship with each of those people and the relationship between those people and each other (cf. Bernard et al. 1990) (Figure 1). In many cases, the actual names are not asked because of ethical considerations and legal issues, but each personal network member is identified by a label or nickname, so the persons answering the questions do not get confused about whom they are describing, and can easily talk about the relationships.

Personal Network Questionnaire

1. How many people have you been in regular contact with in the last 30 days? _____
2. Of the people you had regular contact with in the last 30 days, how many
 - a. are relatives or kin? _____
 - b. are sex partners? _____
 - c. do you use drugs with? _____
 - d. can be counted on to give you support _____
3. Please name the people you had regular contact with in the past 30 days.

1.	6.	11.	16.
2.	7.	12.	17.
3.	8.	13.	18.
4.	9.	14.	19.
5.	10.	15.	20.
4. In the attached matrix, please indicate the age, gender, ethnic affiliation, and any kinship relationships for each of the people named above.
5. In the attached matrix, please indicate which of the individuals you have named have been in regular contact with any and all of the other individuals you have named.

(Other questions specific to the study would then follow.)

Figure 1 Personal, egocentric questionnaire

Analytical Strategies for Personal and Egocentric Data

There are four broad analytical strategies used to describe personal networks. The first provides composite views of the personal network characteristics of different groups of people. The most common descriptions are the size, age composition, gender composition, socioeconomic characteristics, and other demographics of the networks, compared by key subgroups, such as differences between the personal networks of different ethnic groups, gender differences, age, or socioeconomic differences. This allows the researcher to determine if men or women have the same average size of personal networks, or if young people have networks that are predominantly only people their own age, or if the rich have much contact with the poor. The average profile of personal networks can be compared with the profiles found in contrasting social groups.

If there are significant differences in the personal networks found in a research population, then the researcher can create a typology of personal networks and can describe the similarities and differences in the cultural context of people's lives by comparing and contrasting the individuals who are involved in each type of personal network.

The data that describes each person's relationship with each other person can be analyzed to determine the structure of each relationship set. Some personal networks are dense and tightly connected, with everyone knowing and interacting with everyone else, while others are very loosely connected or only connected by the informant. These structural differences are likely to change the way that the informant lives, loves, and takes care of himself and others. The structural analysis of networks, described in more detail below, includes connections among people, the subgroups, and the overall structure of personal networks.

Because personal network data are normally collected along with lots of other data about individual informants, it is possible to correlate the network data with other individual variables. This allows questions to be asked about the relationship between personal networks and other life outcomes. One very interesting example of this approach combines personal network analysis and the concept of the small world experiment, described in the next section. It is called a reverse small world experiment (Bernard et al. 1989; Killworth and Bernard 1978). This approach uses assumptions from several other forms of network analysis. It assumes that everyone is ultimately connected (small world phenomenon) and therefore it is possible ac-

curately to determine the impact of events that affect everyone by collecting a random sample of data from informants in a society. The second assumption is that there is regularity in personal networks; everyone knows a relatively narrow range of people, depending on the type of relationship that is being studied (knows someone, has contact with someone, has someone in their home). The result is that if you know the size of the population, know the average connections between people, and know the average size of personal networks for a particular relationship, you can accurately estimate the impact of a specific event (Bernard et al. 1989; Freeman and Thompson 1989; Freeman et al. 1989; Killworth et al. 1990). The reverse small world experiments have been conducted to estimate the number of people infected with the HIV virus, the number of people who died in natural disasters (such as earthquakes, where the death toll is so high that there is no way to get an accurate account), and for events (such as rape) for which the actual occurrence is under-reported for social and cultural reasons.

Examples of Personal Network Studies

The most common studies of personal networks have been social support studies (Cohen and Syme 1985; Hays et al. 1990; Ostrow et al. 1991; Williams 1993) and diffusion of innovation studies (Coleman et al. 1966; Palmore 1967; Valente 1993, 1995, 1996). In recent times, egocentric network studies have been very valuable in helping prevent AIDS and other infectious diseases (Latkin 1995; Latkin et al. 1996; Trotter et al. 1995a, 1995c, 1996). The personal network studies for these projects have focused on 'risk networks.' Risk networks are the personal networks of individuals who are at risk for some kind of problem. The HIV risk networks of drug addicts include the sex partners and the needle-sharing partners of the drug addicts. Both of these groups put the drug addict at risk of being infected by HIV. The personal network studies in this area have been valuable for identifying the most common problems associated with HIV transmission in networks, and have provided evidence that it is possible to change both individual and network behavior and slow the AIDS epidemic (Needle et al. 1995).

Ego-centered personal network information allows anthropologists to quickly establish some of the important traits of the social context found in a given culture. These traits, such as the size of networks, the closeness and duration of relationships, and the impact of peer norms, can be collected from each person or a selected

sample of persons in a community or a culture. This is normally reported in the form of tables such as Table 2, which comes from the Flagstaff Multicultural AIDS Prevention Project (FMAPP). This table compares the people who provided the information (respondents or egos) with the people whom they named in their personal network (alters). In this case, they were asked about people who were part of their network for the past 30 days and people who were present the last time they used drugs with other people.

The analysis of the personal network data for the FMAP Project demonstrated that the respondents belong to relatively small networks that commonly include both users and nonusers, some kin relations, and close friends. Only 25 per cent responded that all of the people they spend time with use drugs. The ego network data indicated that the majority of drug networks are relatively stable in their composition. The data also indicates that the majority of risks, such as needle sharing activities or sexual relationships, occur with the first three people named by ego as members of their network. This provides a very targeted group for a successful intervention strategy. A smaller portion of the needle sharing and sexual encounters occur with people outside of ego's close personal network, but the data also indicate that these encounters, called 'weak ties,' are the highest risk contacts for the majority of drug users. Based on these data, part of the FMAPP HIV prevention and education effort was directed at

helping individuals break, reduce, or decrease the risks associated with the 'weak tie' types of relationships, while the other efforts were directed at changing relationships in the closest network group.

The project also explored the usefulness of finding proxy measures of network structural relationships (such as percentage of kin in the network, or percentage of sex partners in the network) to determine if it is possible to identify conditions that linked individual social networks to the individual's risk of spending time in jail, or becoming infected with HIV through drug use. This process allowed us to use relatively simple and nonthreatening questions that could be asked about individuals' social relationships (Trotter et al. 1995b). We assumed that risk taking is a generalized, rather than specific, activity for an individual. If they take risks in one area of their life, they are much more likely to take risks in other areas. Therefore, the individuals who accepted early recruitment into the FMAPP program were hypothesized to be more likely to be higher risk takers than the individuals recruited from the same network later in the process. Because these individuals did not know the project well, it was as much a risk for them to participate (and possibly be caught up in a drug sting) as it was for them to interact with other strangers. We believed that coming into the project as one of the first members of a network to be recruited (that is, acting as bridging individuals) would be a proxy measure for individual influence or centrality in the network. We were

Table 2 Gender, age, and ethnic distribution of respondents, and respondent's 30-day and recent-use networks

	Respondent (ego) (N = 52)	People (alters) in respondents' 30-day network (N = 127)	Alters Present in most recent drug-use episode (N = 90)
Gender			
Male	34 (67%)	81 (63%)	62 (68%)
Female	18 (33%)	46 (37%)	28 (31%)
Age			
10-19 ^a	12 (23%)	36 (28%)	28 (31%)
20-29	14 (26%)	38 (29%)	25 (27%)
30-39	23 (44%)	43 (33%)	30 (33%)
40-49	3 (5%)	9 (7%)	7 (7%)
50-59	0 (0%)	1 (1%)	0 (0%)
Ethnicity			
African American	10 (19%)	22 (17%)	16 (17%)
Hispanic	19 (36%)	64 (50%)	42 (46%)
Anglo	18 (34%)	35 (27%)	27 (30%)
Native American	5 (9%)	6 (4%)	5 (5%)

able to show that the program recruitment order data (the rank order in which individuals were recruited into the project for their network) not only correlated with network structure measures (how they were connected or to which subgroup they belonged), but they were also related to increased risk taking (Trotter et al. 1994, 1995c, 1996) and correlated with higher risk behavior. Early arrivals in each network were more likely to have tried a drug treatment program than the subsequent recruits in the same network, while later arrivals were less likely to have injection drug user sex partners. Those recruited earlier in networks were very likely to have sex partners who were also injection drug users (that is, they participated in double-risk relationships).

We also hypothesized that participation in two or more networks involved more potential risk and risk taking than membership in a single network. Most of the people in the project (321) only participated in one drug network (66.5 per cent), while 162 individuals (33.5 per cent) were members of two or more drug networks. Our data indicated that simply asking individuals to self identify either single or multiple network membership provided a direct indication of both their types of risks and the levels of risks that the individual was most likely engaged in, within their personal drug-using networks. As a result, this type of personal, or ego-centered network data collection was very useful for revealing important facts about the most common personal groups (network of individuals) in our projects. The same type of information could easily be collected for educational programs, economic development conditions, or participation in any other form of cultural programs that would be enhanced by understanding the cultural context of people's lives.

CHAINED OR SNOWBALLED NETWORKS

The second approach to network analysis was created to move beyond the individual and to attempt to study larger social structures in a culture. In this approach, relationships are studied by following a trail of connections from each selected key informant outward into the larger society. The approach is similar to a chain letter or to snowball sampling. Each person leads the researcher to another person or a set of persons who are all connected by a particular kind of relationship. There are several forms of this sequential collection of data on relationships, each with its own advantages and disadvantages. The advantages are the relative ease of recruit-

ment of each chain, and the ability to demonstrate actual connections among the people being studied.

In general, the problems with this approach include running into a social box canyon and problems generalizing to the rest of the culture. The box canyon effect occurs when the chains or snowballs start with too few points and become trapped in social loops, while the real relationships actually extend much further out into the community. The problem of generalizability is produced by the sampling methods that need to be used for this type of research. If the respondents are discovered through a biased selection process, or a process that only identifies part of the full range of people who should be interviewed, then the researcher cannot generalize to the community as a whole. New methods associated with probabilistic sampling (Wasserman and Faust 1994), new approaches for generalizing from snowball samples (Frank 1979; Snijders 1992), and sequenced data collection (Klov Dahl 1989; Klov Dahl et al. 1994) help avoid some of the common snowball pitfalls. They also help to make the information more easily generalizable to the population as a whole.

Chained or Snowball Network Examples

The small world experiment (Poole and Kochen 1978) is the classic example of a chained or snowball type of social network research approach. In this type of experiment, individuals are asked to find the best way to get a message (or an object) to a randomly chosen person somewhere in the world. The only things typically known about the target person are his name, the town he lives in, and his occupation. The rules are that the person must pass on the message to someone he or she has personal contact with, with the request to keep passing it along until it reaches the target person. Then, the number of links between the original person and the target person are counted and described. The average number of links between people is used to define the difficulty of any one person in the world contacting any other person through direct social connections. The types of links used (a friend in the town, an acquaintance with the same occupation) allow the researcher to describe the type of strategies that work, and the ones that do not work, for carrying out the linkage task. The experiments have shown that a successful attempt at this type of contact takes an average of about five links within a specific cultural or racial group, about six links if cultural or racial boundaries are being crossed in a single society, and about seven links if significant international boundaries are being crossed.

There is some variation in the number of links found, depending on the importance given to the message, but these approximate averages appear to be fairly stable. The broken chains, ones that did not complete the linkage, also provide very important information about the size of the world and the fact that while everyone is theoretically connected, there are lots of ways that people can be isolated or kept out of the picture.

Kinship analysis is another interesting form of chained network analysis. The description of a kinship network begins with a central character (ego) and that person's kinship relationships. From that point, individuals connected to ego are interviewed (often sampled) and more connections are added to the original, forming first a chain of relationships, and ultimately a model of both individual and complete kinship systems in a community. Early attempts to create an overlap between sociometric network analysis and kinship analysis were unsuccessful, but in more recent studies, the two types of approach to network data have been both complementary and have added new dimensions to our understanding of kinship networks and the impact of kinship on larger social networks (Barnes 1980; Hage and Harary 1991; Plattner 1978; Schweizer 1988; Seidman and Foster 1978; White and Jorain 1992).

Chained Network Data Collection

The basic model for chained data collection is the same in each type of snowball or chained network. One person, or a small number of persons, is chosen as the starting point. This person can be chosen randomly from a community, or chosen because of some special characteristic that makes him or her a good starting point for the study. These individuals are asked to name and describe their relationships with individuals in their personal social network. In some cases, they are asked to name everyone they can think of, and in other cases they are asked to name individuals with whom they have a specific relationship or a specific set of relationships. The next person or persons to be interviewed can be either randomly selected from ego's original personal network (random walk approach) or can be nominated by the first person interviewed, based on their relationship to ego (snowball or referral approach).

Each person to be interviewed is chosen from the personal network of the last person interviewed. This process is followed for as long as needed, allowing more and more people to be nominated and then interviewed. The data set includes a set of interviewed people (known direct connections) and a set of persons

described by them (alters or personal network members of those interviewed, some of whom will also be named in other networks). The first persons can be called the seeds for the chain. The people they identify are their personal networks. The person chosen to move the chain or snowball out one level can be considered a link. Since each person interviewed identifies a personal network, it is both possible and likely that the same person or persons will be identified by more than one of the people who are interviewed. This means that even though the data collection is moving from one person to the next, the overall data sets will have network linkages between both the interviewed individuals and the alters that they name. The analysis of these data can then show a large number of connections between individuals in the community, even though only a small number of people were directly interviewed. Good sampling strategies and statistical analysis allow the researcher to describe a much larger segment of the community than just the people who were interviewed about their networks.

Sampling and Chained Networks

Choosing the starting point or points for network studies (i.e., sampling) and then interviewing all of the people named, or sampling from the persons named by the network seed, has become a critical consideration for both collecting and analyzing all forms of network data, but especially chained or snowball data. Anthropologists have begun to pay increasing attention to the selection of ethnographic informants (cultural consultants) in their research (Johnson 1990; Werner and Schoepfle 1987). Johnson (1994) points out that for many network studies, the sampling frame must be extended beyond individuals to include places, events, and subgroups as points for beginning both observational network studies and interviews.

Chained Network Analysis

The analysis of chained network data can be accomplished in a number of ways. It can involve an attempt to discover how far the chains extend before they truncate. This analysis provides information about how people are connected in a community, and how far those connections go before they disappear, based on some critical kind of relationship. Through this type of research, you could ask how far a community health educator's influence extends, or you could determine how health promotion

ideas or values diffuse through a social system. Another analytical strategy attempts to discover how the characteristics of a network chain change as the chain proceeds outward from its source. For example, if you start a chain with an active group of drug users, how far along a chain of connections do you have to go before the impact of that behavior is no longer visible or felt by the people who are ultimately connected with the first segment of the chain? The small-world experiment indicates that everyone is connected in the world, but it is also obvious that not every single line of relationships can or will extend from any one individual to any other in the world. Sometimes the connections run out, or are deliberately chopped off by persons using their role as a 'gatekeeper' to limit contact with the people they are protecting. This happens when parents prevent their children from seeing, hearing, or reading things that they think are harmful, such as sex education material or violent television shows. Therefore, one line of research is to determine all of the different lengths of chains between people, based on specific types of relationships, and to determine what causes those chains to be maintained and to be broken.

One of the interesting issues that can be studied through chain types of network research is how networks form, how stable they remain over time, and how they disintegrate or change. Several researchers have investigated the reasons why people get to know certain people and not others, and why they form network relationships (Bernard et al. 1982a, 1982b; Killworth and Bernard 1979). These and other studies include an analysis of cross-cultural variation in the size and characteristics of networks, how people respond to different kinds of network or relationship questions (giving different answers for the size of network for the same individual), and attempts to estimate the size of personal networks. This type of information would be very valuable in trying to understand why people join or leave self-help organizations, or participate in charitable groups that are trying to find cures for problems such as leukemia, cystic fibrosis, or genetic disorders.

Another line of analysis is to use the chained or snowball data as an approximation of the distribution of critical problems or relationships in a total population. This is common in research on hidden populations and on rare conditions such as HIV infection or specific genetic disorders. Because it is hard to find all instances of a rare or hidden condition, snowball and chained network approaches can provide data that are analyzed through statistical estimations for the culture or community as a whole, finding one or a small number of people who are

affected and chaining out to other people who have the same condition or problem.

WHOLE NETWORK STUDIES

The third approach to network studies attempts to describe and analyze the reciprocal relationships among all of the members of a social group. Many of these studies have focused on small communities or organizations. It takes time and effort to ask each person about her relationships with every other person in the group. There is a limit to patience that must be accommodated by these studies but, within that methodological boundary, there have been a large number of important discoveries about the nature of communities, businesses, self-help organizations, social clubs, and interlocking power groups that make this approach very valuable.

Full Reciprocal Networks

The research questions that are important for whole network studies require that everyone in the network (or virtually everyone, given the problems of real-life data collection) can be asked and can answer questions about every other member of the network. Sometimes the answers are about relationships and sometimes about the absence of relationships, but both kinds of information are needed. Once the relationship questions have been asked of everyone, it is possible to identify a large number of conditions that have an important impact on the network.

Whole Network Questions

Whole network questions can cover a wide variety of contextual relationships. Some of the questions focus on person-to-person relationships. They include asking people if they have physical ties, such as sexual relationships, or physical contact. Other questions investigate emotional or social relationships by asking people how much they are influenced by or influence other people's decisions, or how often they meet socially or communicate with one another. Whole network studies have significantly contributed to our knowledge about the AIDS epidemic and how to combat it (Needle et al. 1995). Whole network questions can also focus on geographical networks by asking everyone if, or how often, they visit locations (businesses, museums, organizations) or are at the same social events (parties,

visits), where the location is the focus for identifying the social context. Whole network analysis can also be extended to organizations or even societies. Instead of focusing on the individual, these whole network studies ask how organizations are related to one another. Some studies have looked at the overlap in the membership of corporate boards of directors, and have shown how these supposedly separate companies are actually interlocked systems with advantages that individual corporations do not have. Other studies have shown how companies that produce parts or services for other companies can be made more efficient and profitable depending on the types and frequency of contacts between the organizations that all lead toward the completion of a final product.

Whole Network Data Collection Techniques

Whole network data can easily be collected in the form of a matrix. Each person is given a questionnaire or interviewed about his or her relationships with everyone else in the network. In one of our studies about HIV transmission risks, we asked people to fill out a matrix questionnaire about the people in their drug-using network. Figure 2 is an example of the questions we used in that study, and an example of the types of answers that were given. Respondents answered the questions using a scale that was labeled appropriately for each question, with zero being the low end of the scale and five being the high end. The blank lines in the ques-

	Jim	Jenny	Tom	Cille	Marge
How honest is ___ with you?	0	5	1	3	3
How close a friend is ___?	2	5	3	4	3
If you had AIDS, how willing would you be to tell ___?	1	0	2	4	4
How often do you use drugs with ___?	0	3	0	5	3
How comfortable would you feel discussing AIDS with ___?	1	3	1	4	3

Figure 2 Matrix-style questionnaire about Drug and Trust Relationships

tion were used to indicate that the respondent should answer the question about each person represented by the names in the columns.

This form of data is then transferred to a set of matrices (one for each question) for analysis. Each question (or relationship) matrix consists of rows and columns that identify all of the people in the network. Each person is identified with both a row and a column. The square (cell) that is the intersection of a row (one person) with a column (another person) is used to record the answer to the question given by the first person, about the second person. The row and column intersection between the second person and the first is used to record the response in the other direction. Each final matrix represents a single type of relationship, so if data is being collected on multiple relationships like the example above, multiple final matrices are needed.

The data recording is easier to understand with a simple example. If we wanted to understand the relationships between five teenage friends, we might want to ask how often they call each other on the phone during the week. This would provide us with information about calling patterns that may also indicate other characteristics of their relationships. The five friends consist of two males and three females. They all know each other, but their social relationships are different, so they have different calling patterns. If we asked each person how often he or she had called each of the other four people in the past week, we might get a grid that looked like Table 3. In this example, Jim was asked 'how many times in the last week did you call Jenny?,' and then asked the same question for the other three people. He called Jenny, who is his girlfriend, five times, Tom once, and did not call either Cille or Marge, who are very good friends of Jenny's. When Jenny was asked the same question for the other four, she had called Jim, Cille and Marge (probably to talk about Jim), but not Tom, who is Cille's boyfriend. The three girls all called each other during the week, several times. In this example, Marge also called both boys, in addition to her girlfriends. In both cases, she was trying to help her friends get information, and

was acting as a go-between, which is very common in teenage relationships. This is typical whole network data, and when it is recorded as a matrix, can be analyzed to show a large number of important characteristics about the group.

Matrix data has two important attributes that are part of the data recording process. The data can be either binary or valued, and it can be either symmetrical or asymmetrical. Binary data indicates only the presence or absence of a relationship. It is recorded as a one or a zero. Sometimes the questions that are asked in network analysis only focus on whether a relationship exists, not how often or how forcefully something happens. The alternative is to record a value for the relationship. In the previous example, the value represents the number of phone calls in a week. Instead of numbers, the informants could have been asked to rate how important the call was (from unimportant to very important) or they could have been asked to rank the five people in terms of the frequency they call the other person. Each of these is recorded as a value, rather than a one or zero. The statistics that help analyze network structures often require one or the other type of data. The same is true of symmetrical and asymmetrical data. Some relationships automatically involve both individuals, so the data are identical for the pair (the top half and the bottom half of the matrix are identical). In other cases, like the example above, the relationship exists between the two people, but more things are happening in one direction than in the other direction. Jim calls Jenny more than Jenny calls Jim, even though they both participate in all of the telephone calls. This produces a matrix where the number in any cell may be different from any other cell. This helps identify asymmetrical relationships and conditions. For example, there may be a million calls each day that go to New York City, and only a thousand that go to a small town in Arizona. This means that the structure of the phone network will need far more connections into one place and fewer into another. The same structural differences happen in social networks.

Table 3 *Phone-call patterns among five friends*

	Jim	Jenny	Tom	Cille	Marge
Jim					
Jenny			0		
Tom			0		
Cille	0		0		
Marge					0

Whole Network Data-Analysis Techniques

The simple-looking data described in the last section can produce very complex and interesting results. Network relationships can be analyzed from several major perspectives. These include an analysis of every person's interaction pattern, place, and role in the network, as well as an analysis of the overall structure of the network.

The first part of any network analysis is to look at the relationships between each individual in the network and all other individuals. These relationships are often called actor interactions. Formal descriptions of the way these network elements are analyzed are available in methodological books, such as *Social Network Analysis* (Wasserman and Faust 1994). These analytical processes can describe how each actor in a network is connected with each other actor, how each person can or cannot be reached through other people, how much influence each person has in the network, and how central, powerful, or well connected a person is. A second part of the actor analysis allows the researcher to determine if there are subgroups in the network, and if certain positions and/or roles that people take on have an important impact on people's lives. These elements of network analysis are often called social cohesion measures, structural equivalence measures, and regular equivalence measures. The final analysis looks at the overall characteristics of networks.

The possibilities for different types of whole network analysis, along with some specific measures of key relationships, are shown in Table 4.

Each of these types of analysis may be important in answering different kinds of questions that researchers may be asking about the relationships within a community. For example, if a person is very central in a network, is that person more likely to be infected by a communicable disease that is moving through the network than a person who is peripheral to the group? How long does it take tobacco prevention information to saturate a network from any given starting point? If you can only talk to one person in a network and you want that person to change everyone else's eating behavior, who is the best person to talk to? If there are two factions in a network, and you want to separate them to keep them from fighting, which bridges in the network allow you to split the groups by eliminating the smallest number of connections? If you have a community that is made up of many different networks (such as teenage gangs), are there certain positions or roles in each of the networks that allow you to predict that people in those positions will have very similar life conditions and be more like each other than they are like other members of their gang? You might be able to predict, and prevent, fatalities by knowing the conditions attached to each position in the gang.

One key strategy for analyzing a whole network data is to create both a visual and a statistical display of the presence and absence of key relationships. One of the two most common visual displays is a sociometric diagram where individuals (actors) are represented by symbols, such as circles for females and squares for males, and lines or arrows represent the relationship or

Table 4 *Examples of network measures from matrix data sets*⁵

Focus	Analytical strategy	Examples of measures
Relationship between actors	Graph connections	Geodesic distance, reach, flow, volume, walks, influence
Relationship between actors	Centrality, power and prestige measures	Degree centrality, closeness centrality, betweenness, flow betweenness, information, Bonacich power
Subgroups	Social cohesion	Cliques, components, <i>K</i> -cores, <i>n</i> -cliques, <i>n</i> -clans, <i>K</i> -plexes, factions, connectivity sets
Roles and positions	Structural equivalence	Profile similarity, tabu search, CONCOR, CATIJ, automorphic equivalence
Roles and positions	Regular equivalence	Categorical, continuous, tabu search
Whole network characteristics	Structural measures	Density, network centrality, transitivity

connection between them. The thickness of the line may represent the strength of the relationship (for valued data) and arrowheads may represent the direction of the relationship (for directional or potentially asymmetrical) data. The second most common display is to provide a data matrix that indicates the relationships by numbers in a person-by-person matrix. Finally, each type of relationship can be described by accompanying statistics, including such approaches as cluster analysis and multidimensional scaling, as well as summary statistics.

Figure 3 is an example of a sociometric representation of the relationships described in a network where the lines represent sharing drugs. An arrow indicates one way sharing, while a line without a point indicates sharing in both directions. The thickness of the lines represents the frequency of sharing.

In this diagram, Aida (#7) is a nonuser, clearly represented in her lack of connections with the group. Anita (#13) shares the primary influence in the drug network with her son, Marcos (#5), and with Jaime (#9), who is central because he is a bilingual communication bridge between the Spanish (only) and the English (only) portions of the network. Marcos (#5) scores drugs for this network, keeps track of drug-related conditions, and influences the network through his mother's close connections with everyone else. The relationship chosen for this display was sharing drugs. Other data we collected indicated that #4 and #5, who are married to each other, are not strongly tied by social relationships but are not connected by drug use. The kinship ties between #9 and #2 (living as married) are not visible in the drug relationship diagram either, nor is the aunt-niece connection between #6 and #7. This

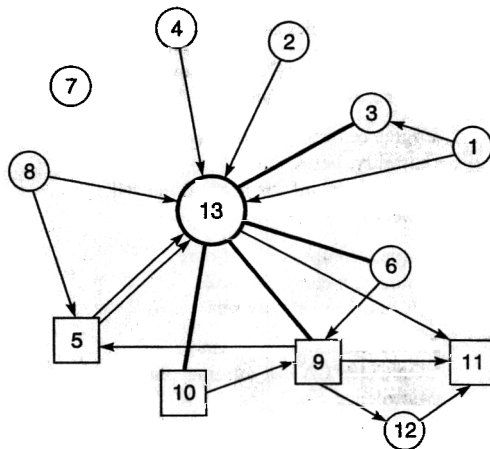


Figure 3 Sociometric diagram of relationships in a drug-using network

points out the need to understand multiple relationships in a group, not just a single relationship, if you want a full understanding of a group.

The overall structure of the group is also important when compared with the structure of other drug-using networks. In this case, the comparative data showed that this is a tighter than normal network, due to the kinship ties among members, and that it has a better structure for solving social and drug-use problems than networks that are based on friendship and acquaintanceship alone. It is more stable and has resisted change longer than other types of drug networks. This condition makes this type of network harder to change, for HIV risk reduction, than networks where people can more easily be isolated from the influence of their peers.

THE FUTURE OF NETWORK STUDIES

The future of network studies in anthropology, and in the other social sciences, combines the continual exploration of the questions asked above with some new areas for the expansion of the paradigm. Anthropologists have not come close to exhausting the limits of the three network paradigms (personal, chained, or whole network approaches) in their studies, either from a geographical or a subdisciplinary focus. Medical anthropology, cognitive anthropology, and economic anthropology have made the most substantial uses of this approach (Johnson 1994). However, political anthropology and educational anthropology have neglected this area of investigation, as have anthropologists who are interested in expression and symbol, in the impact of different schools of anthropological theory on one another, and in the impact of graduate programs on the structure and development of the discipline, to name just a few.

There is a need to re-explore and provide further information on informant accuracy. Policy decisions are being made on a daily basis, with global impact, based on what our informants tell us. While we know more than we did before, there are still areas of both memory and reporting that make this information more vulnerable and less predictable than is desirable.

The diffusion of information and innovation has held the anthropological imagination for decades, and promises to have very important implications for future studies, at the personal and at the whole network level. More needs to be done to define the impact of networks on

contagious diseases (Klov Dahl 1985), on social support for victims of all types of problems (Sarason et al. 1986), and for directing power, influence, and information. This is an area where ethnography, mass media, and social network theory can be combined for very powerful findings.

There is still the need to understand the relationship between anthropological kinship analysis and network analysis. The importance of understanding kinship systems in a global geopolitical economy has been highly underrated and needs to be revisited. The news is full of stories about developing countries where kinship plays the key role in distributing power and influence over important sectors of the national economy, the national armed forces, and the national political system. The news is also full (sometimes only on the society page) of indications that the rich, famous, and powerful marry their children to people from their own social networks, further controlling power and fame in the next generation. The impact of kinship on social forces has a great deal of potential for further analysis.

On the other hand, there are some gaps in our knowledge that should be closed or addressed, even though they do not have the historical importance of those above. There is a great deal that we do not know about the boundaries of networks, or the impact of the borders of nations. There has been a lengthy debate on the definition of the term 'community,' and all of its associated terms and processes. Social network approaches can make a significant contribution not only to identifying rational boundaries, but also to showing how those boundaries change depending on the nature of relationships and the level of analysis that is being undertaken. We are still struggling with concepts of power, information sharing, shared governance, and other forms of social interaction. Social network approaches should be applied to these critical, political, and philosophical conditions.

Another neglected area is understanding and predicting the changes that occur in networks over time, from the micro-level personal network to macro-networks of society and the world. Evolutionary theory in anthropology potentially has a great deal to contribute in this area, and the issues of studying change through time are central to the discipline. Most networks are analyzed on the basis of a one-time picture, even though we know that our personal friends have changed over time, just as global alliances have changed. We need to know the mechanisms that cause the formation of networks, allow them to be stabilized and maintained, and cause their disruption and

regeneration or their dissolution. What expectations should someone have in terms of knowing people as adults that they knew as children? How many friends from grade school do you still talk to? When and how should organizations or corporations, cities, states, or nations create alliances or change alliances, and when should they avoid them?

Finally, there is a very important unexplored area in social network research. This is the area of research ethics and the ethics of research. From one direction, we know very little about the impact of social networks on ethical conduct or ethical reasoning. This is an area that could be explored combining network methods, ethical inquiry, and anthropological theory. An important parallel issue is the exploration of the ethical conditions that need to be applied to conducting network research. Most of our ethical principles for research, such as the rules for the formation of institutional review boards or the Belmont Report (which sets out the basic principles of ethical research in the United States), are based on assumptions that may be either violated by, or in conflict with, the kinds of relationships and interconnections that exist in social networks. One of the three principles of research ethics is autonomy. Single individuals are assumed to be capable of deciding whether it is appropriate for them to participate in a research project, based on their being informed about the nature of the research and its risks (informed consent). However, this autonomy is potentially violated at the network level, when people are identified as part of a social network and information is given about them by the other members of the network, even if they themselves refuse to participate. Their participation may not achieve full autonomy, due to the influence of the network. The other primary principles, justice and beneficence, can also be challenging to apply when research is directed at a group, rather than at individuals. These conditions raise questions such as, 'Who should make the decision for a community to participate in a vaccine trial, individuals who want the vaccine, or community leaders who have an appreciation of the needs and the vulnerability of the community?' Who should benefit most from research on a group? Should it be individuals, the community, society at large, or the researchers? How do we make ethical choices to conduct or not to conduct research that will benefit society as a whole, but will be destructive to individuals or to small groups? How do we make judgements about research that will potentially harm a community (destroy its positive reputation, create stereotypes) but will be extremely beneficial to all of the individuals in the community who need certain services or

need to know the dangers that confront them? How do we handle the ethical dilemmas posed by research that is viewed as positive, needed, and wanted by one subgroup in a culture, and viewed as negative, unwanted, and unneeded by another subgroup? There have been a number of studies that have benefited males but not females, one cultural group over another, and so on. Research, reporting, evaluating, and defining ethics beyond the level of the individual has been seriously under-represented in the literature and deserves attention in the future along with the other questions raised above.

NOTES

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2 There are several reviews of social network theory that are important historical accounts of the theories and methods used in these studies and which form the backdrop for this chapter, but are not reviewed here. These include: Boissevain 1974; Burt 1980; Burt and Minor 1983; Harary 1965; Johnson 1994; Knoke and Kuklinski 1982; Marsden 1990; Marsden and Lin 1982; Rogers and Kincaid 1981; Scott 1991; Wasserman and Faust 1994; Wellman and Berkowitz 1988.

3 Some of the basics are reviewed or identified by Freeman (1979), and details are provided in Wasserman and Faust (1994). While not close to an exhaustive list, some of the seminal approaches that are of interest in anthropology, sociology, psychology, and political science are discussed in: Barnes 1980; Barnes and Harary, 1983; Bernard et al. 1990; Faust 1988; Freeman et al. 1989; Hage and Harary 1983, 1991; Hammer 1980; Johnson 1986, 1994; Johnson et al. 1989; Wellman 1988.

4 In order to participate, individuals had to be 18 years of age or older, could not have been in treatment in the past 12 months, and had to have a positive urine screen for cocaine or heroin, or needle marks (tracks) and a positive urine screen for some other injectable illicit drug. Therefore, this category includes only 18- and 19-year-olds.

5 This table, and the accompanying chapter, ignores dyadic and triadic network methods. These methods are rarely used in anthropology, although they do form a well-established area of social network analysis. These methods are discussed in detail in Part V, *Dyadic*

and *Triadic Methods*, and in Part VI, *Statistical Dyadic Interaction Models*, by Wasserman and Faust (1994).

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