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# **Networks at Harvard University Sociology**

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Without Abstract

# Synonyms

Analysis of social relations; Social interaction; Social network history

# Glossary

# Blockmodel :

A data-partitioning technique to classify actors on the basis of their social ties to others

# Vacancy Chain :

A mobility process wherein one vacates a position (e.g., a job) and moves to a new one; meanwhile the newly vacant position is then filled by another

# Network Sampling :

Drawing a sample of individuals from a connected population of individuals presents unique challenges

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#### Networks

- Mapping Online Social Media Networks
- Network Analysis in Helping Professions
- Social Network Analysis in a Digital Age
- Sources of Network Data

#### **Network Sampling**

► Sampling Effects in Social Network Analysis

# Networks at Harvard University Sociology

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#### Synonyms

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- **Blockmodel** A data-partitioning technique to classify actors on the basis of their social ties to others
- Vacancy Chain A mobility process wherein one vacates a position (e.g., a job) and moves to a new one; meanwhile the newly vacant position is then filled by another
- **Network Sampling** Drawing a sample of individuals from a connected population of individuals presents unique challenges
- **Social Inequality** A primary area of sociological investigation; for network scholars, social connectedness plays a role in the production of unequal social status between individuals

#### Definition

The purpose of this entry is to describe some of the actors and circumstances that led to the Harvard University Department of Social Relations in the 1960s – and then the Department of Sociology in the 1970s - emerging as a critical site for research on social network analysis. This entry differs in some respects from prior historical efforts. While existing accounts have elaborated on highly influential actors and events, a network perspective itself suggests that all actors and events contribute to the production of knowledge in meaningful ways. In order to be encyclopedic, our aim is to systematically elaborate on the network research of any faculty member or graduate student affiliated with the department during the decades specified above.

# Introduction and Historical Background

As both Freeman (2004) and Scott (2000) discuss in their thorough histories of social networks, important sociometric roots of social network research can be traced to working groups at Harvard during the 1930s and 1940s. Strands of this work were subsequently taken

up by George Homans during the succeeding decades. The emergence of a strongly structural and relational turn towards social networks at Harvard during the 1960s and 1970s was notable for its concentration of transformative ideas (Freeman 2004; Pachucki and Breiger 2010). During this period, new thinking about the centrality of relationships to understanding social processes produced a sustained burst of activity in the department.

As background for this entry, we consulted a number of individuals who were active in the department during this period (see acknowledgments). Scholars are largely in agreement that one of the key catalysts in the emergence and growth of network thinking as a systematic enterprise that moved beyond small-group studies occurred in 1965 when Harrison White taught "Social Relations 10," an introductory college lecture course. As Barry Wellman relates, "Harrison created huge buzz in the department, and swept me along with it." Claude Fischer explained that while some scholars worked on egocentric networks (one of his interests), others pursued more complex mathematical algorithms. According to Fischer, "I never sought out White during grad school, but you got a sense from hallway conversations and the second-floor cafeteria that 'social networks' was in the air." Paul Burstein explains that "What got me interested [in networks] was the buzz about Harrison White, the awe surrounding the notes for his introductory sociology course, which were being passed around among grad students in mimeographed form, and the fact that very smart students seemed to be working with him." The ideas explored in the course and the role it played in shaping graduate student interest are explored in detail in a recent issue of Sociologica (Santoro 2008).

A unique aspect of social organization that shaped network research at Harvard is that in the early 1970s the Department of Social Relations for Interdisciplinary Social Science Studies (which had originally been comprised of discrete departments before World War II) went through an administrative re-organization and split into the departments of Sociology, Social Psychology, Clinical Psychology, and Social Anthropology [see Homans 1984]. As such, network and small-group dynamics research was not confined strictly to the Department of Sociology, but rather benefitted from some degree of overlap with scholars in related disciplines, examples of whom included Stanley Wasserman (graduate student in the Department of Statistics) and Robert Freed Bales (faculty in the Department of Social Relations). With this said, for space reasons our focus in this entry is chiefly upon the scholarship that emerged from those individuals affiliated with Sociology.

#### **Conceptual Developments**

In order to describe the shape of network scholarship at Harvard Sociology during this period, we review contributions from alumni whose work relies upon a social network perspective or method. We relied primarily on Thomson Reuters Web of Science(R) and the Library of Congress as research tools and err on the side of inclusion. As such, we do not prioritize research from faculty above that from graduate students or distinguish between persons who published one manuscript above those who produced ten. We mainly focus on research that directly emerged from efforts in the 1960s and 1970s – though we also discuss some work published after the 1970s in situations where the authors in question began their graduate training towards the end of the 1970s or developed network interests after their graduate careers. As one example, Paul DiMaggio recounts, "The [network] ideas took a while to germinate... it wasn't until I got to Yale and spent time with Scott Boorman and worked with Frank Romo that I kind of figured out what Harrison et al. had been talking about and I began doing work on networks."

This broad perspective highlights that while White's contributions clearly stand out (Freeman 2004; Santoro 2008), a variety of actors and circumstances interacted to shape the contours of the field we know today. In what follows, we focus on five key network themes that emerged from members of the department during this era: (1) connections between social roles and relations discerned using new analytic methods such as blockmodels, (2) micro-/macro-linkages between individual action and group-level social inequality, (3) urban networks and neighborhoods, (4) interorganizational and community networks, and (5) network measures of social structure. Notably, many of these concepts are still highly relevant to modern network analysis and contribute to their development today. For coherence, we present ideas thematically rather than chronologically.

#### **Blockmodels, Roles, and Relations**

One advance in network thinking from the Harvard department during this period was the development of the CONCOR algorithm, and to a lesser extent, the BLOCKER algorithm. These programs would form the basis for blockmodeling, an analytic method that allows for the classification of actors based upon patterns of ties to others. White et al. (1976) showed that this partitioning technique could identify role structures using social ties among business managers and, separately, novitiates in the canonical Frank Sampson monastery data. A more detailed treatment of the algebraic properties of roles in sociometric structure is offered by Boorman and White (1976), who mathematically compare role structures to develop more general theory. An alternative take on the mathematical foundations of this work was introduced by Winship (1988) who - in a document written in 1974 but not published until more than a decade later - outlines a theory of roles that not only allows researchers to identify individuals who are in the same role in the same population, but also individuals who are in similar roles in different populations.

Blockmodeling has become useful for understanding a range of phenomena, including structure in co-citation patterns of scientific literature. Most sociologists of science who study networks tend to aggregate the scientists by criteria extrinsic to their social interaction (e.g., career attributes). In contrast, Breiger (1976) documents what the structure of a scientific "field" looks like when scientists are instead aggregated so as to reveal a coherent

pattern across the multiple networks they comprise. Mullins and colleagues use this approach to examine various kinds of social ties (collegial, awareness, and teacher-student) between scientists linked to highly cited science papers (Mullins et al. 1977). The authors find that the application of blockmodeling to co-citations enables the identification of latent scientific specialties. Another novel use of blockmodeling was provided by Breiger and Ennis (1979), who examine the network structure of personality types in small groups. By combining blockmodel analysis with a model of generalized group member types (namely, Robert Freed Bales' SYMLOG approach), their work represents an important early foray into the intersection of personality and social role.

While blockmodeling provided an early set of tools for understanding social structure, other mathematical approaches are equally noteworthy. Though Carley did not graduate from Harvard until 1984, she began her graduate work in the late 1970s and would go on to be a central figure at the intersection of social network analysis, cognitive science, and computer science. Her earlier work focused on the development of cognitively based models of social behavior (1986) while later research turned towards the relative impact of various communication channels on the diffusion of information within science.

# Microlevel Interactions and Macro-level Social Inequality

Harvard researchers have long shown how microlevel processes such as person-to-person interactions can be related to higher-level inequalities. To this day, "The Strength of Weak Ties" (Granovetter 1973) is one of sociology's mostcited papers. Ironically, however - while this work continues to powerfully influence contemporary research on tie strength, diffusion, and intergroup cohesion - Granovetter is less often credited for an even greater theoretical contribution: illustrating the utility of the network approach as a means for linking "micro" and "macro" levels of social analysis. For Granovetter, tie strength is not only an important concept in its own right. Rather, the fact that certain micro-level configurations are very unlikely to occur empirically (in particular, the "forbidden triad," where A is strongly linked with B and B is strongly linked with C but A and C are not themselves linked) has a very important implication for macrolevel network structure: no strong tie is a bridge. In other words, Granovetter demonstrated that a very simple empirical regularity – so simple it involves only three people – has far-reaching consequences for broader social structures and intergroup relations.

This theme of micro- and macro-linkages emerges in a number of papers published during that time period, by Granovetter as well as others. In another notable paper, Granovetter (1978) develops "threshold" models of collective behavior, i.e., models where the choice an actor makes depends on the quantity or proportion of other actors who also make that decision. Rather than assuming a simple relation between individual dispositions and aggregate outcomes, he focuses on the distribution of preferences within the interacting group and demonstrates that even groups with very similar average preferences may generate strikingly different (and seemingly paradoxical) collective results. Similarly, in an analysis of hierarchy and dominance relations among chickens, Chase (1980) develops a model of how cumulative patterns of interactions produce group social structures - structures that cannot simply be explained by differences in individual characteristics among group members. In yet another empirical context, Laumann and Marsden (1982) provide a theoretical groundwork for the microstructural analysis of interorganizational systems. In particular, they posit that where a global structure falls along a continuum - of autonomous actors approximately equal in power, on one hand, to a highly centralized system, on the other – has specifiable consequences for the types of microlevel patterns (i.e., dyad and triad censuses) we should expect to find in the data.

Finally, it is worth noting that the theme of using social networks to link micro- and macro-levels of analysis persists in contemporary collaborations between current Harvard faculty and Harvard alumni of the 1970s. DiMaggio (PhD, 1979) and Garip (current faculty), drawing explicitly on Granovetter's (1978) threshold model, show how system-level social inequality can result from individual choice under varying structural conditions (DiMaggio and Garip 2011). As another example, a collaboration between a 1970s graduate and faculty member (Breiger, PhD, 1975) and then-student in the department (Pachucki; PhD, 2010) provoked a critical analysis of culture and social network analytic approaches (Pachucki and Breiger 2010).

#### **Urban Networks and Neighborhoods**

The idea that social processes in urban settings would benefit from a network perspective was well-understood by Charles Tilly, whose earlycareer work on the Vendée in late eighteenth century France told a story of interconnected collective action in which variations in urbanization affected responses to the revolution (Tilly 1964). Tilly would bring this interest to his work as a junior faculty member, and a number of students interested in urbanity and neighborhood interactions would further enrich this area. In a study of referral networks of abortion provision, Lee (1969) interviews women to learn about the social context of information flow, including the length of successful referral paths, as well as how, and from whom, a successful path was completed. Given the then-relative invisibility of information about abortion available to seekers, Lee's study highlights how information flows in hardto-reach networks, and how information more frequently passes through acquaintances rather than through more formal channels. This latter notion - that acquaintanceship could be more useful in certain circumstances than direct ties was also a key finding in Granovetter's work on job-seeking, and his illustration of the importance of weak ties for community organization (1973).

Laumann et al. (1978) similarly advocate the utility of conceiving of community structure as an aggregate network of interorganizational relations (in contrast with traditional approaches to community in American sociology, which tended to take individual persons as the focal unit of analysis). Shifting attention to intimate networks in urban/neighborhood settings, Wellman (1979) finds that East York residents purposively organize their relations with intimates into differentiated networks rather than grouping people on the basis of shared solidarities. Ginsberg (1975), meanwhile, compares the conjugal role relationships of Tel Aviv neighborhoods with close-knit networks to those with loose-knit networks and finds significant differences in the degree of joint leisure activities between the two. In his assessment of respondent accuracy among urban men, Laumann (1969) also notes that reciprocity of friendship choice is related to frequency of contact, closeness, and spatial proximity and finds some support for the hypothesis that reciprocity of friendship is associated with greater homogeneity of attitudes between the pair. Feagin (1970) provides an important corrective to earlier studies of urban friendship patterns, focusing on trends in friendship among a sample of African-American families in the area he describes as the "Roxbury ghetto area." The author finds, contra prevailing stereotypes of the day, that while respondents were involved in smaller friendship networks than whites, residents were also not as isolated as prior research had assumed.

The topic of interpersonal networks and civic life is a recurrent theme in a pair of books by Claude Fischer (1977, 1982a). In the first, Fischer and colleagues (1977) examine friendship ties in the 1965–1966 Detroit Area Study to understand how one's multiple network relations and network density affect friendships, finding that close and stable friendship ties are not inconsistent with modern urban life. Subsequently, Fischer (1982a) uses the 1977–1978 Northern California Community Study to examine how urban life affects one's personal networks (and vice versa) as well as how urbanity shapes psychological well-being, social isolation, and beliefs.

#### Interorganization and Community Networks

Scholars in the Harvard department devoted considerable effort to elaborating upon relationships between individuals within communities and organizations. For instance, Mullins (1968) analyzes scientific community membership,

status position, and communicative ties among biologists to demonstrate how cultural aspects – how the scientists describe their orientation to research - shape their informal communication networks. For his part, Sheingold (1973) focuses on research in political communities and advocates for a research agenda on voting that includes analysis of social networks to understand the dynamics of partisan alignment. Burstein's (1976) research on Israeli voting patterns took up Sheingold's challenge and showed how the influence of social ties to political parties matters more to one's to party choice than social class or ethnicity, and that the latter background characteristics shape party choice through network ties.

Other research focuses on centrality and power in interorganizational systems. Useem (1979), for instance, shows that the capitalist class is differentiated along an axis of inner group centrality. Importantly, inner group members are substantially more likely than other members of the business elite to be involved directly in the governance of a range of institutions suggesting they may be an important source of political leadership capable of promoting the general interests of the capitalist class. Shifting attention to organizations themselves rather than individuals, Bonacich and Roy's 1986 analysis of interlocking directorates among American railroads reveals that a firm's preeminence among a cluster of related firms is more closely related to interorganizational power than is overall centrality. In other words, the relationship between structural variables (like centrality) and power relationship variables (like interorganizational power) is contingent rather than deterministic. In an important methodological contribution, Laumann and Marsden (1982) argue that network analyses of interorganizational relations should begin by examining how relations are organized at the local (i.e., microstructural) level, lest broader patterns in overall network structure be misinterpreted. Granovetter, also, in his early contribution to network sampling (1976), proposes the utility of this approach to community studies, hierarchical structures, and interorganizational networks in particular.

A small but notable strand of scholarship on vacancy chains also emerged during this period of rapid growth. Briefly, those who study chains prioritize the positions (e.g., a job, a house) entered, occupied, and vacated and the possibilities for movement, rather than the actual individuals associated with those positions. Harrison White's book Chains of Opportunity (1970) offered a theory of how the interlocking set of opportunities individuals have for advancement in positions within jobs affects employment prospects. White and others studying chains commonly rely upon Markov models, in which the probability of moving between discrete states can be estimated. The difficulties in causal inference using chain data are myriad but as Erickson (1979) suggests, can be tractable with careful analysis. She compares biases associated with four types of data - snowball chains, small world chains, natural chains sampled from an endpoint, and natural chains where position is unknown.

#### **Measurement of Social Structure**

A final theme we identified – the measurement of social structure – has been an evolving and integral part of the network enterprise, particularly given that network analysts' relational conception of "social structure" has tended to differ from that of mainstream sociology. The blockmodel itself (and accompanying conceptual developments, e.g., Winship's (1988) "calculus of roles") was a revolutionary method for documenting patterns of relations and identifying social positions. However, blockmodeling was not the only methodological advance that emerged from this time period.

To begin with, Phillip Bonacich's contributions to the measurement of centrality are particularly noteworthy. Prevailing theory of the time assumed a positive relationship between an organization's structural centrality and its relational power. In contrast, Bonacich introduced a novel concept: that one's status is a function of the status of those to whom one is connected (Bonacich 1972). Not only did this contribution pave the way for further measures related to latent class analysis as well as analysis of dominance, it also parallels Breiger's key paper on the interpenetration of networks of persons and networks of the groups that they comprise or the "duality of persons and groups" (1974). Together, these advances broadened the horizon of network analysis to encompass both conventional "social relations" networks as well as the structure or pattern of overlapping group memberships – an "essential sociological phenomenon" (Bonacich 1972:184) that continues to be thriving area of research and methodological development today.

Exploring a topic of perennial interest to network scholars (given the preponderance of studies of friendship networks), Dunphy (1963) studies friendship norms in groups of urban adolescents to provide a conceptual model for how single-gender cliques develop into multi-gender cliques in later adolescence. His focus on how crowds and cliques develop suggests that clique leaders and crowd leaders can have distinct roles at different points in adolescent development. Rodney Stark and William Bainbridge, for their parts, examine how religious beliefs and practices shape personal friendships, as well as how interpersonal relationships shape recruitment and retention within religious sects (Stark and Bainbridge 1980). Fischer (1982b) delves deeply into meanings of friendship using a multi-pass series of name generators in a sample of northern Californians. He finds that "friend" is more a designation of sociability than intimacy, the latter being more strongly associated with "close" ties results that are particularly interesting in light of the formalization of "friendship" today on social media sites such as Facebook.

Another strand of research is related to the development of measurement tools for assessing trust and cooperation (or mistrust and conflict) in small groups. In research involving reciprocity norms, Leifer (1988) provides important insight into the importance of interaction in roleclaiming under conditions of uncertainty. Leifer explains that the reciprocity norm is not the best way to explain actions when roles are unclear - a stabilizing balance of interactions until role clarity emerges instead offers more insight. Leifer (1990) also explores how network enactment (i.e., the timing of reciprocity) is shaped and constrained by network size and other properties. The central problem Leifer wrestles with is that while fairness norms are usually considered at the dyadic level (for instance, between person A and person B), once one begins examining a larger group of people, we observe that all of their fairness norms are interdependent. He proposes a computational solution to the question of how to ensure fairness given such interdependencies, though finds that fair enactment becomes progressively more complicated in larger or denser networks. There are clear parallels between ongoing themes in network research and themes in the early work of Phillip Bonacich (see Recommended Reading) which faults previous experimental work precisely for treating players as atomized, self-interested units (a critique undergirding the network approach) and consequently ignoring the myriad mechanisms that human groups develop to enable cooperation.

A last segment of research on measurement explores the topics of network sampling and respondent accuracy. In "Network Sampling: Some First Steps," Granovetter (1976) describes a practical method for sampling average acquaintance volume from large populations hence providing a gateway for extending network research beyond the study of small groups to which it was typically confined. In the aptly named "Network Sampling in Practice: Some Second Steps," Erickson (1981) build on this foundation using two pretests of a network sampling instrument. They find that network sampling is indeed viable for certain settings, and offer practical guidance for future scholars conducting relational surveys. Laumann (1969), meanwhile, assesses the accuracy with which urban men are able to report the social attributes and characteristics of their friends. He finds that errors are less frequent for relatively objective characteristics such as age and occupation (as compared to political attitudes); and what errors

do occur tend to be in the direction of the respondent ascribing his own characteristics to the friend.)

#### **Future Directions**

Some of the scholars who were graduate students during the 1960s and 1970s would later transition to junior faculty positions at Harvard, including William Bainbridge, Ronald Breiger, Dexter Dunphy, Mark Granovetter, and David Stark. During the 1980s, thinkers with varying degrees of interest in networks would join the faculty, including James A. Davis (who had received his PhD from Harvard in 1955), John F. Padgett (PhD, U. Mich), and Peter Marsden (PhD, U. Chicago). Chris Winship (PhD, Harvard) and Jason Kaufman (PhD, Princeton) joined the faculty in the 1990s, and since 2000, Joel Podolny (PhD, Harvard), David Gibson (PhD, Columbia), Nicholas A. Christakis (PhD, U. Penn), Filiz Garip (PhD, Princeton), Jason Beckfield (PhD, Indiana U.), and Bart Bonikowski (PhD, Princeton) have also joined. Current trends in network scholarship among Harvard faculty and alumni include a shift towards the analysis of "big data" in understanding taste preferences using online social network sites; examination of the myriad impacts of social networks on health; engagement with the ongoing development of network methods; exploration of the network structure of IGOs; and the influence of social capital on migration (see Recommended Reading).

Harrison White's imprint during his time at Harvard – both during this period of growth and subsequent intellectual waves – is quite notable. As Joel Levine and Kathleen Carley (1997) related at a career retrospective in honor of White, "Harrison assembled the most enjoyable, intellectually diverse, and most productive work groups I've ever seen. The work was abetted by the simultaneous birth of cheap computing, by late nights, and by the central figure, Harrison, and something happened. To understand what Harrison did as the central figure there is a good analogy in a famous observation of Thomas Jefferson's. Jefferson applauded the culture of the rural farmer as compared to the corruption of the urban dweller. But the reason for this, Jefferson argued, was that the farmer succeeded by beating nature whereas the city dweller succeeded by beating other men. In this group that Harrison attracted, we succeeded by beating nature."

Simultaneously, we observe that White's contributions - while clearly quite important are also part of a broader context of diverse scholarship that emerged from scholars affiliated with the department. It is an obvious shortcoming of this entry that space constraints prevent us from more completely exploring the intellectual contributions of any one person in this remarkable group, or pursuing more microscopically the mix of faculty and peer influences that shaped each scholar's attraction to network thinking. According to Wellman [see acknowledgments], graduate student peers like Nick Mullins, Mike Weinstein, and Brian Sherman shaped his thinking alongside White and Tilly. On the other hand, for DiMaggio [see acknowledgements], White and Breiger were formative influences, but to a lesser extent Granovetter, Winship, and David Stark were as well. Finally, we concede that without a more comprehensive exploration of the intellectual biographies of every alumnus, we have likely missed research that those scholars may themselves consider more noteworthy than that discussed here. And so we concede that by necessity this is only one dimension of a rich history that others have written about, and that hopefully others will build upon.

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#### **Cross-References**

- ► Centrality Measures
- Distance and Similarity Measures
- ► Economic Network Analysis Based on Infection Models
- ► Futures of Social Networks: Where Are Trends Heading?
- ▶ History of Networks at Columbia University
- Interlocking Directorate Networks
- Inter-Organizational Networks
- ► Networks in Social Psychology, Beginning with Kurt Lewin
- Origins of Social Network Analysis
- Path-Based and Whole-Network Measures

Questionnaires for Measuring Social Network Contacts

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► Stability and Evolution of Scientific Networks

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# **Network Science**

- Networks in Geography
- ► Web Science

# **Networks Dynamics Analysis**

Semantic Social Networks Analysis

## **Network Similarity**

Similarity Metrics on Social Networks

### **Networks in Art**

► Arts and Humanities, Complex Network Analysis of

# **Networks in Culture**

► Arts and Humanities, Complex Network Analysis of

# **Networks in Geography**

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#### Synonyms

Actor-network theory; Network models; Network science; Small-world networks; Spatial networks

#### Glossary

- **Tobler's First Law of Geography** Everything is related to everything else, but near things are more related than distant things
- **Nework Science** The study of network representations of physical, biological, and social phenomena leading to predictive models of these phenomena
- **Spatial Network** Any network in which the nodes are located in a space equipped with a metric
- **Small-World Network** A special type of network in which most nodes are not neighbors of one another, but they can be reached from every other by a small number of hops or steps
- Actor–Network Theory (ANT) An approach to social theory and research, originating in the field of science studies, which treats objects as part of social networks

### Definition

Tobler's first law of geography has generalized a fundamental fact in geographic studies: everything is related to everything else, but near things are more related than distant things (Tobler 1970). Having any understanding of "how everything is related to everything else"