Social Networks and Social Networking

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Social networking is built on the idea that there is a determinable structure to how people know each other, whether directly or indirectly. Notions such as "six degrees of separation" — that everyone on Earth is separated from everyone else by no more than six intermediate personal relationships — have popularized the idea that people can be (however unknowingly) connected through common associates.

This issue's theme includes three articles on research activities that have drawn on ideas from social networking to drive innovative designs. The focus stays close to our own intellectual home — the design, development, and study of social technologies at the level of individuals, groups, and organizations — although we refer to the broader issue of business, community, and societal impact in this short introduction.

Origins

Most contemporary lay discussion of social networking seems to center on online interactions via the Internet and focus on "hooking up" with others to get a job, get a date, or share stories with people who have, say, the same breed of dog. Yet, for decades researchers in the behavioral sciences have been systematically studying social networks of all kinds — "offline" interactions (face to face, letters, telephone, and so on) as well as online to determine how social networks are developed and maintained and how social-network connections affect our lives.

John Scott's introduction suggests that contemporary social network analysis (SNA)[1] draws on three lines of inquiry:

- Sociometric analysts in the US during the 1930s, whose work had roots in Gestalt psychology, aimed to investigate how feelings of well-being are related to the structure of people's social lives. This movement is most closely associated with Jacob Moreno, who devised the *sociogram*, a visual diagram of people's relationship networks in which individuals are represented as points and their connections to others as lines. Other major players in this research movement were Kurt

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Lewin, whose greatest legacy was his promotion of mathematical models of group relations, and Fritz Heider, who focused on people's perceptions about their relationships with others.
- Also in the 1930s, Harvard University researchers began focusing on cliques in social groups to identify cohesive subgroups (such as work, church, family, associations, and clubs) within social systems. This group was influenced by anthropologist Alfred Radcliffe-Brown, whose work focused on factory and community life in the US.
- A group of anthropologists in Manchester, England, also drew on the work of Radcliffe-Brown in the 1950s. John Barnes, a member of this group, is attributed with having coined the specific term "social networks" in 1954. His work with Elizabeth Bott drew on the sociometric approach, but focused on people's informal social relationships rather than those associated with institutions and associations. In addition, their work focused on conflict and change in these networks. Clyde Mitchell extended the traditional sociometric approach with insights from the mathematics of graph theory to better deal with observations that were gathered.

Influenced by these investigations, Harvard researchers led by Harrison White further explored the mathematical basis of social structure in the 1960s and '70s. They drew together algebraic models of groups using set theory and multidimensional scaling to establish concepts such as the strength and distance of connections. The general approach gained legitimacy and popularity with the publications of Mark Granovetter's analyses of how information from informal social contacts was used in job seeking in a US community.[2,3] These works laid the foundation for the methods of study and analysis used in SNA today.

Definitions

SNA data is essentially relational rather than attribute-based (that is, concerned with relationships between things versus the attributes of individual entities). Thus, the unit of analysis isn't the individual, but structures (networks) that consist of at least two social entities (usually more) and the links among them. Examples of the data gathered include kinship relations (for example, brother of), social roles (boss of, friend of, and so on), actions (such as has dinner with, dance with, or fights with), affective (loves, hates, and so on), material exchanges (such as business transactions) and common behaviors (for example, wears the same jeans or goes to the same tattoo parlor).

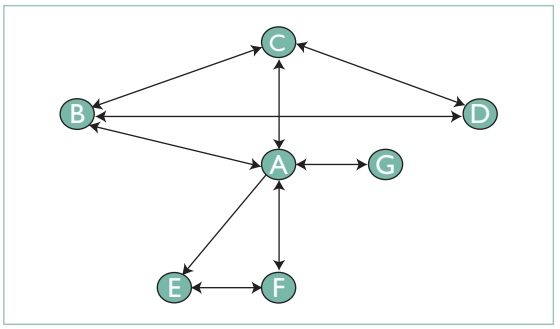

Figure 1. Elements of a social network, illustrated in a simple sociogram. The nodes in this network are represented as circles, and the links or connections between them are the arrowed lines. Between the nodes are one unidirectional and eight bidirectional links. A is at the centre of two subgroups of linked nodes consisting of B, C, and D, and E and F, respectively. A also has a connection to G. A connects to E, but E doesn't connect to A.

Figure 1 is a sociogram depicting the structure of relations between entities A through G, the "nodes" in a simple network. In the figure, the circles are nodes and the lines between them are links (also called arcs, edges, or ties). Entity A is connected to two subgroups and one singleton, G. One subgroup is made up of entities B, C, and D, and the other comprises entities E and F. The arrows depict whether the flows are uni- or bidirectional:

- A is connected to — say, sends email to — B, C, E, F, and G.
- A receives email from B, C, F, and G.
- E and F send email to each other.
- B,C, and D all send and receive email from each other.
- A doesn't receive email from E.

We could characterize A as spanning the boundary between the two subgroups, thus serving as a potential connection source between individuals in each. Figure 2 (next page) shows the connectivity matrix visualized in Figure 1.

Information passes between nodes as *flows* — the movement of diseases among cattle populations, connections between musicians based on musical

	A	B	C	D	E	F	G
A	1	1	1	0	1	1	1
B	1	1	1	1	0	0	0
C	1	1	1	1	0	0	0
D	0	1	1	1	0	0	0
E	0	0	0	0	1	1	0
F	1	0	0	0	1	1	0
G	1	0	0	0	0	0	1

Figure 2. Connectivity matrix for entities A through G in Figure 1. In the matrix, a 1 indicates a connection, and a 0 shows no connection. The absence of a connection between A and D is shown by the 0 in both cells. A is also connected to E via a unidirectional connection: E does not connect to A.

styles, letters, money, emails, blog entries, gossip, love, or virtually anything else.

In analyzing the flows between nodes along links, we can characterize nodes as powerless, active, stationary, transient, or permanent. Links can be strong or weak, private or public, singular or multiple, unique or redundant, and parallel or intersecting. Flows between nodes can be copious or sparse, constant or intermittent, one-way or bidirectional, and meaningful or meaningless.

Using the simple concepts of nodes, ties, and flows, analysts can derive relational matrices and sociograms for anything in which connections exist. Network analysis also reveals substructures within networks — for example, cliques within a larger group. Some common network characterizations are as follows:

- centralized, decentralized (that is, multicentered), or distributed (centerless);
- hierarchical or horizontal;
- bounded or boundless;
- finite (with fixed limits on the number of nodes and ties);
- accessible or inaccessible;
- inclusive or exclusive;
- intensive (that is, few nodes linked by a multiplicity of dense, strong ties) or expansive (many nodes enabling reciprocal, multidirectional flows); or
- noninteractive (enabling only unidirectional flows).

Changing patterns in networks over time show how networks form, grow, and wane. By understanding such patterns in different network types, we can also derive the potential causes and consequences of change, and predict network evolution given different interventions.

Why Do Networked Computers Matter?

The advent of Internet communications has greatly increased SNA's popularity in recent years. Broadly speaking, the Internet has sparked curiosity (why and how are people connecting with others?), opportunity (we can track communication flows efficiently via computer logs), and commerce (what services will be compelling enough for people to pay for them?).

For researchers interested in the dynamics of human communication, it's fascinating that people are increasingly available for online communication, often with others they would never have encountered prior to the Internet's emergence. Connections are no longer as bound by propinquity; rather, people can seek out or "bump into" others from all over the globe. Further, the potential for network density increases with social software that emphasizes group communications (Tribe.net, for example, explicitly focuses on groups and communities as well as person-to-person contacts). In this regard, the drive for human-to-human communication has become more evident — at least initiating, if not maintaining it, as evidence shows that many "connections" through online sites are ephemeral.

Along with this surge in sociability among friends and strangers, computer-based networks have let researchers instrument and measure what communications are taking place in evolving, stable, and fluctuating social networks. As people increasingly interact online, analysts are interested in observing and characterizing when, where, and how connections are made, how long they are maintained and in what ways, and what function these connections serve. At the level of interpersonal communication and communities of interest and affiliation, researchers have examined social information flows for strong and weak ties in Internet communications[4] and online spaces,[5–7] how online socializing impacts people's psychological health,[8] and how online socializing affects face-to-face interactions in communities.[9] Considerable research is also exploring impression management — that is, how people represent themselves through constructed online identities.[10] At the societal level, Manuel Castells places computer-based communications at the center of

Resources on Social Networks, Social Networking, and Social-Network Analysis

Simply typing "social network" into a search engine will yield thousands of hits pointing to papers, books, journals, and bibliographies, as well as tools for analyzing and visualizing social networks. Here, we offer a more focused list of relevant readings and tools.

Readings and Resources

Wikipedia offers a good basic introduction to social networks and social-network analysis (SNA), with links to numerous resources (http://en.wikipedia.org/wiki/Social_networks).

Several academic bibliographies dedicated to social networks and SNA are available online. (See www.socialnetworks.org, for a good example.)

NetLab (www.chass.utoronto.ca/~wellman/netlab/) provides up-to-date information on social networks in the broadest sense, including pointers to many activities and resources that intersect with SNA. This is an excellent, scholarly resource.

Robert Hanneman from the University of California and Mark Riddle from the University of Colorado maintain a particularly good bibliography of SNA resources at http://faculty.ucr.edu/~hanneman/nettext/Bibliography.html.

Bruce Hopper and Patti Anklam also maintain a fairly good, annotated SNA bibliography at http://connectedness.blogspot.com/2005/05/annotated-bibliography-of-social.html.

Specifically business-related resources are often listed under the banner of organizational network analysis (ONA), which has been dubbed an x-ray into the inner workings of an organization. Rob Cross and colleagues have focused on ONA in their work (www.robcross.org/sna.htm).

Network-analysis modeling techniques can be quite complicated as researchers use considerable mathematical rigor and sophisticated statistical techniques to uncover patterns of nodes, links, and flows.

We recommend beginning with John Scott's *Social Network Analysis: A Handbook* (Sage Publications, 1991). Scott offers an excellent introduction to the area.

A good follow-up is Stanley Wasserman and Joseph Galaskiewizc's *Advances in Social Network Analysis* (Sage publications, 1994), as well as Wasserman and Katherine Faust's *Social Network Analysis* (Cambridge Univ. Press, 1994).

Darin Barney's *The Network Society* (Polity Press, 2004) offers an interesting introduction to the broader area of the Networked Society, inviting readers to consider the larger scale (global, for example) ramifications of sociotechnical networks.

Elsevier publishes an excellent journal called *Social Networks* (www.elsevier.com/wps/find/journaldescription.cws_home/505596/description). See also the online *Journal of Social Structure* (www.cmu.edu/joss/).

Tools

Social networking is an increasingly hot topic in software design. Sites and services are built around common interests, geographical proximity, professional communities and practices, and so on. Social networking sites such as Ryze, LinkedIn, Friendster, Orkut, MySpace, and Tribe are growing in popularity, although effective revenue generation remains elusive.

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changes in global socioeconomics.[11,12] He isn't alone in expressing concerns about rising inequities between those with access to technical – and therefore social – networks, and those with such access.

Social-network concepts have become increasingly interesting to companies such as Ryze, LinkedIn, MySpace, Tribe, Orkut, and Friendster, which have launched networking sites in the past few years, although no particularly lucrative business model has emerged. At the inter- and intraorganizational levels, analysts have used SNA to map the ways in which people communicate and cooperate – that is, to identify knowledge flows: Who do people seek information and knowledge from? Who do they share their information and knowledge with? As applied to business, SNA is often about revealing the informal communication networks that exist within organizations – how information actually flows around and between the formal procedures and relationships mapped to organizational hierarchy charts. Several consultancy firms are offering services based on SNA, promising optimization of information flow as a way to improve efficiency, reduce costs, and improve productivity. Within the research context, understanding how these informal networks flow within and among organizations has even given rise to a separate area of study, called organizational network analysis (ONA).[13,14]

Articles in this Issue

All three theme articles take up social networks and social networking in terms of relationships among individuals (rather than at the organizational, community, or societal level). In addition, all share our own penchant for sociotechnical design intervention – that is, all are concerned with using SNA to drive innovations that help people use communication technologies to understand and manage their social networks more effectively.

Danyel Fisher's "Using Egocentric Networks to

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Mobile social software (MoSoSo) services and applications are increasingly popular. Similarly, building and maintaining social networks by sharing digital media is becoming more common, both online (Flickr's photo-sharing site, for example; www.flickr.com) and offline (Fuji Xerox's interactive bulletin boards, the CollaboPosters; see www.designingassociates.com/displays). Undoubtedly, the future will bring new visions for such sites and services.

Various tools have also emerged for visualizing explicit and tacit social networks and carrying out SNA. We can apply such tools and metrics at the level of individuals, organizations, and industries to analyze computer networks (to optimize topologies, and so on) and information systems (to offer representations of link structures, for example). These tools reveal densely or sparsely connected clusters, which can be mapped to "affiliative groups" or communities of practice to reveal people who are connectors and boundary spanners between groups.

Tools are designed for different areas and levels of investigation – for example, some are better suited for social-science research and others for business analysis. They also differ in the level of mathematical understanding they assume, and in their ability to deal with large data sets. As with all forms of data analysis, selecting the "right" tool depends on the questions posed, desired output, specifics of the data sets to be analyzed, and the analysts' interest in manipulating the underlying parameters.

Orgnet.com's InFlow 3.0 is frequently used in business contexts. The site also includes a good range of articles on SNA as well as product information on InFLow, which the company describes as "a social network mapping and measurement tool."

Other examples of SNA software include NetMiner (www.netminer.com/NetMiner/home_01.jsp), SociometryPro (www.sociometry.ru/eng/index.php), Pajek (see http://vlado.fmf.uni-lj.si/pub/neworks/pajek/), and UCINET (see www.analytictech.com/ucinet_5_description.htm).

We also recommend checking the International Network for Social Network Analysis (www.insna.org/INSNA/soft_inf.html) for more pointers to SNA tools and techniques.

Understand Communication" stays closest to the current characterizations of social networking through online communication. Focusing on the networked "ego" of the sophisticated email user, he presents two systems: Soylent looks at interaction patterns in email, and Roles applies SNA to messages and replies within Usenet. Both projects examine connections that are explicit and volitional – connections are based on conscious decisions to communicate, as opposed to, say, bumping into someone serendipitously in a hallway – with no assumption that links are bidirectional. Soylent presents sociograms as end-user visualizations of connections between individuals who've been coaddressed on email messages. Fisher describes core patterns that emerge from such connections. The Roles project applies SNA to public Usenet group communications to identify individuals' roles as well as point toward interaction patterns between individuals.

In "Social Networks as Health Feedback Displays," Margaret Morris also focuses on individuals, concentrating on self-perception and mental well-being. Her work at Intel takes a proactive approach to health by using social-networking and pervasive computing technologies to help reduce feelings of social isolation and depression in elderly individuals. Building on cognitive behavioral ideas and notions of mindfulness, Morris and colleagues use network displays to provide a form of social biofeedback. They use sensor data (measuring phone calls and visits) to derive public displays of social interactions with relations and friends, which they introduced into select elders' homes. This approach shows the persuasive power of mobilizing concepts such as social networks: as people see their social interactions illustrated in these feedback displays, their feelings of social isolation are subtly and gently refuted.

Finally, Quentin Jones and Sukeshini A. Grandhi's "P3 Systems: Putting the Place Back into Social Networks" takes us furthest from current discussions of social networking. Although very much part of early SNA work, geographical space, location, and architectural space are often forgotten in discussions of abstract "connections" via communication technologies. This article brings together physical place, mobile technologies, and social networks in what the authors call the P3 framework, which is intended to help designers consider what geographic context cues are appropriate for specific social interactions. In their framework, Jones and Grandhi distinguish between people- and place-centered techniques for communication or location-aware community systems. As we see an increase in cellular technologies that promise perpetual availability, it seems there will also be an increase in tools and applications for social

networking via these devices. Examples of such mobile social software (MoSoSo) services include Dodgeball (www.dodgeball.com), which connects people to their friends on the basis of physical proximity, and Morca (www.common.net), which helps people discover common interests from each other's profiles, indexed by their email addresses. Jones and Grandhi's framework begins to address the complexities inherent in making judgments about our availability by bringing into focus the fact that desire for contact is moderated by who is contacting us and where we are at the time.

Central to SNA is the interplay between the activities of nodes and the dynamics of the networks they're part of. The Internet has made us aware of people's desires and abilities to network socially beyond the confines of geographical proximity.

The articles in this special issue attempt to honor the actions of the nodes (the individuals) while keeping in mind the bigger picture of collective behavioral patterns. Although the tools described here are all intended for individuals, each article highlights how new technologies and technical competencies will further push our understanding of human social-networking drives and desires. Specifically, socially adaptive location-aware technologies, large-screen displays, and visualization methods for quickly representing group dynamics and socio- (rather than bio-) feedback will surely highlight even more about how people establish, manage, and maintain their social networks in mediated and face-to-face communication situations — and, for that matter, manage their identities and relationships as there are more and more ways to connect and "be connected to."

Although we can't do full justice to the theme topic in terms of sociological analysis, communication-tool development, personal experience, or business analysis and applications, we hope this special issue proves provocative.

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