A Multitheoretical, Multilevel, Multidimensional Network Model of the

Media System: Production, Content, and Audiences

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Abstract

This article examines the network mechanisms which underlie major parts of the media system: the industry, the content, and the audience. It identifies key theoretical frameworks that can be used to explain the formation and dissolution of ties in each of those areas. The paper presents a relational reinterpretation of classic mass communication theories and advocates the use of a multitheoretical, multilevel, and multidimensional network approach to media studies research. The article discusses the network structures behind media production, output and consumption. We examine interorganizational ties (industry sector), semantic relations (content sector), and social bonds (audience sector). Key studies and theoretical mechanisms that bridge two or all three of those domains are reviewed.

Keywords: media studies, media effects, network analysis, network theory, agenda-setting, framing, diffusion, hyperlink analysis, semantic network

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The systematic study of social relationships and structures has a long tradition across disciplines including communication, media studies, sociology, social psychology, and anthropology (Freeman, 2004). Since the 1970s the volume of published network research in particular has grown exponentially, marking a gradual shift from individualist to relational scientific explanations (Borgatti & Foster, 2003). In the last decade, technological advances have contributed to a boom in academic studies of diverse networks (Watts, 2004). Information and communication technologies have enhanced networked forms of organization, bringing to light previously implicit social relations (Castells, 2005). Technological innovations have also provided scientists with the data collection tools and computational capacity needed to develop resource-intensive network-analytical techniques.

The rapid progress of network theories and methods prompted a wave of studies offering systematic overviews of network processes and their integration in existing theoretical frameworks from a variety of academic fields (Carrington, Scott, & Wasserman, 2005). Scholars have investigated the implications of a relational approach in the areas of organizational communication (Monge & Contractor, 2003), health (Valente, 2010), economics (Schweitzer et al., 2009), management (Borgatti & Foster, 2003), warfare (Arquilla & Ronfeldt, 2001), and Web science (Turow & Tsui, 2008), among others.

Building on that foundation, this article examines the mechanisms and frameworks explicating communication flows and relational ties in the context of media studies. Our premises are consistent with theories of mass communication examining media effects in the context of larger social structures (Ball-Rokeach, 1985). The framework explores the dynamic relationships between audience members and news organizations. Those ties of influence are seen as grounded in the capacity of media sources to produce content serving individual information and social goals (Ball-Rokeach, Rokeach, & Grube, 1984). In view of that, we adopt a broad definition of the *media system* that comprises media organizations, the content they produce, and its consumers. We identify the relevant nodes and links underlying those three

major components (see Figure 1). The media industry sector (or domain[1]), is characterized by links among news organizations. Media content is grounded in ties between key terms, concepts, frames and news stories. The third part of the media system, audiences, consists of connected news consumers. Although in principle the range of available media is very broad and may encompass film, music, games and more, for the sake of simplicity and clarity this work focuses specifically on news media.

The analysis begins with a discussion of the networks within each specific media domain, called *intra-sector networks*. These networks are comprised of nodes and links belonging to a single sector, such as media organizations linked by ownership patterns (industry sector, see Figure 1, [1-1]) or networks of news stories linked through semantic similarities (content sector, see Figure 1, [2-2]). Intra-sector structures can also be multiplex. That is to say, they may include more than one type of link within a single domain. One example of this is an industry network with both ownership and partnership ties (Arsenault & Castells, 2008a).

The article then explores the interactions that occur between sectors. We review *inter-sector networks* - structures that involve nodes from a focal domain, and additional nodes and/or relations from one or both of the other two domains. For instance media organizations could be connected through content-based ties, such as the hyperlinks between their websites (see Figure 1, [1-2]). Affiliation networks (see Figure 1, [1-3] [3-1]) which link individual news consumers (audience nodes) to their preferred news organizations (industry nodes) are also considered *inter-sector*. We further discuss the more complex patterns that emerge from interdependencies between different parts of the media system. Such structures may contain multiple different kinds of nodes (e.g. individuals and news organizations) and multiple kinds of relations (e.g. social and mediated). The former type of network is known as *multimodal* and the latter type is called *multiplex* (or multirelational). Inter-sector networks may also be *multidimensional* (Contractor, Monge, Leonardi, 2011). This term applies to networks that consist of both multiple kinds of nodes (multimodal) and multiple kinds of relations (multiplex).

This approach to the study of media facilitates an important shift in theoretical focus. The emphasis moves from the attributes of organizations, news stories, and consumers to the

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[1] Throughout this text we use the terms *sector* and *domain* interchangeably to refer to the three components of the media system: industry, content, and audience.

similarities, social relations, interactions, and flows of information and resources among them (Borgatti, Mehra, Brass, & Labianca, 2009). Research can thus investigate the structural determinants of social, economic and political processes, the network patterns of power and influence (Castells, 2009), as well as the impact of interpersonal ties on individual preferences and public opinion (Wasserman & Faust, 1994). This reframing of how media systems operate does not replace the examination of individual characteristics, such as political attitudes, gender, and socioeconomic status, nor does it dismiss the explanatory power of content attributes, such as news, entertainment, or opinion. Rather, it supplements and contextualizes these features by providing the web of friends, families, coworkers, neighbors, and other sources that supply the information, norms, values and motivations determining how people select and use various media.

As Castells (2009) points out, relational thinking becomes even more important in the context of a media industry moving to networked forms of content production, delivery, and consumption. We are currently seeing industry-wide trends towards consolidation, interorganizational collaborations, local and global partnerships (Arsenault & Castells, 2008b). Online formats and new technologies connect newsrooms and audience members (Cardoso, 2006), making content diffusion faster and easier to track through digital traces (Anderson, 2010). Professional and personal social ties affect individual news consumption and distribution habits (Boczkowski, 2010). News stories themselves are placed within networks of semantic relations (Diesner & Carley, 2005) and hyperlink connections (Turow & Tsui, 2008).

An early criticism of network research claimed that the field is overly descriptive: a combination of algorithms lacking a native theoretical framework (Kilduff & Tsai, 2003). More recently, scholars working in the area have argued that this claim is no longer true, suggesting that a rich network theory is now yielding new explanations in a variety of disciplines (Borgatti et al., 2009). Relational interpretations have been used to redefine key concepts, test existing theories, and develop new understanding about the structural causes and consequences of social phenomena (Marin & Wellman, 2010).

In its approach to theory, the present work draws on the multitheoretical, multilevel (MTML) analytical strategy put forward by Monge and Contractor (2003). Their proposed model incorporates a range of properties, from individual and dyadic, through more complex structural

patterns, to network-level measures. Studying changes over time as well as the analysis of separate co-evolving networks are also part of the MTML approach. Monge and Contractor further argue that explaining these complex multilevel mechanisms requires the use of multiple theoretical frameworks, some independent, others competing or complementary.

Accordingly, this article identifies a number of theoretical mechanisms explicating the formation, dissolution and consequence of links in the media system. The theories described in the following sections come from media studies, organizational communication, economics, web science, sociology and linguistics. Some of them (e.g., diffusion theories, communication infrastructure theory) are already framed in network terms. Others, like agenda-setting and framing, need to be adapted to a relational interpretation.

The model we propose here provides a framework organizing existing knowledge at the intersection of media studies and network science. Serving as a map of the field, it is intended to help readers think through the multiple theoretical domains, the various levels of analysis, and diverse types of linkages involved in a relational perspective on the media system. Similarly to the more comprehensive work of Monge and Contractor (2003) in the area of organizations, this study identifies layered explanations of network dynamics in mass communication. It makes explicit the structures that have remained hidden in previous works exploring the increasingly networked news media of today. In that effort, the present study aims to synthesize the core dynamics underlying a number of important works like those of Castells (2009) and McChesney (2004). As the field of mass communication undergoes a paradigm shift, adopting a relational perspective will enable scholars to integrate disparate theories, bridge separate levels, and explore multidimensional linkages, thus filling the gaps in the existing literature.

The value of multilevel network interpretations is also evident in the context of media theories explicitly employing relational explanations. The *two-step flow of communication* (Katz & Lazarsfeld, 1955; Lazarsfeld, Berelson, & Gaudet, 1944) is one classic example, as it brings together media effects and social structures. Another case in point at the macro level of analysis comes from the *media system dependency* theory (Ball-Rokeach, 1985) in its examination of power relations within and across social systems.

Monge & Contractor's (2003) work outlining their MTML approach identifies seven families of social theories that can be applied to communication networks. It explores the

implications of using those theories at multiple levels, offering insights that no single framework by itself could provide. Adopting this strategy, we examine the multiplicity of theories across levels of analysis. Important to note, it is not our intention to claim that all of those theoretical frameworks need to be fused together. We do not suggest that a single empirical analysis should incorporate and test the full range of mechanisms presented here. Instead, throughout this article we identify various combinations of theoretical perspectives, analytical tools, and network definitions that could, when applied together, advance our understanding of the media system. The judicious selection and integration of theories at multiple levels and alternative types of linkages should prevent a misuse of the MTML model sometimes referred to as an eclectic approach to theorizing.

The following sections of the paper provide a systematic overview of relevant network mechanisms and theoretical frameworks. A summary of the proposed theories is available in Table 1. Examples providing fruitful directions for future research are presented in the conclusion of this article.

Intra-Sector Networks

The Industry Sector: Interorganizational Networks [1-1]

From a macro-level perspective, the media industry can be seen as an interconnected set of corporate actors (see Figure 1, [1-1]), linked through economic, social, political, and cultural ties (Arsenault & Castells, 2008a). Networked forms of organization, production, and distribution, which are becoming ubiquitous across industries, are particularly prominent in the media sector (Castells, 2009). The well-studied ongoing processes of media ownership concentration (McChesney, 2000, 2004) contribute to the complex layer of dense ownership, partnership, and cross-investment relationships between news outlets. Deregulation and digitization have further lead to convergence in the information sector as media, telecommunication, and technological companies merge and expand (Chon, Choi, Barnett, Danowski, & Joo, 2003; Danowski & Choi, 1999).

Interorganizational networks have been a subject of inquiry in the fields of sociology and organizational theory (Baum, 2002). In this type of analysis, individual organizations constitute the network nodes, each of which may have a set of properties based on the research questions posed by the study. A wide range of formal and informal relationships can be used to define the network ties. Baker and Faulkner (2002) list some of the most relevant link types: market exchanges, strategic alliances, joint participation in syndicates, joint political action, interlocking directorates, family ties, and illegal activities such as collusion. All of those are applicable to the media industry which is, in addition, characterized by frequent content/information exchange relationships.

Another set of ties between companies in the media sector can be constructed on the basis of human resources (Gulati, Dialdin, & Wang, 2002). This is especially relevant for media organizations both because the industry is known to have high turnover rates and because journalists, more so than other professionals, tend to work for multiple organizations.

Two frameworks that capture the relationships outlined above are *resource dependency* and *social exchange theory* (Blau, 1964; Emerson, 1962). These theories seek to explain interactions and relationships based on the supply, demand, and exchange of material and information resources (Monge & Contractor, 2003). Initially limited to interactions between two actors, the frameworks have expanded to explore larger structures going beyond the dyadic relationship. Participating in a network allows members to gain access to various resources: financial, institutional, and information-related among others (Gulati et al., 2002). Financial resources are linked to capital acquisition and investments, while institutional resources have to do with gaining legitimacy, credibility, and status. Both money and reputation can be accumulated based on network ties. Knowledge and information resources are particularly important in the media industry, where information dissemination is crucial and the adoption of new technologies and practices needs to happen faster than it does in many other sectors (Pew Project For Excellence in Journalism, 2010).

While network members can benefit from increased financial opportunities, improved survival chances and enhanced learning capabilities, it is important to note that some patterns of network ties can also be detrimental (Gulati et al., 2002). A disadvantageous network position may make companies vulnerable to exclusion from valuable resources (Monge & Contractor,

2003). Furthermore, having extensive ties may prove to be a liability: over-embeddedness can prevent members from discovering new opportunities existing outside the scope of their network (Uzzi, 1997).

Monge, Heiss and Margolin (2008) demonstrate that *evolutionary* and *ecological* theories provide a useful lens through which the dynamics of network change can be studied. Evolutionary theory, by definition a general theory of change, looks into organizational birth, development, transformation, decline, and death (Baum, 2002). The ecological approach focuses on the composition of organizational populations and the resource environments in which they are located (Aldrich & Ruef, 2006). It emphasizes the interdependencies between organizations, looking into both competitive and cooperative relations. As Monge et al (2008) have pointed out, the combination of evolutionary and network theory can be applied to the area of mass media, providing the tools to study the changing interactions between news outlets as they compete for the scarce resource of the attention of the public. One useful analytical perspective to the investigation of dynamic interorganizational networks involves the evolutionary mechanism of V-S-R: *variation*, *selection* and *retention* (Campbell, 1969). *Variation* refers to the idea of exploring a range of possibilities, while *selection* involves accepting some of those options and rejecting others. *Retention* describes the persistent maintaining of a selected variation over time. The three processes can operate on a number of levels - within individual organizations, populations, and communities. In the context of media industry networks, important sources of variation exist in partnership and collaboration ties, some of which are selected and retained over time (Monge et al., 2008). The ecological framework is particularly helpful in the context of one rather difficult task that empirical research on interorganizational relations presents: defining the network boundaries. The set of media outlets that need to be included in a research study is not always immediately obvious. Considering only companies which operate within a certain geographic region (such as the area where a newspaper is circulated) becomes somewhat problematic as the Web lifts territorial restrictions on content distribution. In a book taking an ecological perspective to the media sector, John Dimmick (2003) proposes using the *theory of the niche* to define the scope of populations and industries. Organizations are in the same population - or occupy the same niche - if they compete for the same set of resources. Among the resource dimensions suggested by Dimmick are consumer time and spending, advertising

revenues, type of gratifications provided by the media (as described in Ball-Rokeach & DeFleur, 1976), and content.

The Content Sector: Semantic Networks [2-2]

Another sector in which networks play a fundamental role is that of content (see Figure 1, [2-2]). News articles, either individually or as a larger corpus of multiple texts, can be presented as maps of interrelated concepts. This allows for an exploration of the way issues and ideas are linked together in journalistic materials. It also facilitates the comparative analysis of different discourses that develop around contested social issues.

Two major frameworks come together in studies that employ concept maps to analyze news content. The theoretical background is provided by the media effects theory of *framing* (Gamson & Modigliani, 1989; Goffman, 1974). The analytical approach is that of *semantic network analysis* (SNA).

Semantic analysis is based on the premise that knowledge can be presented as networks of words and their relationships to each other in a given context (Carley, 1993). SNA software identifies the important concepts in a written work based on the frequency of their occurrence. Some types of words, such as transitive verbs, prepositions, conjunctions, etc., tend to appear often in any text but are not necessarily considered very important. Those are typically excluded from the analysis (Murphy & Maynard, 2000). A semantic network, sometimes also called a semantic map, is constructed based on a set of terms which have been identified as most relevant.

A number of methods have been developed to evaluate the strength of semantic relationships. The ties in a semantic map are typically based on related or overlapping meaning. One simple and often used way to detect a link between two words is based on the frequency of their proximate co-occurrence. If two concepts are related in the context of the framing applied to a text, they are also likely to frequently appear within several words of each other (Doerfel & Barnett, 1999). This approach has theoretic foundations grounded in cognitive processes (Scott, 2005). Words are hierarchically clustered in memory and their meaning is retrieved through associations with other words. If we assume that some patterns of those cognitive associations emerge in written text, semantic maps could be one way to capture them (Doerfel, 1998).

This type of analysis has been applied to the study of media texts, extracting important themes, central ideas, and the connections between them. Semantic studies have been used to examine journalistic representations of nicotine (Murphy, 2001), artificial sweeteners (Hellsten, Dawson, & Leydesdorff, 2009), the SARS crisis (Tian & Stewart, 2005), and political actors (Danowski & Cepela, 2009; Van Atteveldt, Kleinnijenhuis, & Ruigrok, 2008), among others. More detailed discussion of the interplay between semantic maps and media frames, as well as of their impact on audience members can be found in the inter-sector section of this article.

Once the semantic map is compiled, it can be interpreted directly based on the researcher's knowledge of the domain, or used to derive other measures and perform different types of quantitative analyses (Rice & Danowski, 1993). Clustering analysis, for example, may be used to examine groups of concepts that tend to appear together. Different frames emerge as different clusters of the focal concepts. Another type of analysis takes separate bodies of texts and constructs a semantic network for each one of them. Network correlations can be used to assess the level of similarity between different semantic maps over the same concepts (Doerfel & Barnett, 1999).

Though it has its disadvantages (e.g. problems with precision and flexibility), automated semantic mapping is likely to produce more consistent results across texts than human coders (Vlieger & Leydesdorff, 2011). It is, furthermore, particularly well-suited for analysis of large corpora of media content which would present some challenge to manual coding.

The Audience Sector: Social Networks [3-3]

The third type of network-centric research studies media distribution and consumption. The focus is on audience members and the connections between them. Those connections may be social ties of friendship, common affiliations and media preferences, as well as links based on information exchange (See Figure 1, [3-3], [3-2], [3-1]).

In the context of media research, communication connections between audience members are crucial as they provide an infrastructure allowing the spread of media preferences and the diffusion of content. This is especially visible online: social consumption of news is both

easy to track and ubiquitous on the Web (Purcell, Rainie, Mitchell, Rosenstiel, & Olmstead, 2010).

The pattern of ties between individuals is a well-studied research area. In the field of social networks, a host of mechanisms underlying the structure of interpersonal relationships has been identified. Those include, among others, balance, homophily, and proximity theories (Monge & Contractor, 2003). Balance models suggest that two people are more likely to be connected if they have friends in common. In a network context, this manifests in a tendency towards triadic transitivity. The premise of balance theory is borrowed from cognitive consistency frameworks (Cartwright & Harary, 1956; Heider, 1946) which propose that friends will evaluate objects in a similar fashion and, as a corollary, will have similar attitudes towards the people they meet.

Homophily is colloquially known as the "birds of a feather flock together" principle: individuals have a preference for social ties with those who are similar to them (Monge & Contractor, 2003). Associating with like-minded others makes interactions more predictable, reducing the potential stress or discomfort associated with encountering diversity (Brass, 1995). As a result, personal networks are often homogenous with regard to multiple socio-demographic characteristics including age, gender, race, religion, and occupation (McPherson, Smith-Lovin, & Cook, 2001).

Another closely related theory proposes geographic proximity as an important factor predicting interpersonal relationships. Occupying the same physical space gives people opportunities for interaction, thus facilitating closer relationships. Spatial propinquity has been found to foster the formation and maintenance of ties between similar individuals (Preciado, Snijders, Burk, Stattin, & Kerr, 2011).

Studying the impact of communication technologies on relationship patterns, scholars have investigated the principles affecting online tie formation. Internet interactions may be expected to relax somewhat the constraints of proximity and homophily, as they allow for diverse and long-distance relations (Cairncross, 1997). Yet geography and similarity remain crucial for social structures. In one example, a recent study of social ties on Twitter demonstrates that a substantial portion of ties on the platform were formed between users in the same metropolitan region (Takhteyev, Gruzd, & Wellman, 2011). Ties connecting individuals across

regional clusters, furthermore, were predicted by distance, nationality and language. Research further indicates that online social networks tend to mirror close personal relationships from the offline world (Hampton, Goulet, Rainie, & Purcell, 2011).

Inter-Sector Networks

In this section we review inter-sector networks: structures that involve nodes from a focal domain, but have additional nodes and relations from one or more of the other two domains. For instance, the following two sections discuss adding content elements (Industry-Content) or audience-defined nodes and links (Industry-Audience) to interorganizational networks of media venues.

Industry-Content Networks: News Organizations and Content Production [1-2]

Organizational ecology suggests that the content produced by media outlets is bound to be influenced by some of their organizational characteristics. Larger, generalist companies have broad content niches in that they provide a wide variety of materials in an attempt to appeal to large audiences. Smaller, specialized news enterprises have narrow niches in that they focus on a limited number and type of stories (Dimmick, 2003). At an institutional level, selection of stories depends on established internal routines. Those routines are subject to the *variation-selection-retention* mechanisms discussed earlier.

Media outlets vary in type, location, projected identity, social context, target audiences, political orientation, production technologies, available resources, and ties to other organizations. All of those characteristics – and many more – affect content production (Allern, 2002; McManus, 2008). It is only to be expected that the properties of an individual outlet will affect the type, volume, and diversity of its content. What is more interesting is that content is also influenced by the *links* between organizations. The network relationships described in the previous section - financial, corporate, interpersonal - have considerable bearing on the production process and output.

Ownership and partnership ties are particularly important in that they influence the homogenization and diversification of media content. Research has found that the corporate policies of parent companies affect the news agenda of their subsidiaries - as do ties with advertisers and sponsors (Duplessis & Li, 2004). The impact is not only due to the adoption of formal policies. As corporations seek economies of scale, they share organizational knowledge and resources, including information and staff, between the media outlets they own. As a result, journalistic and editorial practices are transferred between different news sources. Studies in this area have confirmed the impact of ownership structure on news quality (Dunaway, 2008) and diversity (Huber, 2006).

In addition to being affected by links between organizations, media content can also constitute a link in itself. One potential tie of that kind is created through the exchange of stories between partnering news outlets. Another possibility, suggested by Ognyanova (2010), involves defining links based on the overlap of issue coverage between media outlets. Researchers studying the interdependencies between the topics covered by different news providers often employ the mass communication paradigm of intermedia *agenda-setting*. Theory suggests that elite media like the New York Times have the ability to influence the topic selection of other outlets (Rogers, Dearing, & Bregman, 1993). The current dominant approach in agenda setting research involves computing correlations between rank-ordered lists of media issue priorities (Coleman & McCombs, 2007). While useful in demonstrating similarities, this method is problematic when trying to answer more specific questions about directions of influence, centrality of outlets and external factors affecting the agenda overlap. Moreover, it does not provide a particularly helpful description of the global patterns of shared issue priorities. A network approach, on the other hand, allows for a more sophisticated exploration of the social influence between media organizations and content selection.

Industry-Audience Networks: Media Companies and Online Audiences [1-3]

As media outlets increasingly offer their content on the Web, researchers have developed online methods to trace patterns of influence. News websites, like nytimes.com, can be seen as online representations of their respective media organizations - in this case, The New York

Times. Hyperlinks embedded in the content constitute the network connections. While the analysis of online link structures may present methodological challenges (Barnett, Chung, & Park, 2011), this approach provides a rare opportunity for longitudinal studies of online patterns, tracking Web configurations over time (Park, Barnett, & Chung, 2011).

A number of scholars have used the hyperlink perspective to explore the ties that exist between mainstream news sites and blogs (Kelly, 2008; Meraz, 2009; Tremayne, 2006; Turow & Tsui, 2008). For the purposes of those studies, blogs are often implicitly regarded as a special, more opinionated, individualized online form that gives voice to audience members. Online presence of this kind allows news consumers to interact with professional journalists, potentially engaging them in a productive conversation. In some prominent cases, bloggers have succeeded in influencing the US media industry agenda and focusing public attention on previously ignored issues (Ward, Cahill, & Petelin, 2007).

Three major approaches to deriving meaning from hyperlinks can be identified in existing research. The distinctions stem from viewing online links as signifying *affiliation, similarity*, or *value*. The first two approaches posit that more linking is likely to occur between the websites of companies or people who share some common ground. The *affiliation* frame regards hyperlinks as a proxy for social and organizational relationships (Mika, 2007; Park & Thelwall, 2003). This may refer to existing relations such as those between people who know each other, between organizations that work together or between subsidiaries of the same parent company (Ali-Hasan & Adamic, 2007; Weber, 2012; Weber & Monge, 2011).The *similarity* frame views the existence of online links as an indicator of a different type of commonality based on shared properties. Elite news venues may, for instance, only post links to other outlets of the same type (Meraz, 2009). Political bloggers may overwhelmingly link to people with similar political ideology (Adamic & Glance, 2005; Nahon & Hemsley, in press; Park & Thelwall, 2008).

Network methods, which take into account individual attributes, dyadic connections, and the dependencies between the two, are particularly well-suited to study these processes. Network clustering provides one way to explore the tendency of similar online actors to link to each other. Another method that has been used to examine the social patterns of linking in blogs employs community detection algorithms (Chin & Chignell, 2006).

The *value* frame, the third view on the significance of online connections, sees the hyperlink as an information exchange tie. Links are expected to point to content or organizations that are considered relevant, credible, and authoritative (Park, Barnett, & Nam, 2002). Similar to citations in scientometric research, hyperlinks are treated as indicators of quality and as markers for reputation (Park & Thelwall, 2003; Thelwall, 2009). In its simplest version, this approach can assess the influence of a media website based on its *in-degree centrality*, calculated in this case as the number of hyperlinks pointing to the site. More sophisticated network algorithms have also been developed to explore the relevance of online content within a specific knowledge domain (Easley & Kleinberg, 2010). One framework suggests distinguishing between sites containing valuable new material, called *sources*, aggregation sites that filter information and add value, called *authorities*, and sites which "collect links and direct users to the most relevant or appropriate information for a given topic," called *hubs* (Kleinberg, Kumar, Raghavan, Rajagopalan, & Tomkins, 1999; Weber & Monge, 2011).

Researchers looking into patterns of online influence have found that mechanisms of preferential attachment are shaping the structure of the Web. "The rich get richer" mechanism leads to a power law distribution[2] of links to mainstream media and blog sites (Drezner & Farrell, 2004). Studies have associated those findings with the existence of an *elite bias*. There is evidence that a small number of high-profile news venues have a major impact over the rest of the media and the public opinion (Pew Project For Excellence in Journalism, 2010, 2011).

Link analysis has thus emerged as a useful new method in the area of *agenda-setting* research. The ability of prominent news sources to set the issue coverage priorities of other outlets and audience members is assessed through patterns of hyperlinking. In one study of that kind, Meraz (2009) looks at links to examine the power of the New York Times and the Washington Post to set the political news agenda. Her results suggest that mainstream media outlets, while not the sole source of influence online, remain dominant agenda-setters on the web.

While most of the articles referenced in this section do not employ multiplex designs in their study of ties between news sources and individuals, this approach can provide a useful

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[2] That is to say, the probability that a web page will have k incoming links is inversely proportional to a power of k. In particular, k is roughly proportional to $1/k^2$ *(Easley & Kleinberg, 2010)*

analytical framework for future investigations in the area. In addition to looking into organizational ties, for example, scholars may explore a second type of connection between online media that is constructed through web co-link analysis (Zuccala, 2006). This technique allows researchers to evaluate the relationship between two news sites based on the number of cases in which individual audience members have linked to both.

In the context of a media interorganizational network, co-link relationships provide a new set of ties determined by co-occurrence of hyperlinks generated by the general public. Using analytical tools similar to those of bibliometrics, researchers can further identify clusters of news sources that typically get "cited" together by consumers (Thelwall & Wilkinson, 2004).

Another key application of hyperlink analysis emerges from *world system theory* studies investigating international flows of information (Park et al., 2011). Works in that line of research explore the structure of online and telecommunication networks among countries, identifying a core-periphery structure with central positions reserved for first-world rich economies (Barnett, Jacobson, Choi, & Sun-Miller, 1996). One relevant aspect of *world systems theory* lies in its capacity to predict the prominence of nations in foreign affairs news (Chang, 1998). While international networks are beyond of the scope of this work, as nations do not fall into the core node types examined by mass communication research (e.g. audience members, media organizations, and content),this application of link analysis deserves to be mentioned as a fruitful direction for further research.

Content-Audience Networks: Framing Research and Public Opinion [2-1]

One important aspect of the interaction between content networks and audience members is captured by the classic theory of framing. The main idea behind it is that media can affect the way we think about an issue by making some of its aspects more salient while ignoring others. Framing is not necessarily limited to a media "spin" on controversial issues. Rather it serves as a parsing mechanism, a collective sense-making tool aiding the understanding of everyday events and social interactions (Goffman, 1974). Recognizing the significance of frames as socially shared, persistent organizing principles that structure meaning (Reese, 2007), scholars in media and political studies began looking for ways to access those structures. Developing a practical

definition of framing that can be used in empirical research is recognized as a notoriously difficult task (Koenig, 2004). One attempt to do that comes from Entman (1993), who suggested looking for the presence or absence of certain "keywords, stock phrases, stereotyped images, sources of information and sentences that provide thematically reinforcing clusters of facts or judgments". Semantic network analysis provides a useful set of methods allowing scholars to identify central concepts, evaluate the relationships between them, and uncover the constellations of terms or ideas that tend to cluster together.

Most of the research on framing confirms the assumption that media frames have a powerful impact on public opinion (Castells, 2009; Shen & Edwards, 2005). Pan and Kosicki (2001) go as far as to suggest that it is an essential part of public deliberation. Semantic links established in the news should then have an observable impact on its consumers.

Guo and McCombs (2011) further developed this line of research, testing empirically the capability of semantic relationships present in media content to influence the cognitive concept maps held by audience members. Their study found similarities between media-generated and public-opinion semantic networks of attributes about Texas gubernatorial candidates. Analysis of this type provides a good example of multiplex thinking about the media system. Guo and McCombs in effect study a media content network with an additional set of semantic links generated by audience members.

Content-Industry Networks: Framing Research and Media Organizations [2-3]

Researchers have applied semantic analysis in a wide diversity of contexts to explore the implications of media framing. SNA research has examined political debates, organizational literature, media framing of genetic testing, health crises, nicotine, artificial sweeteners and other topics (Hellsten et al., 2009; Murphy, 2001; Murphy & Maynard, 2000; Samkin & Schneider, 2008; Tian & Stewart, 2005). These studies analyze clusters of terms frequently used within a thematic domain in order to identify implicit frames employed by media outlets or political factions.

Semantic mapping can be particularly helpful in studies that bridge the content and organizational levels of analysis. Research may, for instance, explore the theoretically predicted

similarity between the frames employed by news outlets which are part of the same media conglomerate (Allern, 2002; McManus, 2008). Scholars have already used SNA to compare the framing strategies of different media companies (L. Kim, 2011; Tian & Stewart, 2005). Work in this area of content research can be further advanced through a multiplex network perspective. One direction for future research in this field involves analyzing news stories produced by different media organizations and testing whether interorganizational links are associated with semantically similar structures of content.

In addition to providing an instrument for the analysis of news content, a semantic approach can be applied to study the internal discourse of media companies. As Monge & Poole (2008) suggest, the texts and conversations generated by an organizational discourse can be viewed as networks of intertextual and reflexive links. Constructing those links as semantic relationships allows for the study of discourse structure and evolution over time, giving a network interpretation to the symbolic and rhetorical dynamics involved in the process.

SNA is expected to become more methodically sophisticated and more popular as a research technique with the advent of the Semantic Web (O'Hara, Berners-Lee, Hall, & Shadbolt, 2010). The key driving force behind that new strategy of information representation is the use of formal languages that computers can process to describe the meaning of online content (Mika, 2007). Embedded metadata will allow machines to understand the context of information, combining facts from multiple sources to perform an ever more intelligent knowledge analysis. Media outlets like the New York Times have already begun releasing their stories under a new *linked open data* format (The New York Times, 2009). This makes it possible for computers to automatically determine which names in the text refer to people, organizations or places, and retrieve background information about those entities.

Audience-Industry Networks: Explaining Media Preferences [3-1]

In the realm of media studies, multiple paradigms provide insight into audience relationships with news organizations. *Media system dependency* suggests that individuals rely on media for their information needs such as understanding the environment, learning social norms, and escaping from everyday pressures through entertainment (Ball-Rokeach, 1985; Ball-

Rokeach & DeFleur, 1976). The *uses and gratifications* approach (Katz, Blumler, & Gurevitch, 1973) similarly emphasizes the role of the consumer in selecting the appropriate media to meet their needs.

One perspective which explicitly focuses on both social ties and news organizations is *communication infrastructure theory* or CIT (Ball-Rokeach, Kim, & Matei, 2001; Y. C. Kim & Ball-Rokeach, 2006). The framework builds on media system dependency (Ball-Rokeach, 1998), investigating interpersonal and mediated interactions along with their civic outcomes (Ball-Rokeach et al., 2001). It proposes a holistic, multi-method approach to studying the community *storytelling network,* an integrated system encompassing local residents, organizations and media outlets. CIT emphasizes the importance of both interpersonal ties and engagement with media as factors contributing to civic engagement. The social networks connecting residents, as well as the affiliation links between residents and their preferred media outlets, are among the important aspects of the local storytelling system. Higher-level multiplex structures are implied here as we can envision an additional set of ties between individuals constructed on the basis of their shared news source preferences.

In the ideal case, CIT suggests that micro-level agents (residents) and meso-level agents (organizations and news media) should form a single, well-integrated network (Matei & Ball-Rokeach, 2002). As the Internet becomes an increasingly important part of local communication infrastructures, ties between audience members and online news organizations become another relevant set of connections linking micro- and meso-level actors (Matei & Ball-Rokeach, 2001).

Research in this area has already identified a number of individual properties affecting the patterns of ties between audience members and local news providers. Generational differences, socio-economic status and ethnicity may have an impact on both interpersonal contacts and individual links to media organizations (Y. C. Kim & Ball-Rokeach, 2006).

Audience-Content Networks: Diffusion of News Stories [3-2]

In the context of media studies, social structures can be seen as a part of a larger system. Online and offline connections between audience members form the infrastructure over which media content can be propagated.

A classic media effects theory, the two-step flow of communication, provides the basis for network studies of media content diffusion. The model suggests that instead of reaching the public directly, the ideas broadcasted by media outlets are channeled through a particularly active segment of audience members: the opinion leaders (Katz, 1957; Katz & Lazarsfeld, 1955). Translating the two-step flow into network terms, we can see the mechanism it describes as a diffusion process (Valente, 1996). Certain central, well-connected nodes in the network, known as the opinion leaders, pick up ideas or other information from the media. That information is then disseminated further through their interpersonal network connections.

The diffusion of media content has been particularly well-studied in an online context. In the past few years, Web platforms have started providing multiple tools that allow users to reconstruct their real life social networks in an online space (Kleinberg, 2008). Sites like Facebook and Twitter give audience members the option to forward media content to their connections with the click of a button. A recent Pew report suggests that that's exactly what 37% of U.S. Internet users are doing (Purcell et al., 2010). More than half of the people using social networking sites, furthermore, receive and follow links to news items on a daily basis.

Blogs are another medium in which news content is propagated. As it is an accepted norm for bloggers to link to their sources (Chin & Chignell, 2006; Ferdig & Trammell, 2004), information diffusion in the blogosphere can be tracked based on hyperlink patterns and time stamps.

Taking into account these new trends, scholars have started studying the spread of topics through both social networking platforms (Oh, Susarla, & Tan, 2008) and blogs (Leskovec, Backstrom, & Kleinberg, 2009; Leskovec, McGlohon, Faloutsos, Glance, & Hurst, 2007). The two analytical approaches used to explore the online diffusion of media content involve threshold models (Valente, 1996) and cascade models (Cointet & Roth, 2009). In threshold models, an actor's decision to disseminate a topic is based on the proportion of their connections who have already started discussing the subject. In a cascade model, each time an actor is "infected" with a new topic, there is a certain probability that the infection will spread to neighboring nodes.

Epidemic models of diffusion are often used for online content as their robustness has been well established through long use in other scientific fields. Much of the research looking

into the network flow of information is based on methods initially developed to model the spread of disease through interpersonal connections. Clinical research in epidemiology often uses the *SIR* (*susceptible - infected - recovered*) cycle to describe the stages through which a node may pass (Easley & Kleinberg, 2010; Lewis, 2009). The same model has been adapted to study audience members and their exposure to media content (Leskovec et al., 2007). In the online-diffusion version of SIR, users may become *susceptible* to a topic when it is suggested to them by a friend (either through a blog post or via a service like Twitter or Facebook). The person may then be *infected* with the topic, in that they write a post about it or publish it on a social networking platform. With this, the individual is considered to have *recovered* from the topic, although a relapse is possible when something new appears on the subject.

Modeling the spread of media content through social networks has allowed researchers to understand topic life-cycles, spikes and declines (Cointet, Faure, & Roth, 2007; Gruhl, Guha, Liben-Nowell, & Tomkins, 2004; Leskovec et al., 2007). It has also provided a way to explore patterns of influence and identify opinion leaders (Java, 2006; Nakajima, Tatemura, Hara, Tanaka, & Uemura, 2006).

Conclusion, Limitations and Future Research

This article has presented a multilevel, multitheoretical, and multidimensional network model of the media system. Three major sectors were described: the media industry, content, and audiences. The role of networks linking nodes within these three sectors, called *intra-sector networks,* was examined. *Inter-sector* networks were further introduced as a way to tie together entities from different domains, creating macro-level networks among different components of the media system. *Intra-* and *inter-sector* network interactions, including multiplex and multidimensional structures, were shown to influence media production, output, and consumption. Existing studies and theories that bridge two or all three media domains were briefly discussed. Grounded in Monge & Contractor's (2003) multilevel, multitheoretical network model, expanded to include multidimensional links, we suggested that complementary theoretical mechanisms and analytical tools are needed to explain network phenomena in the increasingly interconnected media system (Castells, 2009).

Several of those combinations deserve to be highlighted here as they provide particularly promising directions for future research:

- *Ecological theory and organizational networks*. This group of theoretical tools allows for the construction of networks between media outlets based on resource exchange, competition, ownership, partnership, or strategic alliances. A study taking this approach may explore the effects of strategic content and audience resources (Dimmick, 2003) on organizational networks.

- *Agenda-setting theory and hyperlink networks*. As media organizations and audience members coexist on the Web and link to each other's content, patterns of influence can be detected from existing hyperlink networks. Studies in that area can identify prominent news outlets, but they can also look for bottom-up effects of topics crossing from audience members to mainstream media.

- *Framing theory and semantic networks*. This type of analysis is set to become widely used in the social sciences as the Semantic Web and open linked data format allow an intelligent automated parsing of media content. Semantic maps are already used to identify the dominant frames of media texts. While this approach focuses on content, it has potential applications bridging the levels of media organizations and consumers. Semantic tools may, for example, be used to compare the framing of issues between different news outlets.

- *Communication infrastructure theory (CIT) and social networks*. CIT is explicitly formulated in network terms, as it emphasizes the importance of links between residents, media and community organizations. The storytelling system described by the theory incorporates social relations based on local information exchange. Research using this framework may investigate the structure, density and clustering patterns of the storytelling network. Central actors, as well as actors serving as bridges between different groups can be identified.

- *Diffusion theories and semantic or hyperlink networks*. Social contagion and diffusion theories are used to track the online spread of topics or specific stories between media outlets and consumers. Extracting the underlying topics from text requires the use of semantic parsing (Leskovec et al., 2009). Tracking the spread of specific media stories can also be done based on hyperlink structure. Studies in the area model the diffusion, trying to identify cyclical patterns, influential nodes, and mechanisms guiding the dissemination.

While this work focuses on the promise of relational approaches to media studies, we recognize a number of limitations that also need to be taken into consideration. Network data is, by its nature, relatively difficult to collect (Hanneman & Riddle, 2005). Studying full networks may be an expensive and lengthy exercise. Moreover, because of the relational focus, sampling strategies may be difficult to design. Network researchers frequently encounter boundary specification problems (Marin & Wellman, 2010). While it is usually easy to identify all members of a particular group, the same is not true of networks (Marsden, 2005). Deciding where a network "ends" can be challenging, as networks often have no natural boundaries (Borgatti & Halgin, 2011).

As with other statistical techniques, establishing causality is a major challenge in network research (Fowler, Heaney, Nickerson, Padgett, & Sinclair, 2011). This is particularly problematic in studies which need to determine whether social ties are the cause or consequence of individual attributes (Shalizi & Thomas, 2011).

While the challenges in data collection and analysis are serious, it is our belief that most of them are far from permanent. The parallel advancement of network theories and methods is living up to its early promise in the social as well as the physical sciences (Borgatti et al., 2009). In a new media landscape characterized by networked production, networked distribution and networked consumption, relational thinking should be an essential aspect of theorizing and research.

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Table 1

Theories Explaining the Formation and Structural Properties of Networks within and between the Domains of Media Industry, Content and Audiences

Domains under Study	1. Media Industry	2. Media Content	3. Media Audiences
1. Media Industry	▪ Evolutionary Theories, Population ecology, Theory of the Niche ▪ Resource Dependence ▪ Exchange Theories ▪ Equilibrium Theories		
2. Media Content	▪ Evolutionary Theories, Population ecology, Theory of the Niche ▪ Intra and inter-media level agenda-setting ▪ Media bias	▪ Semantic Networks, cognitive concept mapping, Framing theories	
3. Media Audiences	▪ Media Ecology ▪ Selective exposure ▪ Uses & Gratifications ▪ Media System Dependency ▪ Information Seeking ▪ Transaction cost economics	▪ Two Step Flow Theory ▪ Contagion/Diffusion ▪ Social Capital ▪ Structural Holes ▪ Collective Action, Public Goods	▪ Homophily theories ▪ Proximity theories ▪ Electronic Propinquity ▪ Balance theories ▪ CIT & Storytelling Networks

Figure 1. The Composition of Media Networks
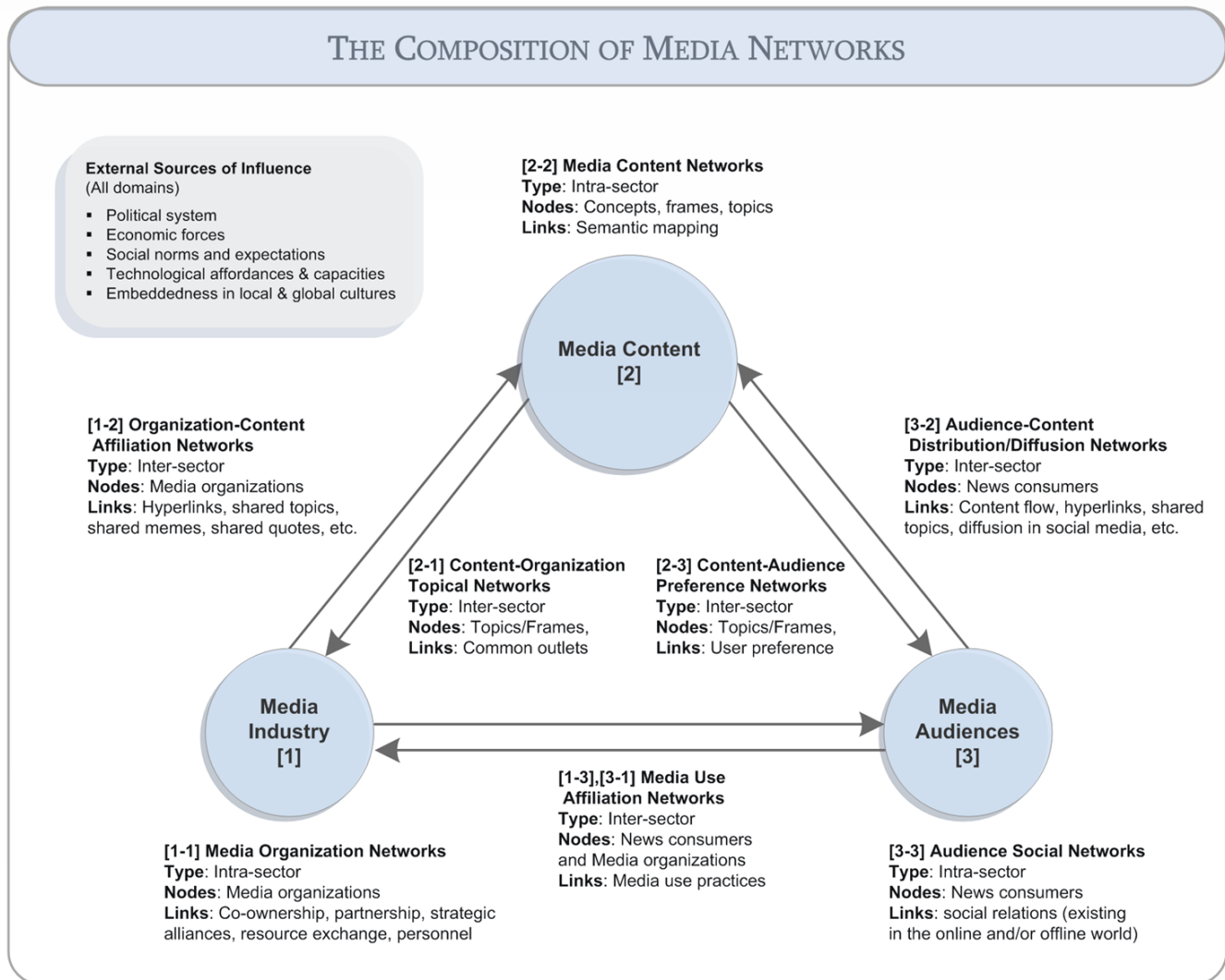
Note: The numbers within brackets represent the three media sectors: (1) industry, (2) content, and (3) audiences. The sequence of numbers in square brackets indicates that a network is composed by nodes in the sector represented by the first number and relations/nodes from the sector represented by the second number. Intra-sector networks are represented by the same numbers: 1-1, 2-2, and 3-3. Inter-sector networks are represented by different numbers, e.g., 1-2, 3-1.