Social Network Theory

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Research history and key concepts

A diverse array of research traditions has shaped the current state of social network theory. As Scott (1991) summarizes, there are three lines of research that contributed to the theory's early development: the sociometric analysis tradition, which relies on graph theory methods from mathematics; the interpersonal relations tradition, which focuses on the formation of *cliques* among a group of individuals; and an anthropology tradition that explores the structure of community relations in less developed societies.

These research traditions did not evolve into a coherent theoretical framework until the 1960s. A number of sociologists significantly advanced the social network approach by synthesizing previous theoretical traditions and extending them to understand both formal and informal social relations. For example, the sociometric view of social networks was elaborated, emphasizing structural properties, such as the relative location of individual nodes in the network. Researchers during this time also advanced social network techniques by proposing *block modeling* and *multidimensional scaling*. Block modeling considers the particular position of a node in a social network. This method enables researchers to identify nodes that have similar network positions, or what is called *structurally equivalent* nodes. The scaling technique, on the other hand, allows researchers to convert social relationships into sociometric *distance*, thereby mapping these relationships in a social space (Wasserman & Faust, 1994).

Three key network concepts that have organized research on network effects are centrality, cohesion, and structural equivalence. Freeman (1979) proposed three distinct measures to indicate structural centrality: degree, closeness, and betweenness. This seminal paper afforded a nuanced understanding of centrality, and it established a process through which new network measures were developed to have a raw form, a normalized form, and a network-level form. Freeman's (1979) paper also motivated subsequent research to assess how different forms of network centrality interact with the flow of information differently. For example, Borgatti's simulation study (2005) identified a typology of flow processes, and he showed that the values of different central positions depend on the characteristics of the process (e.g., gossip diffusion versus goods delivery).

Network cohesion measures the degree of interconnections among a group of nodes. This measure has long been useful to detect subgroups or cliques within the larger

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social network (Burt, 1987). In the context of media effects research, network cohesion serves as an important structural feature that moderates the influence of interpersonal networks. Friedkin's (1993) longitudinal study, among others, found that personal influence grows stronger within more cohesive social networks than less cohesive ones.

Finally, structural equivalence indicates two or more network positions that share a similar pattern of connections with the rest of the network. Actors that occupy structurally equivalent positions often have similar characteristics, such as social status or other individual traits. Because equivalent nodes are connected to a similar set of actors, they are more likely to receive similar information or social influence. In understanding the process of diffusion, Burt's (1987) study found that innovations were more likely to flow via structural equivalence than direct ties, suggesting equivalence influence may be a stronger predictor of behavioral adoption than cohesive influence. Burt (1999) further elaborated on these mechanisms to explain the role of *opinion leaders* in the media effects context. He argued that there were two different network mechanisms at play: a two-step flow process that consisted of opinion leaders spreading information to the group, and a contagion process via structural equivalence that generated adoption behaviors within the group.

The years since the 1990s have witnessed extensive applications of key network concepts in diverse research contexts, and the field has also constantly been updated with more refined network measures and analytic tools. In the arena of media effects research, the fundamental question is: How do social networks, including the quality and quantity of relational ties, the structural position of individual actors in a network, and the overall network properties (e.g., its density, centralization, and modularity) impact the flow of media messages and their effects on the audience? These effects include public opinion formation, marketing, uses and gratifications of media consumption, and behavior change due to prosocial campaigns.

Although communication research did not substantially shape the initial development of social network theory, there is an emerging trend of cross-pollination between social network theory and media effects research. In large part, this cross-pollination stems from the emergence of computer-mediated communication, which affords explicit social networks as well as the modes of communication that bind them. The following sections review three theoretical approaches that best represent the influence of social network theory.

Two-step flow of communication hypothesis

The two-step flow of communication hypothesis was first proposed by Lazarsfeld, Berelson and Gaudet in the book *The People's Choice* (1944). In their study of voting decisions, they found personal influence, which was largely derived from people's social contacts and friendship networks, significantly affected voting decisions. And this effect was even more pronounced among people who were less committed to their existing beliefs or who changed their minds during the course of a campaign. The hypothesis is called *two-step* because the mass media initially influence opinion leaders, individuals who are perceived as influential, who in turn influence their social contacts.

Building on its initial formulation, Katz (1957) reviewed a number of corroborating studies on this hypothesis and further elaborated on three important aspects of it. First, the magnitude of personal influence could be greater than that of mass media, as first identified in the 1940s voting study. Similar findings also emerged from subsequent cases, such as the Decatur Study, which examined individuals' fashion decision making (Katz & Lazarsfeld, 1955). Second, in terms of the flow of personal influence, opinion leaders are not always concentrated at certain social strata, nor does personal influence always flow from a higher social stratum to a lower one. On the contrary, studies have observed many cases of *local leadership* or *issue-specific leadership*. That is, leaders differ for different groups of people and leaders lead in some domains but not others. Finally, personal influence does not necessarily work in isolation from mass media. The voting study revealed that opinion leaders tended to be those who were more exposed to the mass media. And, depending on the specific context, personal influence can either reinforce or attenuate the effect of traditional mass media.

Central to the two-step flow of communication process is the concept of *opinion leaders*, a group of individuals influential in specific domains. Numerous studies have attempted to identify the key characteristics associated with being *influential* along three lines (Katz, 1957): *who one is*, the individual characteristics of the opinion leaders, such as personality traits, charisma, or demographic and socioeconomic backgrounds; *what one knows*, the characteristics pertaining to individuals' competence, such as their knowledge, expertise, or ability to provide information or guidance on particular issues; and *whom one knows*, the characteristics related to an individual's structural position in a network. In other words, individuals may become opinion leaders not only because they possess certain attributes but also because they occupy the right network positions that enable them to effectively spread information and exert personal influence. Centrality measures have been particularly useful for identifying leaders based on their network position.

As discussed, social network theory has proposed three types of network centrality measures to identify the advantageous position that opinion leaders usually occupy: degree, betweenness, and closeness (Freeman, 1979). Degree centrality measures the number of links to and from an individual in a network. Individuals with high degree centrality are more likely to become opinion leaders because more social ties can mean greater opportunities to receive as well as disseminate information (see Figure 1, black node). Betweenness centrality measures the frequency at which an individual node lies on the shortest path connecting other nodes in the network. Individuals high in betweenness centrality are more likely to serve as a *bridge* in the network—defined as a node that connects otherwise unconnected network clusters. Just like gatekeepers in a network, if individuals high in betweenness centrality oppose the dissemination of an idea, this piece of information may not be able to flow to other areas of the network. In Figure 1, the light gray node occupies this critical position. Finally, closeness centrality measures the average distance between an individual node and all other nodes in the network. Individuals with higher closeness centrality need relatively fewer steps to reach all other individuals in the network and thus can potentially move information faster. The ability to effectively reach other contacts in one's network makes individuals

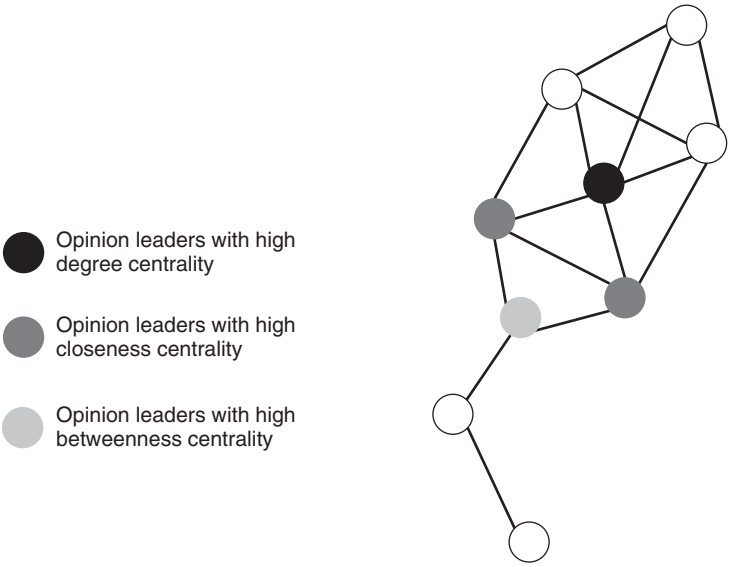

Figure 1 Network illustration of opinion leaders with high degree centrality, closeness centrality, and betweenness centrality. Source: Adapted from Everett's kite, in Brandes and Hildenbrand, 2014.

with high closeness centrality influential. In Figure 1, the dark gray nodes have high closeness centrality.

As one of the most applied theories in media effects research, the two-step flow of communication hypothesis has been rigorously tested in various empirical settings. The research on public opinion formation and agenda-setting, for instance, has studied how influential individuals, such as *early recognizers* of social issues, may mediate the public and the media agendas by identifying emerging issues in the media, diffusing them among public audiences, and ultimately affecting the media agenda (Brosius & Weimann, 1996). Research on health interventions has examined the dual influences of interpersonal networks and mass media. In Valente and Saba's (1998) study of a reproductive health communication campaign, they found both the mass media campaign and personal networks were associated with individuals' contraceptive adoption, but the impact of mass media was stronger for low threshold individuals, those whose personal networks were composed of few contraceptive users, than high threshold individuals, those whose networks contained a majority of users.

Although the two-step flow hypothesis has been validated in numerous studies, scholarship since the 1980s has pointed out that media influence may take multiple, recursive steps, and the overall process is more complex than a singular, one-directional flow. With the rapid change in today's media and communication environment, some scholars also argue that the role of opinion leaders is becoming less pivotal. Bennett and Manheim (2006), among others, have proposed that the traditional two-step flow of media messages has gradually transformed into a one-step flow process, where

mass media are becoming more fragmented and niche media increasingly engage in *narrowcasting*. Under this changed landscape, media messages may directly reach their audience and opinion leaders thus would play a less significant role than was previously theorized.

The theory of weak ties

The theory of weak ties, articulated in Granovetter's (1973) seminal piece "The Strength of Weak Ties," concerns the role of weak social ties in diffusing ideas and information. In his labor-market study, Granovetter observed that people more often found jobs through their weak social ties, as opposed to relying on their family or close friends. He measured tie strength through the frequency of contact, asking respondents how often they saw each contact around the time they acquired the piece of job information.

In addition to contact frequency, studies have proposed a combination of factors to indicate the strength of social ties, such as the duration of interaction, the amount of effort individuals invest in a relationship, the extent to which the social ties provide reciprocal utility (e.g., social support), and the level of intimacy exchanged in a relationship. Based on these criteria, weak ties are generally defined as social relations requiring little investment, and they are composed mostly of acquaintances or other loosely connected actors, as opposed to kin or close friends.

Why are weak ties more likely to channel novel information than strong ties? To explain the underlying mechanism of Granovetter's findings, it is necessary to return to the network concept of bridging, mentioned previously in the definition of betweenness centrality. Bridging ties are social connections that link two otherwise unconnected network clusters. In other words, bridging ties provide the only path between two disconnected clusters, such as Cluster A and Cluster B in Figure 2. Granovetter found weak ties were more likely to be bridging ties, because weak ties' peripheral position made them better able to reach outside information than strong ties. In Figure 2, imagine each network cluster represents a circle of close friends, as all the nodes in each cluster are connected to each other. In such highly interconnected circles, each person is likely to

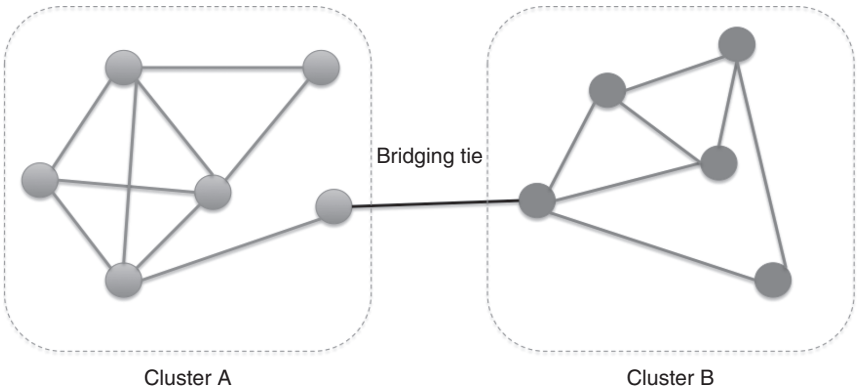

Figure 2 Bridging ties.

receive a similar set of information. The bridging tie (sitting between the two clusters), on the other hand, becomes the only opportunity for any nodes in Cluster A to access novel information from Cluster B.

Although strong ties often emerge from the center of a network, which gives them greater capacity to diffuse information and exert social influence, Granovetter's thesis highlights the bridging function of weak ties and their ability to spread novel, nonredundant information. The strength of weak ties, therefore, is not about the number of connections. Rather, it lies in weak ties' ability to reach a broader, and potentially more heterogeneous, set of information sources. In the process of job hunting, for example, the utility of strong ties diminishes, because they provide similar and potentially redundant information to individuals.

Granovetter's findings have led to a series of replication studies, such as in the context of general information seeking, organizational knowledge sharing, the diffusion of innovations, community building, and many more. In the area of media effects, studies have explored the role of weak discussion ties in promoting civic engagement. For example, de Zúñiga and Valenzuela (2011) examined the association between strong versus weak ties and individuals' online and offline civic engagement. Among factors such as discussion frequency and discussion network size, they found the frequency of weak-tie discussion was the strongest predictor of individuals' civic behaviors.

The emergence of new media and social networking sites has created an increase in online weak ties. Indeed, new media provide novel platforms through which individuals can connect with geographically distant others, and functions such as "add friends," "follow the post," "mention," and "retweet" have been theorized as forms of weak social ties. Some research has found evidence of online, mediated weak ties in maintaining individuals' bridging social capital, such as Ellison, Steinfield, and Lampe's (2007) study on college students' Facebook friends networks, whereas other scholars have argued that online connections may breed *slacktivism*, as they fail to nurture meaningful civic participation. The rise of new media platforms thus urges scholars to reconsider the definition, conceptual boundary, and new typologies of weak ties. It also encourages new research to examine the role of mediated weak ties in diffusing information and exerting social influence.

Diffusion of innovations

The diffusion of innovations occurs between individuals or organizations in a social system. The connection pattern between the actors who initiate, relay, and adopt innovations can be viewed as a social network, where network connections may take the form of friendship, advice, communication, or social support. The diffusion process is essentially a networked process. As innovations travel through an interconnected web of social connections, the structure and characteristics of this network can determine how widely and how soon the innovations get adopted (Valente, 1995).

In several editions of the book *Diffusion of Innovations*, Rogers (2010) formally introduced the model for diffusion and defined it as "the process in which an innovation

is communicated through certain channels over time among the members of a social system" (p. 5). Rice (2011) defined the process of diffusion in the context of media effects "as the process through which an innovation (an idea, product, technology, process, or service) spreads (more or less rapidly, in more or less the same form) through mass and digital media, and interpersonal and network communication, over time, through a social system, with a wide variety of consequences (positive and negative)" (p. 1).

The groundbreaking study in the field of diffusion was conducted by Ryan and Gross in 1943 while they were investigating the diffusion of hybrid corn seeds among farmers in Iowa (see Valente, 1995). The early network approach of diffusion studies looked at how opinion leader status, indicated by the number of times an individual was nominated as a network partner, was correlated with the time of adoption. Later there emerged a more structural approach, and this approach shifted the focus to examine how the overall network pattern influenced the adoption of innovations, such as network density, the presence of weak ties (Granovetter, 1973) or structurally equivalent positions (Burt, 1987), and so forth. Valente (1995) proposed a social network threshold model, and this model is particularly characterized by its system-level emphasis.

A large body of diffusion studies has focused on identifying the factors and forces that lead to the adoption of innovations among members of a certain population. These studies also aim to understand why some individuals or organizations adopt the innovation sooner while others take more time to accept the same idea or practice. Current scholarship has identified four main elements of the diffusion model (Rogers, 2010; Valente, 1995): the rate of adoption, which can be influenced by the perceived characteristics of the innovation and can be measured by mathematical models (Valente, 1995); the rate of adoption over time, which yields a cumulative S-shaped pattern; the various stages during the adoption process, which can be further classified as knowledge, persuasion, decision, implementation, and confirmation; and the modification of the innovation.

In general, the adoption process entails learning about a new product, getting more information about it, making a decision to adopt it or not, experimenting with it, and eventually confirming the use of the product. The pace of diffusion can be determined by certain characteristics of the innovation, which include its: relative advantage, compatibility, complexity, trialability, observability, cost, and radicalness. Less radical, less complex, and less expensive innovations, and innovations perceived as more advantageous, compatible, trialable, and observable, spread more rapidly.

The five adoption stages—knowledge, persuasion, decision, implementation, and confirmation—have long been useful for understanding media effects and behavioral change. Additional theories have further developed the adoption stages to evaluate media campaign effects. For example, the hierarchy of effects model proposed 12 steps leading to behavioral change, and it estimated that individuals usually proceed from one step to the next at a rate of 80% (Valente, 1995). The transtheoretical model proposed specific cognitive stages of change—precontemplation, contemplation, preparation, action, and maintenance—for quitting a behavior such as smoking (Prochaska, DiClemente, & Norcross, 1992). It should be noted that a homogenous model usually cannot capture the varying diffusion processes in different contexts.

Network models have been developed to model social influence processes with network weight matrices, such as relational, positional, and centrality measures, and the weights based on social distance.

Diffusion research peaked in the early 1960s, and it has been rekindled with the rapid emergence of newer and more advanced network models and technology. The application of diffusion theory spans a wide array of disciplines, such as marketing, economics, mathematics, sociology, anthropology, and epidemiology, among many others. In the area of media effects research, the main premise of the theory is that innovations enter into communities from external sources such as mass media or technological advancements, and then they spread via social networks and interpersonal communication.

Mass media play a critical role in initiating diffusion among opinion leaders and low threshold adopters, as these individuals are more likely to rely solely on media information to adopt an innovation (Figure 3). For opinion leaders or early adopters, their initial decision of adoption may be independent of their social network ties. Through processes such as the two-step flow, opinion leaders then spread the innovation to their adjacent social network partners. At this stage, the early majority and late majority may seek additional validating information to reduce uncertainty regarding the innovation, from both traditional mass media and online media platforms such as Facebook and Google. Toole, Cha, and González (2012) studied the spatiotemporal adoption of Twitter, a microblogging web application, while also considering the interplay between media and word of mouth. Media influences at later stages of adoption increased the Twitter user base twofold to fourfold. A study on news diffusion across various social media platforms analyzed over 386 million Web documents over a 1-month period in 2011. It found that, depending on issue domains, different types of media had varying

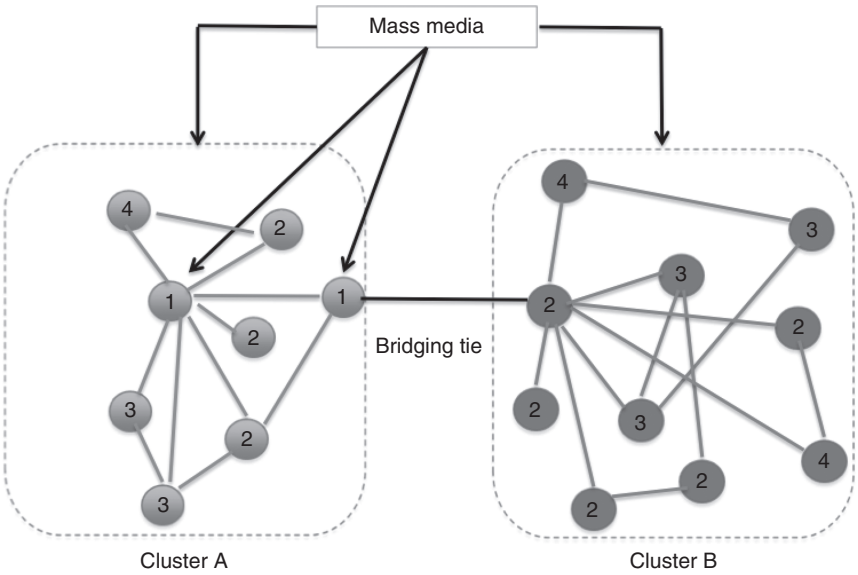

Figure 3 Two-step flow. 1: early adopter; 2: early majority; 3: late majority; 4: laggards.

degrees of influence. Specifically, social networking sites and blogs were most influential in politics and culture, news media in the arts and economics, social media in controversial topics such as protests, and single social platforms in entertainment (Kim, Newth, & Christen, 2013). Therefore, media can influence one's perception of innovations as well as one's adoption behaviors.

Key contributions and future directions

Social network theory and methods offer a distinct perspective on and set of tools with which to understand media effects, enabling consideration of how micro- and macrosocial structures mediate and moderate media effects. The theories of two-step flow and diffusion of innovations examine the paths by which mediated messages travel through social networks, and the concepts of opinion leadership and tie strength offer insights into critical variables that affect this flow. While each of the theories discussed here was developed in the twentieth century during the golden age of mass media technologies, their theoretical contributions endure as scholars continue to test and refine them in an era of social media and rapid evolution in media technologies. Three directions for current and future research are highlighted below.

First, new media technologies such as social networking sites, microblogging tools, and online recommendation systems offer intriguing opportunities for further application and extension of social network theory in the study of media effects. Current research in this area falls into two broad categories. One category investigates whether and how network-based media effects theories such as diffusion and the strength of weak ties operate differently in different forms of social, as opposed to mass, media. For example, research suggests that some of the traditional social network measures of opinion leadership discussed above may not be the best indicators of social influence on Twitter (Gruzd & Wellman, 2014). A second category of research capitalizes on the large amount of and novel types of data available through social media to rigorously test network-based media effects theories in ways not previously possible. For example, large corpuses of digital trace data that avoid potential self-report biases of survey data can be used to create randomized controlled experiments of the diffusion of consumer and political behavior on Facebook.

Second, media effects researchers have begun to extend social network theory and methods beyond classic social contagion processes to engage in what Ognyanova and Monge (2013) describe as a "relational reinterpretation" of numerous mass communication phenomena. Hyperlink networks, for example, in which the nodes are websites and the ties are the hyperlinks that connect them, may be analyzed to trace the diffusion of content between mainstream media and blogs, or to determine the extent to which prominent mainstream media versus bloggers wield influence in media and public agenda-setting. Semantic networks, in which the nodes are words and the ties are cooccurrences of those words in various media, may be mapped to identify patterns in how content is framed across different outlets over time. These network approaches offer promising new methods for research on core media effects theories.

Third, ongoing advances in the statistical approaches used in social network analysis promise continued improvement in the sophistication with which researchers are able to model how social structure shapes or is shaped by media effects. In particular, the development of models that allow for multiplex (multiple types of ties), multimode (multiple types of actors), and multilevel networks enables consideration of greater complexity in the study of diffusion and mediated social influence. These developments are particularly relevant in a new media environment in which actors may be both producers and consumers (potentially necessitating multiplex ties), and people may access content from many different types of sources and using many different types of media (requiring multiple modes and levels). In sum, communication research has never been more promising or relevant, and the theories introduced here offer insights into how to move communication research forward.

SEE ALSO: Agenda-Setting: Individual-Level Effects Versus Aggregate-Level Effects; Diffusion Theories: Logic and Role of Media; Diffusion Theories: Media as Innovation; Diffusion Theories: News Diffusion; Multistep Flow of Communication: Evolution of the Paradigm; Multistep Flow of Communication: Network Effects; Multistep Flow of Communication: Online Media and Social Navigation; Multistep Flow of Communication: Opinion Leadership and Personality Strength; Network Society: Networks, Media, and Effects; Social Networking

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