4th Edition

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SOCIAL NETWORK ANALYSIS

§SAGE

ONE

What is Social Network Analysis?

The idea of the social network has become commonplace since the recent rapid development of 'social networking' websites and the growth of social media. Facebook, Twitter, LinkedIn, and similar websites encourage their users to build up lists of 'friends', 'followers' and 'contacts' that can grow through indirect connections to others. These sites attempt, in different ways, to take seriously the old adage that 'it is not *what* you know but *who* you know': a network of connections can provide help, support, opportunities, and even a sense of well-being that would not otherwise be possible. These social media develop the established business technique of 'networking', of meeting and greeting influential others at meetings, seminars and conferences.

In sociology, the idea of a social network has a far longer history and a much broader meaning. Social networks include digital and online networks but also include such networks as face-to-face relationships, political associations and connections, economic transactions among business enterprises, and geopolitical relations among nation states and international agencies. Over the years, sociologists have devised a variety of ways of examining and interpreting relationships of all kinds and so of subjecting them to systematic forms of analysis. What has come to be called *social network analysis* is not a practical guide to making friends or building business contacts, though it may be able to help in these activities. Rather, it comprises a broad approach to sociological analysis and a set of methodological techniques that aim to describe and explore the patterns apparent in the social relationships that individuals and groups form with each other. This reference to 'patterns' suggests that social network analysts are particularly interested in the construction of pictures and diagrams that disclose the patterns that are not generally apparent to human observers. This is, indeed, true, but social network analysis seeks to go beyond the visualisation of social relations to an examination of their structural properties and their implications for social action.

Social network analysis developed first in a relatively non-technical form from the structural concerns of sociologists and anthropologists who explored the 'interweaving' and 'interlocking' relations through which social actions are organised through using such textile-based metaphors as the 'fabric' and 'web' of social life. From the 1930s to the 1970s, an increasing number of these and other social scientists began to take these metaphors more seriously and began to use mathematics to investigate the 'density', 'connectedness' and 'texture' of social networks. Groups of specialists began to concern themselves with devising more systematic translations of the key ideas involved in the metaphor. From the early 1970s, an avalanche of technical work and specialist applications appeared, and it is from these writings that the key concepts of social network analysis have emerged. The various techniques developed have gradually been incorporated into the mainstream of data analysis and a wider sphere of applications.[1]

This development of techniques has encouraged many social researchers to seek the advantages of using social network analysis. However, when they turn to the technical literature they find that it is, indeed, highly 'technical'. Many who have seen the potential offered by network analysis have found it difficult to come to grips with the highly technical and mathematical language that necessarily characterises much of the discussion in the technical literature. Practical researchers rarely have

the time or inclination to grapple with texts and sources that have, by and large, been produced by highly numerate specialists with a strong mathematical and methodological background. Those without a good mathematical competence find this literature especially daunting. Ostensibly introductory texts written by methodological specialists can often fail to adequately convey the possibilities that can be realised through the use of social network analysis.

I am not a specialist with any mathematical training, but a researcher who came to social network analysis because of the particular needs of data handling I had in a research project that I was undertaking on corporate power. Over the years I, too, have struggled to achieve a degree of understanding of what is involved in the principal measures of network structure and dynamics. I have attempted in this book to translate that mathematics into a simpler language – I hope without over-simplification – and to assess the relevance of particular mathematical models and measures for specific research needs. My aim in the book, therefore, is to draw on this experience and to present a systematic summary of these measures together with some illustrations of their uses. I have not attempted to present a comprehensive treatise on structural analysis in sociology (for these see Berkowitz, 1982; Crossley, 2010), nor have I tried to review the large number of applications of social network analysis that have been published (see, for example, Wellman and Berkowitz, 1988). Many powerful applications have appeared in the important series 'Structural Analysis in the Social Sciences' edited by Mark Granovetter (see, for example, Mizruchi and Schwartz, 1987; Schweizer and White, 1998; Ansell, 2001; Ikegami, 2005). My aim has been to identify the key concepts used in assessing network structure and to translate the mathematical discussions of these ideas into more comprehensible terms.

It is of the utmost importance that researchers *understand* the concepts that they use. There are, for example, a large number of different definitions of what constitutes a 'clique' and the various ideas related to it, and a researcher cannot simply take a computer program off the shelf and assume that the way in which it operationalises the clique concept will correspond with the idea that she or he has in mind. It is for this reason that I emphasise, throughout the book, that the choice of measures and decisions on their application to particular topics are matters that always require the *informed judgement* of the practising researcher. These choices and decisions involve theoretical and empirical questions that cannot be avoided by a reliance on mathematical measures that are only partly, if at all, understood. Only if the researcher has a clear understanding of the logic of a particular measure can he or she make an informed *sociological* judgement about its relevance for a particular piece of research.

THE DATA USED IN SOCIAL NETWORK ANALYSIS

A first task must be to define the kinds of data for which social network analysis can most appropriately be used. Readers who are interested in applying it in their research

will, undoubtedly, have some ideas about this already: it seems to be particularly useful for investigations of kinship patterns, community structure, interlocking directorships and so forth. What is essential is that the common features of the data used in these studies are clearly understood. The central assumption made here is that social network analysis is appropriate for 'relational data', and that techniques developed for the analysis of other types of data are likely to be of only limited value for research on social networks.

All social science data are rooted in cultural values and symbols. Unlike the physical data of the natural sciences, social science data are constituted through meanings, motives, definitions and typifications. As is well known, this means that the production of social science data necessarily involves a process of interpretation. Through such processes of interpretation, social scientists have formulated distinct types of data, for each of which distinct methods of analysis are appropriate.

The principal types of data used in social science are attribute data and relational data.[2] Attribute data are those that relate to the attitudes, opinions and behaviour of agents, in so far as these are regarded as the properties, qualities or characteristics that belong to them as individuals or groups. The items collected through surveys and interviews, for example, are often regarded simply as attributes of particular individuals that can be quantified and analysed through many of the available statistical procedures. The methods most appropriate for attribute data are those of variable and multivariate analysis, whereby attributes are measured as values of particular variables such as income, occupation and education.

Relational data, on the other hand, concern the contacts, ties and connections, and the group attachments and meetings that relate one agent to another and that cannot be reduced to the properties of the individual agents themselves. Relations are not the properties of agents, but of the relational systems of agents built up from connected pairs of interacting agents. The methods appropriate for relational data are those of network analysis, in which the relations are treated as expressing the linkages that run between agents. Relational data consist of agents as 'cases' together with the connections and affiliations that comprise their social relations. While it is, of course, possible to undertake quantitative and statistical counts of relations, and to investigate the statistical significance of relational patterns, network analysis comprises a body of qualitative measures for describing network structure and development.

Attribute and relational data are not the only types of data used in the social sciences, although they are the most widely discussed in texts on research methods. A third type comprises what can be called 'ideational' data, which directly describe the meanings, motives, definitions and typifications involved in actions. Techniques for the analysis of ideational data are less well developed than those for attribute and relational data, despite their centrality to the social sciences. Typological analysis of the kind outlined by Weber (1920–21), together with various forms of discourse analysis, is the most fruitful approach here, but these methods are in need of further development

(see Layder, 1992).[3] Recent work in social network analysis has begun to explore the ways in which cultural meanings are discursively involved in the constitution of social relations and help to shape the networks into which they are formed (Emirbayer and Goodwin, 1994; White, 2008; Mische, 2003, 2011).

Although there are distinct types of data (as set out in Figure 1.1), each with their own appropriate methods of analysis, there is nothing specific about the methods of data collection and sampling that can be used to produce them. There is, for example, nothing significant that distinguishes methods for the collection of attribute data from those for the collection of relational data. The types of question used in a social survey may differ, for example, but the principles of survey construction and analysis are the same. The three types of data are often collected alongside one another as integral aspects of the same investigation. A study of political attitudes, for example, may seek to link these to group memberships and community attachments; or an investigation of interlocking directorships may seek to link these to the size and profitability of the companies involved. In either case, questionnaires, interviews, participant observation or documentary sources can be consulted in order to generate the data. This combination of approaches has been much discussed in recent literature on mixed methods or multi-methods research (Creswell, 1994; Creswell and Plano, 2007). While mixed methods are nothing new in social research, they have recently been given a more comprehensive rationale as a systematic research strategy. The aim is to combine the strengths – and so minimise the weaknesses – of quantitative and qualitative methods, seeing the two methodologies as complementary and as allowing a more objective and comprehensive triangulation on relational data. Their utilisation in social network analysis has recently been reviewed in Hollstein and Dominguez (2012).

Studies of friendship, for example, have tended to follow the lead of a pioneering study carried out by Moreno (1934), who used questionnaires to investigate friendship choices among selected children. In such studies, researchers simply ask respondents to identify their friends, by asking such questions as 'Please name the friends that you see most often' or 'Please name your four closest friends'. Methodological problems do, of course, arise with this kind of research: an unlimited choice question has sometimes been found to be difficult for respondents to answer; some people may not feel that they have four friends to name; and many people find an open question both time-consuming and tedious.[4] An alternative approach has been to use the roster choice method, in which respondents are asked 'Which of the following people would you regard as a friend?' This question requires considerable knowledge and preparation on the part of the researcher, who must compile a list with which respondents can be presented, but it has the advantage that it can be adapted by asking respondents to rank or to rate their affiliations, so indicating their intensity or significance. In both cases, however, these methodological problems of knowledge and respondent co-operation are exactly the same as those that arise in collecting information on attitudes and opinions. I will discuss these issues of data collection more fully in Chapter 3.

Figure 1.1 Types of data and analysis
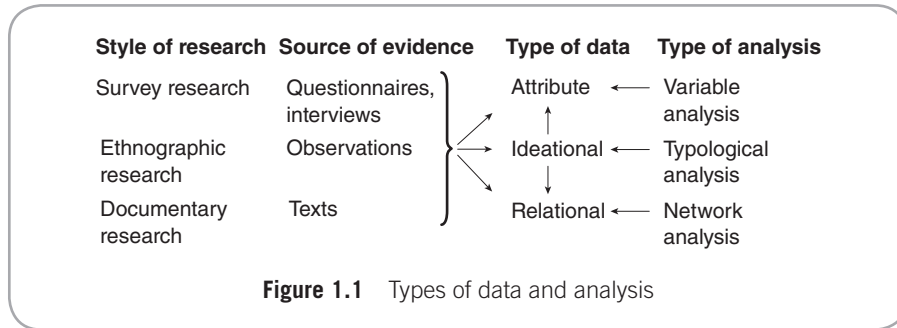
Relational data are central to the principal concerns of the sociological tradition, with its emphasis upon investigating the structure of social action. Structures are built from relations, and the structural concerns of sociology can be pursued through the collection and analysis of relational data. Paradoxically, most of the existing texts on research methods and methods of data collection give little attention to relational data, concentrating instead on the use of variable analysis for the investigation of attribute data. The formal, mathematical techniques of social network analysis, the methods that are specifically geared to relational data, have developed and have been discussed outside the mainstream of research methods. While they have made possible a number of spectacular breakthroughs in structural analysis, they have been largely inaccessible to many of those who would most wish to use them.

IS THERE A NETWORK THEORY?

The growth of social network analysis has led many to see it as a new theoretical paradigm rather than simply a collection of techniques. Barnes and Harary (1983), for example, have argued that it is possible to advance from the use of formal concepts to the use of formal theory. They argue that the promise of social network analysis can be realised only if researchers move beyond the use of formal concepts for purely descriptive purposes (see also Granovetter, 1979). Mathematics consists of theorems that specify the determinate logical links between formal concepts. Barnes and Harary argue that if the formal concepts prove to be useful ways of organising relational data, then the theorems too should be applicable to those data. The application of theorems drawn from formal mathematics, then, 'reveals real world implications of the model that might otherwise have not been noticed or utilized by the designer of the model' (Barnes and Harary, 1983: 239).

Some have gone even further, seeing social network analysis as constituting a particular theoretical paradigm. There is, however, little agreement as to the basis of this theoretical approach. Most typically, social network analysis has been seen as rooted

in a form of exchange theory (Emerson, 1962, 1964; Cook, 1977, 1982; Cook and Whitmeyer, 1992; Willer, 1999). This is sometimes seen as involving a wider 'trans-actionalist' approach (Bailey, 1969; Boissevain, 1974) or rational choice theory (Lin, 1982; see also Banck, 1973, and van Poucke, 1979). From this point of view, the mak-ing and breaking of social relations are seen as the rational decisions made by reflective agents acting according to their self-interest. This seems, to many, to be a plausible interpretation of the emphasis placed by network analysts on 'transactions' and the flow of resources. This argument is, however, too restrictive. While human actors may indeed act rationally, they do not act exclusively in terms of self-interest and may co-operate for a whole variety of reasons.

Social network analysis has also recently been linked with one particular substan-tive theory: the theory of social capital, first outlined in a systematic way by Putnam (2000). According to this point of view, social networks are a particular form of social capital that individuals can employ to enhance their advantages and opportunities. This has generated some powerful applications of social network analysis (Lin, 2001; Burt, 2005; Lin and Erikson, 2008), and it has, perhaps, been stimulated by the already noted growth of 'social networking' websites such as Facebook, MySpace and Twitter, through which people can build up networks of contacts and can come to regard their 'friends' as a source of social capital. Such a limitation of social network analysis is too restrictive. Social networks *are* relevant as sources of social capital, but they are more than this – they may, for example, be networks of economic transactions and political conflicts as well. Similarly, the 'social networks' built up through friendship and contact websites are simply one form of the myriad social connections in which individuals are engaged. Social network analysis must be seen as a comprehensive and all-encompassing approach to the relational features of social structures.

The actor-network theory derived from the work of Latour (2005) has sometimes been seen as a theoretical approach specific to the analysis of social networks. For these theorists, 'actors' are not to be equated with human individuals or even groups but are to be seen as constituted by the relations that connect individuals to mate-rial objects, other people, cultural meanings and environmental conditions. It is these 'networks' that act: people-in-cars are actors in traffic systems, people-with-armaments act in warfare, people-with-implements carry out medical operations, and so on. In each case, the particular form of action is incomprehensible without an awareness of the 'network' that acts. Important as these insights are, they do not incorporate ideas from social network analysis, and the approach of social network analysis continues to offer possibilities for investigating the social networks formed by the actor-networks.

The work of Manuel Castells (2000) has popularised the idea of a 'network soci-ety'. He has set out a view of the global structure of economic, political and cultural relations as a network and he has highlighted the need to examine the processes through which global integration has been achieved and its implications for busi-ness enterprises, nation states and social movements. Castells has rejected social

network analysis as a tool of analysis, regarding it as a body of formal 'theory' that is too abstract to be useful in studying the global political economy. However, I have shown that social network analysis is not a specific body of theory but a collection of theoretically informed methods. As such, it has great potential for investigating the network society. In fact, powerful analyses of the world system have been undertaken using just these methods (see Maoz, 2011).

The relation between theory and method in social network analysis is best understood on the basis of the arguments of Emirbayer and his colleagues (Emirbayer, 1997; Emirbayer and Goodwin, 1994; see also Berkowitz, 1982), who see social network analysis as a specific implementation of the relational orientation to sociological explanation. This incorporates an awareness of the subjective meanings that define social relations and so is closely linked to cultural theories (see White, 1992a, 1993, 2008, and the discussion in Brint, 1992, and White, 1992b; see also Crossley, 2010, and Scott, 2011b: Ch. 6). Other writers have recently developed alternative, but complementary, conceptualisations of relational sociology that see it as implemented through social network analysis (Powell and Dépelteau, 2013a, 2013b). As such, a number of relational theories are compatible with the techniques of social network analysis: not only exchange theory but also structural functionalism, structuralism and many forms of Marxism. Social network analysis provides a vocabulary and set of measures for relational analysis but it does not imply the acceptance of any one particular theory of social structure (but see Borgatti and Lopez-Kidwell, 2011).

AN OVERVIEW

This book is a guide or handbook for social network analysis, and not a text to be read through at one sitting. I have tried to confine subsidiary points and abstruse technicalities to footnotes, but a certain amount of complexity necessarily remains in the main text. I hope that this is at an absolute minimum. The newcomer to social network analysis is advised to read Chapters 2–4 and then to skim through the remainder of the book, coming back to points of difficulty later. Those readers with more familiarity with social network analysis may prefer to reverse this procedure, scanning Chapters 2–4 and then giving greater attention to a thorough review of Chapters 5–10. The chapters are best read in detail whenever a particular technique is to be used in a specific investigation. Although later chapters depend upon arguments raised in earlier chapters, each can be treated as a reference source to return to when attempting to use a particular technique.

Chapter 2 discusses the history of social network analysis, looking at its origins in early sociology and the social psychology of small groups and its subsequent development in sociological and social anthropological studies of factories and communities, and moving on to the advanced work undertaken by sociologists at Harvard University

in the 1970s and physicists since the 1990s. The chapter shows how key theoretical ideas emerged within the various traditions of research and that the corpus of models and measures available today is the outcome of an accumulation of independently developed ideas that have come together since crucial work carried out from the 1970s.

In Chapter 3, I look at some of the issues that arise in data collection for social network analysis. I look at issues in defining the boundaries of social networks, in selecting and sampling relations for study, and in formulating questions and observational protocols for compiling relational data. In Chapter 4 I turn to the questions of how relational data are to be organised in databases that allow a ready analysis of their structural properties. I introduce matrices and sociograms as easy and intuitive ways of modelling relational data and I survey the leading computer programs that help in the analysis of social networks.

Chapter 5 introduces the basic building blocks of social networks. It starts with a consideration of the fundamental sociometric idea of representing a network as a 'graph' of 'points' and 'lines', and it shows how these can be used to develop concepts such as 'distance', 'direction' and 'density'. I also look at the relationship between the analysis of 'egocentric' networks focused on particular individuals and whole networks with global properties. In Chapter 6, I look at how issues of popularity, brokerage, mediation and exclusion can be explored through the 'centrality' of points and the 'centralisation' of whole networks, building on the argument of Chapter 5 to show how it is possible to move from local, 'egocentric' measures to global, 'socio-centric' ones. Chapter 7 turns to the investigation of groups, factions and social divisions, introducing the concepts of 'cliques' and 'circles' as the subgroups into which networks are divided. In Chapter 8 there is a shift of focus to the question of structural locations and class positions, utilising concepts of 'blocks' and their articulation into more complex 'topological' structures. Chapter 9 is concerned with the change and development of networks over time, using recent work on network dynamics. The chapter also considers recent studies of statistical approaches to explaining network dynamics and testing alternative hypotheses about network structure and change. Finally, Chapter 10 returns to the pictorial representation and modelling of social networks, showing how formal approaches to the display of relational data move beyond simple network diagrams to the production of multi-dimensional 'maps' of social structures and a variety of graphical methods for the visual display of network structure.

Most chapters conclude with a consideration of the application of the measures discussed in particular empirical studies. The investigations that are reviewed cover such areas as kinship, community structure, corporate interlocks and elite power. The aim of these illustrations from leading researchers is to give a glimpse of the potential offered by social network analysis. In Chapters 3–10 these are complemented by exercises in which readers are invited to engage with the concepts through devising and undertaking studies of their own.

FURTHER READING

Scott, J. (2012) *What is Social Network Analysis?* London: Bloomsbury Publishing.

Aims to give an introduction to the area that assumes no prior knowledge.

Scott, J. and Carrington, P. (eds) (2011) *The Sage Handbook of Social Network Analysis.* London: Sage Publications.

A comprehensive reference book that provides introductory chapters and more advanced discussions that you will want to come back to throughout your studies.