

# Theories in communication science: a structural analysis using webometrics and social network approach

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**Abstract** This exploratory study analyzes the networked structure of theories in social sciences represented by co-occurrences on the World Wide Web. For this, co-occurrences of communication science theories were retrieved from the Web and analyzed using social network analysis tools. Several networks and node-level properties were measured to examine the relationships of theories in terms of co-occurrences. Communication science theories were grouped into four clusters. The results shed some important light on structural dynamics of communication science theories on the academic and social Web.

**Keywords** Social science · Theories · Communication science · Structural dynamics · Web · Webometrics · Social network analysis

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## Introduction

A relatively young discipline, communication sciences (or studies) have witnessed rapid growth because communication has become an important topic in the twentieth century (Barnett et al. 2011). Scholars' intense interest in communication has been driven by the continuous development and rise of communications technologies such as television, the Internet, and mobile devices and the dominant philosophy of progress and pragmatism in the twentieth century, which aims at improving society by stimulating individuals' desire for social change (Littlejohn and Foss 2010). This increasing scholarly interest can be easily demonstrated by the steady growth of representative professional organizations such as the International Communication Association (ICA), whose members and publication programs have increased exponentially in the last several decades (Chung et al. 2009; Lee and Barnett 2006).

Despite the growing interest in communication, there has been no general understanding of what communication sciences are, and there have been diverse perspectives on the nature of communication studies (Barnett et al. 2011). In this regard, one seminal work is the special edition of the *Journal of Communication* (1983) entitled "Ferment in the Field," whose articles emphasized the discrete nature of several subspecialties (or fields) within the same heading of the communication discipline (Lee 2008).

Historically, communication sciences have their roots in several cognate areas, including sociology, psychology, and political science, among others, and have frequently imported several theoretical frameworks from cognate disciplines (Berger et al. 2009). As a result, the fragmentation of subspecialties in communication studies has continued (Delia 1987).

In this context, skeptical communication scholars have lamented that communication studies are no more than a simple "interdisciplinary clearinghouse" for other disciplines or the "debtor discipline" and thus cannot be treated as a legitimate discipline (Craig 1999). In some respect, they have continuously shown some concern that theoretical development within the communication science domain can be attenuated (Berger et al. 2009).

On the other hand, several advantages of the interdisciplinary nature of communication studies cannot be underestimated. Researchers can benefit by employing the broad purview of communication disciplines that may provide more convincing evidence of the original theory (Berger et al. 2009; Craig 1993). There are several cases in which theories imported from other disciplines have been elaborated on and expanded by communication scholars.

This study empirically investigates the issues arising from the struggle to establish communication studies as a legitimate discipline through the lens of its theoretical development. Several scholars have claimed that theoretical development within their own turf in many social sciences is deemed essential to their progress and acceptance as a legitimate discipline (Berger et al. 2009; Park and Leydesdorff 2009; Scholl 2006). For example, Grönlund (2005) argued that a common study object alone does not establish a discipline but that distinctive theories and methodologies define a conventional discipline in its own right (Grönlund 2005).

This raises the question of what, if any, is the disciplinary ground of communication studies in terms of theoretical development. Alternatively, if communication studies do not fit the "classical" discipline or transcend the scope of any one discipline, what are the main characteristics of this multidisciplinary or interdisciplinary science through the lens of theoretical development? These questions motivate this study.

Given the above discussion, this study addresses the following major research questions: Are there any theoretical frameworks that function as the conceptual nucleus of communication studies and to what extent are they reflected in the World Wide Web? What are the relational patterns of the academic and social Web in communication studies? In this regard, this study examines the intellectual structures of theories in communication studies by using webometric and social network analysis (SNA) methods. That is, the study examines the patterns of relationships among communication science theories that may show some conceptual ground and scholarly connections.

This study offers important insights into and empirical evidence of the current status of communication studies. In addition, the study provides a deeper understanding of where communication studies stand within social sciences in cyberspace.

## Literature review

### Overview of areas of communication inquiry and theoretical development in communication sciences

Communication studies have split into many academically heterogeneous subspecialties with attributes different from original ones because much of their theories come from a diverse range of other disciplines (Park and Leydesdorff 2009; Barnett 2008). However, boundaries and categories of subspecialties can vary across scholars even when they share some common grounds to some extent (Treadwell 2006). In addition, communication sciences are continually evolving and changing (Littlejohn and Foss 2009).

Nevertheless, there is a consensus that the communication discipline initially has two major strands as its origin: the study of rhetoric (or speech) and that of the mass media (Berger et al. 2009; Bryant and Pribanic-Smith 2009; Craig 1999; Littlejohn and Foss 2009). The study of rhetoric has humanistic roots originating from ancient Greek sophists and has a long history of exploring public discourse. Early rhetoric studies in communication sciences mainly emphasized how the practice of communication, particularly in public discourse, can be improved through education (Craig 1999). Several scholars in the rhetorical tradition later studied interpersonal communication based on the realization that more knowledge of social interaction processes is needed for the more efficient practice of communication activities (Roloff, 1981). In this regard, several studies of social interactions and relationships dealt with interactions in the workplace and between children, among others, in the 1920s and 1930s in allied fields such as psychology, contributing to the development of interpersonal communication until it was institutionalized as one of the identifiable subspecialties in communication studies in the 1960s (Bryant and Pribanic-Smith 2009). As a result, several theories have been employed in this tradition, including *uncertainty reduction theory* (investigating how interpersonal exchanges occur for understanding and knowledge), *symbolic interactionism* (examining how meaning is constructed in relationships), and *social identity theory* (investigating how an individual's identity is derived from his or her organization), among others (Littlejohn and Foss 2009).

In addition, the field of mass communication has been highlighted as another important field since the inception of communication studies. The theoretical development and conceptual boundaries of mass communication can be best defined and described by its counterpart, namely interpersonal communication. The fields of interpersonal and mass communication have been divided as follows: (1) channel type, (2) the amount of potential

recipients into which a given message can be transmitted, and (3) opportunities for feedback. Many studies of interpersonal communication have focused on face-to-face communication. On the other hand, studies of mass communication have placed greater emphasis on all means of transmitting messages (e.g., print media, radio, TV, and other audiovisual media) except for interpersonal face-to-face channels. In contrast to interpersonal communication scholars, mass communication scholars have drawn mainly from sociology and political science (Reardon and Rogers 1988). In a limited sense, research and theories in mass communication have focused mainly on beneficial and detrimental effects of the mass media (Brousius 2011). The major theories in this tradition include *two-step flow theory* (investigating how the human agency called the opinion leader plays a role in effects of the mass media on audiences), *agenda-setting theory* (examining how the media influence the audience's prioritization of social issues), *framing* (looking at ways in which a story is told by developing arguments with metaphors and imagery that promote a particular problem definition, causal interpretation, or moral evaluation and prescribe certain remedies), and *medium theory* (examining how different media filter what is known) (Littlejohn and Foss 2009; Entman 1993; Kim 2013).

In a broader sense, however, McQuail (2010) classified theories relevant to mass communication as social-scientific, cultural, normative, operational, and everyday theories. Among these, social-scientific theory focuses on common rules concerning the nature, workings, and effect of mass communication based on systematic observations. On the other hand, cultural theory (i.e., mass media theories of culture and society) typically examines how different types of cultural production can be facilitated according to some quality criteria. The rhetoric tradition of communication studies has spawned other areas of communication research in addition to interpersonal communication, including the study of language and linguistics, and organizational communication (Bryant and Pribanic-Smith 2009; Littlejohn and Foss 2009). The study of language and linguistics in communication research has emerged as an intellectual subgroup of interpersonal communication research in the last three decades, but its relevance to interpersonal communication has weakened since the 1990s. The major purpose of research in this tradition of communication sciences is to examine “the meaningfulness of what individuals say to certain other individuals in certain circumstances” (Bryant and Pribanic-Smith 2009, p. 26). Many studies in this tradition have addressed language pragmatism, conversation analysis methods, language, social psychology, discourse analysis methods, and the ethnography of communication (Fitch and Sanders 2005).

Organizational communication can be traced to ancient rhetoric studies, as in the case of interpersonal communication and the study of language and linguistics (Bryant and Pribanic-Smith 2009), but the formal field was established in the early 1900s (Redding and Tompkins 1988). Early studies during the 1900-1950 period focused mainly on skill-based training, including speaking and writing, to achieve effective communication in organizational settings. In the 1950s, there was an intellectual shift toward employing scientific research methods to examine the role of communication in improving organizational output and life (Bryant and Pribanic-Smith 2009). In addition, studies after the 1980s have focused more on the dynamic emergence of organizations and their communication processes (Goldhaber and Barnett 1988; McPhee and Zaug 2001) characterized the development of ideas and theories in the area of organizational communication based on the following three traditions: the rational structure tradition (investigating ways in which uncertainty can be reduced and the value of production can increase), the organizational process theory tradition (looking at the dynamic emergence of organizations), and the structural tradition (the mediation of these two traditions). The field of communication

processes emerged in the 1940s, and this area of communication research has features different from those of other traditions of communication research, including rhetoric traditions, in the way that the usual assumptions about differences between human and nonhuman information-processing systems are challenged (Craig 1999). One remarkable concept related to this tradition is Wiener's (Wiener 1948, 1950) "cybernetics," which can be understood as the study of self-regulation and control in systems. Scholars in this tradition have argued that communication cannot be represented as a sequence of events, that is, one following another, asserting that communication is instead a continuous interaction with no fixed beginning or end (Berlo 1960). System theory (investigating self-regulating systems with a self-correcting mechanism through feedback) is one of the most well-known theories in this tradition (Littlejohn and Foss 2009; Barnett and Thayer 1997).

Marketing-related and practice-oriented studies of advertising and public relations have become a distinct research area in communication sciences (Littlejohn and Foss 2009). By its nature, advertising is an applied field combining communication and marketing. In this regard, various marketing theories have been employed in advertising research (Cho and Khang 2006). Although advertising concepts date back to ancient Greece and Rome, scholars have tried to establish their own distinct theories since the early 1900s (Gillian 2009). According to Littlejohn and Foss (2009), the most widely covered topics in advertising include functional areas (e.g., examining campaign creation and media placement), advertising processes (e.g., emphasizing rational and emotional theories of persuasion), and popular culture (e.g., viewing advertising as an expression of a symbolic structure).

In the case of public relations, which can be usually understood as the practice through which relationships and shared meanings among stakeholders can be established, it has a short history as an area of communication sciences, although its ideas and concepts can trace back to ancient civilizations. Public relations has been an important practice since the nineteenth century (Cutlip 1994; Heath 2005). One of the most important studies providing the theoretical basis for and contributing to the establishment of public relations as a subspecialty is J. E. Grunig's public relations theory (Bryant and Pribanic-Smith 2009).

Given the rapid development of information communication technology (ICT) represented by the Internet, scholars in communication sciences have shown growing interest in ICT as a process and addressed how this process is related to other communication perspectives (Chung et al. 2013; Lee and Barnett 2006). In this regard, studies of ICT and new media as another field of communication sciences emerged in the 1970s, exploding since the 1990s (Bryant and Pribanic-Smith 2009). Studies in this tradition have emphasized the difference between the "old" (i.e., the mass media) and the "new" (e.g., ICT), including the level of interactivity, sender-receiver relationships, synchronicity in message transmission, and how these distinct characteristics lead to different outcomes in their effects on attitudes, behaviors, organizations, and policies (Littlejohn and Foss 2009).

Health communication is another field of communication studies applied since the mid-1970s (Bryant and Pribanic-Smith 2009). This field typically focuses on the role of human and mediated communication in the delivery of health care and the promotion of health-related activities (Littlejohn and Foss 2009). Health communication is by nature a multidisciplinary subfield importing many theoretical and methodological approaches from various academic fields such as public health, medicine, marketing, and anthropology (Atkin and Marshall 1996). Theoretical development and ideas in health communication can be understood based on the following four factors: (1) the delivery of health care (e.g., patterns of interactions and communication between healthcare consumers and providers), (2) the promotion of health (e.g., the adoption of desirable health behaviors such as the

prevention and treatment of diseases through communication), (3) health and risk communication (e.g., how to communicate with the at-risk public to enable it to confront pending health risks when they occur), and (4) health communication in new media communications technologies (e.g., the delivery and promotion of health information in the context of digital information technology) (Littlejohn and Foss 2009).

### Analytical frameworks for the disciplinary identity

There are various analytical frameworks for examining how scientific (or intellectual) knowledge is developed, diffused, and structured in any given discipline, including bibliometrics, the social network analysis method, and the semantic network analysis method (Chung et al. 2013; Jiang 2014; Park and Leydesdorff 2009). Most such frameworks for identifying the study field come from the seminal work of Kuhn (1970): *The Structure of Scientific Revolution*. He challenged the conventional accretionary perception of the growth of science (Lievrouw et al. 1987; Tai 2009), asserting that science moves through paradigms such that “concepts enable the process of science to undergo periodic revolution, not a linear accumulation of new knowledge” (Lee et al. 2010a, b, p. 29). In particular, he emphasized the nature of consensus-building and interactive processes in scientific development, by approving and disproving within the scientific community, to find the best way to practice science (Lee 2008). Crane (1972) agreed with this view, suggesting that science is formed through the process of interactions within a scientific community.

One of the most widely employed analytical frameworks for the disciplinary identity is bibliometrics (Chung et al. 2013; Park and Leydesdorff 2009). Bibliometrics is a set of quantitative measurement methods for examining the structure and process of scholarly communication (Borgman and Furner 2002). Bibliometrics includes word frequency, citation, and co-word analysis methods, among others, and usually has two major applications: evaluative and relational (for further details, see Thelwall (2009)). In particular, relational bibliometrics is relevant to the disciplinary identity based on “the levels of connectedness, the strength of relationship, or the direction of flow, *between* documents, people, journal, groups, organizations, domains, or nations” (Borgman and Furner 2002, p. 6).

Although relational bibliometrics in the conventional sense examines relationships within science mainly through the Institute for Scientific Information (ISI), it has undergone a revolutionary change through the wide diffusion of new important sources of scholarly communication, such as webpages and online article databases represented by *Google Scholar* (Delgado and Repiso 2013; Lee et al. 2009; Park 2010; Thelwall 2009). In this regard, the use of webometrics as a new type of bibliometrics has emerged. Webometrics is widely understood as the study of web-based content and web phenomena based mainly on quantitative methods to reach research goals in social sciences (Thelwall 2009). The method typically addresses problems relevant to conventional bibliometrics, and its range includes link, web citation, and search engine evaluation analysis methods, among others (for further details, see (Thelwall 2008)). Several studies have demonstrated several advantages of webometrics over traditional bibliometrics. Data sources for metrics (i.e., the Web) in the case of webometrics are more timely than those for conventional bibliometrics (e.g., published journals), which are generally retrospective in nature. In addition, webometrics takes advantage of a wider range of scholarly objects such as presentations, patents, and websites as evidence of research influence (Thelwall 2008; Chu et al. 2002). Webometrics has been widely employed to identify the structure of scholarly

communication across many academic disciplines, including communication sciences (Chung and Park 2012).

The social network analysis (SNA) method is another widely used analytical technique for understanding the structure of scholarly communication across many academic disciplines (Chung et al. 2013; Park and Leydesdorff 2009). The SNA method is used to identify structural properties based on relationships or patterns of relationships among interacting components (Wasserman and Faust 1994). This method is based on the assumption that “the patterning of social ties in which actors are embedded has important consequences for those actors” (Freeman 2004). Several scholars have argued that the combination of the SNA method and bibliometrics can provide a richer picture of the status of a given field (Leydesdorff 2007; Tai 2009). In the area of communication sciences, the SNA method has been used by several scholars to examine the status of various fields (Chung et al. 2009; Lee and Barnett 2006).

The present study identifies the structural patterns of theoretical relationships in communication sciences by using both webometric and SNA methods. Despite their wide acceptance and popularity in determining the disciplinary identity, most studies based on bibliometrics have been limited in that they have focused mainly on patterns of journal-to-journal and author-to-author citations. Such studies been criticized because their findings are not intuitively and succinctly interpretable (Callon et al. 1986). In addition, the validity of citations has been a subject of intense debate in the development of citer motivation. In addition, web-based data have become an important new source for scholarly communication (Chung and Park 2012; Delgado and Repiso 2013; Kenekayoro et al. 2015; Leydesdorff 1998; Thelwall 2008, 2009).

In this regard, the webometrics of theoretical structures can be a more appropriate analytical method for identifying the identity of communication sciences based on the assumption that “theory is not only a set of textual propositions so nominated, but the ongoing practices of intellectual communities” (Anderson 1996, p. 8). In addition, webometrics, together with the SNA method, can provide a richer picture of the status of communication sciences.

## Methods

### Data collection

To reveal the relational patterns of theories in communication studies, a webometric analysis was conducted. The relationship (link) of theories was defined as the level of visibility, that is, web mentions of theory names (co-occurrences) on the Web. This visibility of communication theories was determined through Google.com by using Webogoogle (<http://webo.yu.ac.kr>), a webometric analysis tool for automatically collecting indexed data from Google (Barnett et al. 2015; Park 2011). The program provides hit counts of web mentions based on the Google Search API. Google started its Search API service in 2002, and the reliability of Google’s API service has been verified in previous research (Park 2014; Lazer et al. 2014; Delgado and Repiso 2013; Dugas et al. 2012; Olson et al. 2013; Lee et al. 2010a, b).

The Google Search API allows for the retrieval and display of Google Custom Search results programmatically. This API allows for 100 requests per day for free but requires the user to register for the application’s paid key for 1,000–10,000 requests per day. For data

collection purposes, communication theories were considered as the search query. The list of communication theories was based on the webpage of Communication Studies at the University of Twente (<http://www.utwente.nl/cw/theorieenoverzicht/Theory%20Clusters/>).

Then the output was entered into a communication theory relationship matrix. In this matrix, cell (i, j) indicates the number of times two theories were related. For example, Theory 1 (T1) and Theory 2 (T2) were mentioned 80 times, and Theory 3 (T3) and Theory 4 (T4) were mentioned 38 times. Note that this matrix was symmetrical. That is, their relationship was indirect.

There were 95 theories and nine sub-strands categorized according to the theory topic. The titles of theory categories were “interpersonal communication and relationship theories,” “mass media theories,” “communication process theories,” “language and linguistics theories,” “public relations, advertising, marketing, and consumer behavior theories,” “organizational communication theories,” “communication and information technology theories,” “health communication theories,” and “media, culture, and society theories.” Some theories belonged to more than one strand. To compare the theoretical proximity or differences for each strand, each strand was collected separately, and full data were analyzed. As a result, there were nine different matrices (i.e., nine networks). Data were collected from August 28, 2011, to September 8, 2011.

### Analysis procedures: SNA and webometric methods

For the analysis of collected data, the social network analysis (SNA) method Hanneman and Riddle (2005) was employed to measure network-level properties of the co-occurrence network of theories. Here NodeXL (Smith et al. 2010; Smith 2015; Xu and Feng 2015) and VOSviewer (Van Eck and Waltman 2010) were used to construct and analyze this network. The Webometric Analyst was used to extract and analyze top-level domains of webpages mentioning theories. With the SNA technique, density, the average clustering coefficient, the average degree, and average degree centrality were measured. The density of a network measures the ratio of actual links to the number of all possible links in a network. Density can be calculated as the number of links in a network divided by the number of all possible links between pairs of nodes in the network (for an undirected network, the number of all possible links can be calculated as  $n(n-1)/2$ , where  $n$  is the number of nodes in the network). A fully connected network in which each node is connected to every other node has a density of 1. The clustering coefficient of a network is the degree to which nodes in the network tend to cluster together. In addition, average degree centrality measures the average number of links between different nodes in a network. Betweenness centrality is used to examine the ability of a node to control or facilitate collaboration or information flow from its central position in the network (Liu et al. 2005). Eigenvector centrality examines the importance of a node in a network based on its connections to other important nodes and can provide a better understanding of a node’s networking ability in comparison to that of others (Marsden 2008).

## Results

The results are presented in two parts: (1) a co-occurrence network of strands of communication science theories and (2) a web visibility analysis of theories.



## Strand 1: Interpersonal communication and relationship theories

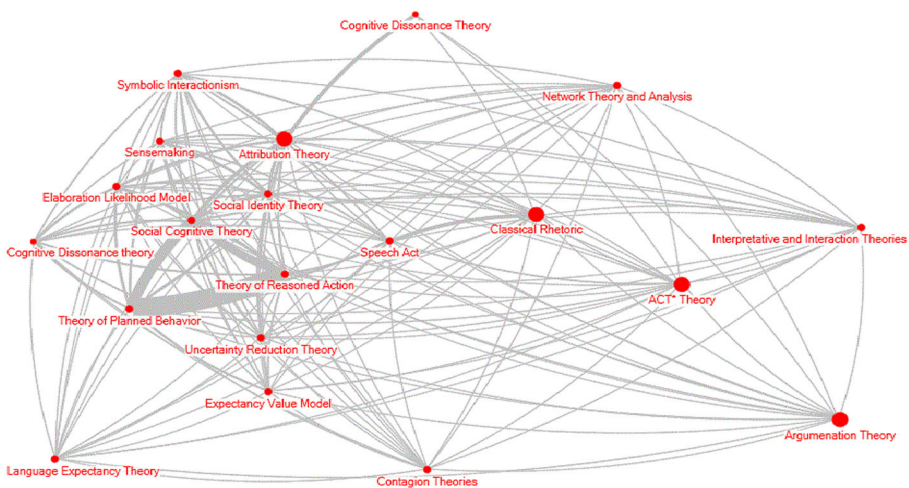
### Network properties

Strand 1 includes 20 *interpersonal communication and relationship theories (ICRTs)*. Overall, there were 342 links (i.e., co-occurrences) between ICRTs. The average degree was 17.10 (i.e., each theory co-occurred 17.10 times by average), the density of the network was 0.90, and the clustering coefficient was 96. The high clustering coefficient indicates the tight clustering of theories. The strongest co-occurring relationships were observed among the theory of planned behavior, the theory of reasoned action, and social cognitive theory (as indicated by the width of links in Fig. 1; Table 1).

Table 2 shows the top 10 theories in terms of degree, betweenness, and eigenvector centrality. In terms of degree centrality (i.e., the average number of links or co-occurrences) and eigenvector centrality (i.e., connections to other important theories in the network), uncertainty reduction theory, theory of reasoned action, and theory of planned behavior were the top three theories. However, in terms of betweenness centrality, classical rhetoric, attribution theory, and argumentation theory were the top three theories.

### Web visibility

Tables 3 and 4 show the results for the web visibility of theories. Table 3 shows top-level domains of webpages for strand 1. It is clear that 70 % of the webpages (number = 98) mentioning theories were from the .com domain, followed by 20.7 % from the .org domain. Table 4 shows the sites of webpages for strand 1 (only the top 15 results are shown). The URL column lists the number of URLs returned by the query with the given site listed in the Site column. Sites indicate domain name segments based only on the end of the domain name up to the segment before the top-level domain (e.g., .com) or the standard second-level domain (e.g., .ac.uk). The results indicate that largest number of .com URLs was for



**Fig. 1** The network of interpersonal communication and relationship theories (nodes represent theories; node size, betweenness centrality; links, co-occurrences; and link width, the strength of co-occurrences)

**Table 1** Network-level properties of interpersonal communication and relationship theories

No. of nodes	No. of links	Density	Average geodesic distance	Average degree	Average betweenness centrality	Clustering coefficient
20	342	0.90	1.05	17.10	2.0	0.96

**Table 2** Top 10 theories in terms of degree centrality

No.	Degree	Betweenness	Eigenvector
1	Uncertainty reduction theory	Classical rhetoric	Uncertainty reduction theory
2	Theory of reasoned action	Attribution theory	Theory of reasoned action
3	Theory of planned behavior	Argumentation theory	Theory of planned behavior
4	Elaboration likelihood model	ACT theory	Elaboration likelihood model
5	Symbolic interactionism	Uncertainty reduction theory	Symbolic interactionism
6	Speech act	Theory of reasoned action	Speech act
7	Social identity theory	Theory of planned behavior	Social identity theory
8	Social cognitive theory	Elaboration likelihood model	Social cognitive theory
9	Sensemaking	Symbolic interactionism	Sensemaking
10	Network theory and analysis	Speech act	Network theory and analysis

**Table 3** Top-level domains of webpages for the whole strand

TLD	Domains	%
com	98	70.0
org	29	20.7
kr	6	4.3
net	6	4.3
info	1	0.7

scribd.com (7.5 %), followed by sagepub.com and quizlet.com (5.1 % each). In addition, social media sites such as YouTube and WordPress played important roles in the web visibility of theories, accounting for 2.8 % of all URLs. YouTube generated more URLs for strand 1 in comparison to Wiley.com and emeraldinsight.com.

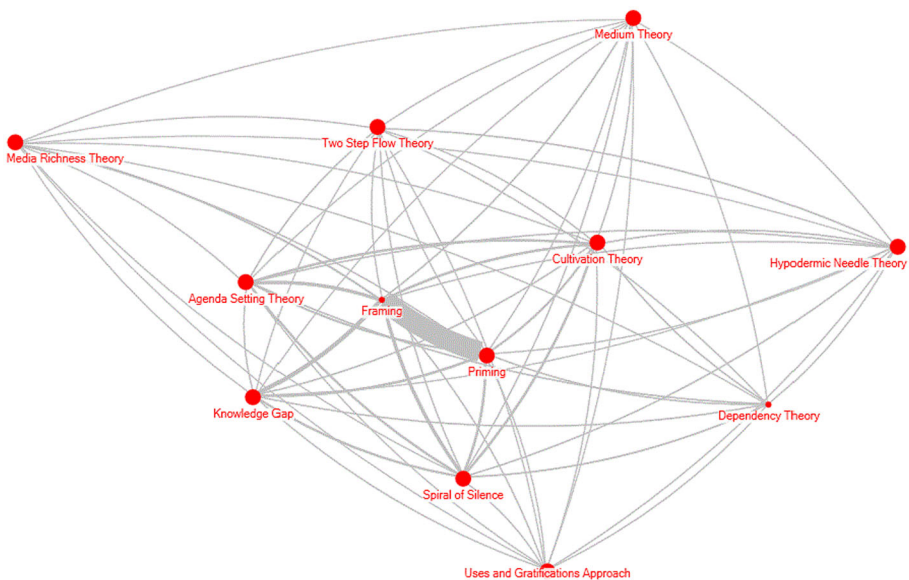
## Strand 2: Mass media theories

### *Network properties*

Strand 2 was composed of 12 mass media theories (MMTs). In strand 2, there were 130 links between MMTs. The average degree centrality was 10.8, the density of the network was 0.98, and the clustering coefficient was 98. The high clustering coefficient indicates the tight clustering of theories. The strongest co-occurring relationship was observed between framing and priming (as indicated by the width of the links in Fig. 2). In terms of degree, betweenness, and eigenvector centrality, medium theory, the uses and gratifications approach, and media richness theory were the top three theories (Tables 5, 6).

**Table 4** Sites of webpages for the whole strand

Site	URLs	%
scribd.com	16	7.5
sagepub.com	11	5.1
quizlet.com	11	5.1
blogfa.com	6	2.8
youtube.com	6	2.8
wordpress.com	5	2.3
wiley.com	5	2.3
apa.org	5	2.3
emeraldinsight.com	4	1.9
springerlink.com	4	1.9
slideshare.net	4	1.9
proquest.com	3	1.4
wikispaces.com	3	1.4
docstoc.com	3	1.4
google.com	3	1.4



**Fig. 2** Mass media theories (nodes represent theories; node size, betweenness centrality; links, co-occurrences; and link width, the strength of co-occurrences)

*Web visibility*

The results for the web visibility of theories in strand 2 are shown in Tables 7 and 8. Overall, a majority of the theories in strand 2 co-occurred in the.com domain (76 %), followed by the.org domain (12.7 %). Table 8 shows the sites of webpages for strand 2

**Table 5** Network-level properties of the mass media

No. of nodes	No. of links	Density	Average geodesic distance	Average degree	Average betweenness centrality	Clustering coefficient
12	130	0.98	0.93	10.8	0.17	0.98

**Table 6** Theories in terms of degree centrality

No.	Degree	Betweenness	Eigenvector
1	Medium theory	Medium theory	Medium theory
2	Uses and gratifications approach	Uses and gratifications approach	Uses and gratifications approach
3	Media richness theory	Media richness theory	Media richness theory
4	Two step flow theory	Two step flow theory	Two step flow theory
5	Spiral of silence	Spiral of silence	Spiral of silence
6	Priming	Priming	Priming
7	Knowledge gap	Knowledge gap	Knowledge gap
8	Hypodermic needle theory	Hypodermic needle theory	Hypodermic needle theory
9	Cultivation theory	Cultivation theory	Cultivation theory
10	Agenda setting theory	Agenda setting theory	Agenda setting theory
11	Framing	Framing	Framing
12	Dependency theory	Dependency theory	Dependency theory

**Table 7** Top-level domains of webpages for the whole strand

TLD	Domains	%
com	48	76.2
org	8	12.7
kr	4	6.3
net	3	4.8

(only the top 15 results are shown). The results indicate that the largest number of .com URLs was for scribd.com (10.2 %), followed by wordpress.com (6.1 %) and youtube.com (5.1 %). Social media played an important role in the web visibility of theories generating a majority of the URLs co-mentioning theories. For example, YouTube, WordPress, and wikis generated more URLs than academic publishers such as Wiley.com and mcgraw-hill.com.

### Strand 3: Communication process theories

#### *Network properties*

Strand 3 was composed of 7 communication process theories (CPTs). In strand 3, there were 42 links between CPTs. The average degree centrality was 6.0, the density of the network was 1.0, and the clustering coefficient was 1 (Table 9). The high cluster coefficient indicates the tight clustering of theories. The strongest co-occurring relationships

**Table 8** Sites of webpages for the whole strand

Site	URLs	%
scribd.com	10	10.2
wordpress.com	6	6.1
youtube.com	5	5.1
quizlet.com	5	5.1
wecommunication.blogspot.kr	5	5.1
wikispaces.com	4	4.1
wiley.com	3	3.1
slideshare.net	3	3.1
mcgraw-hill.com	3	3.1
docstoc.com	2	2.0
ask.com	2	2.0
incommetrics.com	2	2.0
matei.org	2	2.0
wrneuman.com	2	2.0
issuu.com	2	2.0

**Table 9** Network-level properties of communication processes

No. of nodes	No. of links	Density	Average geodesic distance	Average degree	Average betweenness centrality	Clustering coefficient
7	42	1.0	0.86	6.0	0.00	1

were observed between framing, priming, and system theory (as indicated by the width of links in Fig. 3). In terms of degree, betweenness, and eigenvector centrality, system theory, psycho-linguistic theory, and the model of text comprehension were the top three theories (Table 10).

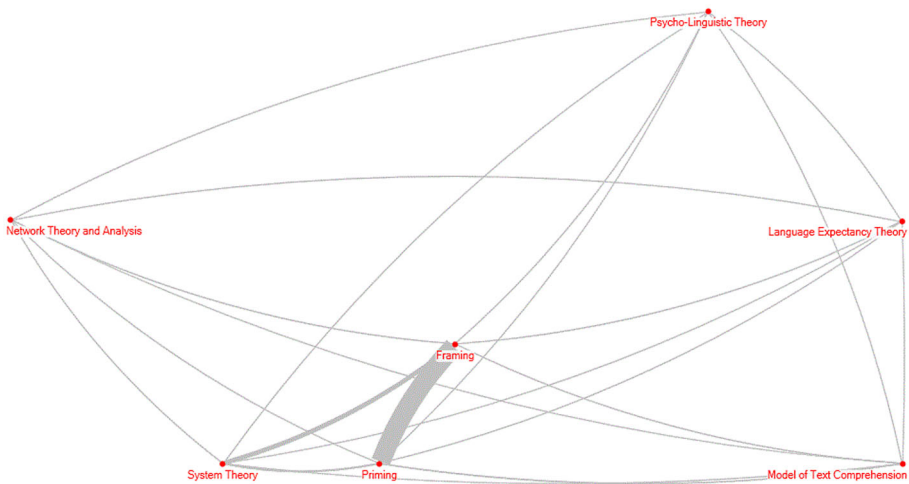
*Web visibility*

The results for the web visibility of theories in strand 3 are shown in Tables 11 and 12. As in strands 1 and 2, a majority of the theories in strand 3 co-occurred in the.com domain (62.1 %), followed by the.org domain (12.1 %). Table 12 shows the sites of webpages for strand 3. Noteworthy is that these results indicate that the largest number co-occurrences was for the.org domain, such as apa.org (22.9 %) and acm.org (5.5 %). A majority of the.com URLs were for sagepub.com (8.3 %) and wordpress.com (5.5 %). Unlike in the cases of strands 1 and 2, social media played no dominant role in the web visibility of CPTs. The dominant role was played by academic publishers and organizations such as apa.org and sagepub.com.

**Strand 4: Language and linguistics theories**

*Network properties*

Strand 4 was composed of 8 language and linguistics theories (LLTs). In strand 4, there were 56 links between LLTs. The average degree centrality was 7.0, the density of the



**Fig. 3** The network of communication process theories (nodes represent theories; node size, betweenness centrality; links, co-occurrences; and link width, the strength of co-occurrences)

**Table 10** Theories in terms of degree centrality

No.	Degree	Betweenness	Eigenvector
1	System theory	System theory	System theory
2	Psycho-linguistic theory	Psycho-linguistic theory	Psycho-linguistic theory
3	Model of text comprehension	Model of text comprehension	Model of text comprehension
4	Framing	Framing	Framing
5	Priming	Priming	Priming
6	Network theory and analysis	Network theory and analysis	Network theory and analysis
7	Language expectancy theory	Language expectancy theory	Language expectancy theory

**Table 11** Top-level domains of webpages for the whole strand

TLD	Domains	%
com	36	62.1
org	14	24.1
kr	4	6.9
net	4	6.9

network was 1.0, and the clustering coefficient was 1.0 (Table 13). The high cluster coefficient indicates the tight clustering of theories. The strongest co-occurring relationship was observed between classical rhetoric and the speech act (as indicated by the width of links in Fig. 4). In terms of degree, betweenness, and eigenvector centrality, the coordinated management of meaning, psycho-linguistic theory, altercasting, and psycho-linguistic theory were the top three theories (Table 14).

**Table 12** Sites of webpages for the whole strand

Site	URLs	%
apa.org	25	22.9
sagepub.com	9	8.3
wordpress.com	6	5.5
acm.org	6	5.5
blogfa.com	5	4.6
docstoc.com	4	3.7
scribd.com	4	3.7
springerlink.com	2	1.8
cogpsych.org	2	1.8
beaugrande.com	2	1.8

**Table 13** Network-level properties of language and linguistics theories

No. of nodes	No. of links	Density	Average geodesic distance	Average degree	Average betweenness centrality	Clustering coefficient
8	56	1.0	0.88	7.0	0.00	1

*Web visibility*

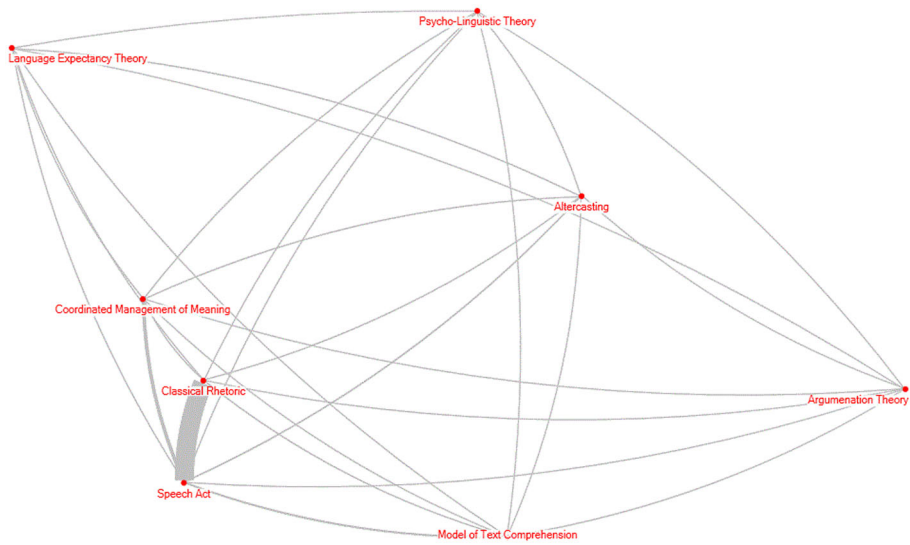
The results for the web visibility of theories in strand 4 are shown in Tables 11 and 12. As in the other strands, a majority of the theories in strand 4 co-occurred in the.com domain (58.3 %), followed by the.org domain (27.8 %). Table 16 shows the sites of webpages for strand 4. The results indicate that the largest number of co-occurrences was for the.com domain, followed by the.org domain (Table 15).

Because of space limitations, the results for the remaining strands are presented without accompanying tables.

**Strand 5: Public relations, advertising, marketing, and consumer behavior theories**

*Network properties*

Strand 5 includes 11 theories related to public relations, advertising, marketing, and consumer behavior theories (PRAMCBTs). Noteworthy is that strand 5 was a star-like network with attribution theory at the center of the network. There were 24 links between PRAMCBTs. The average degree centrality was 2.0, the density of the network was 0.22, and the clustering coefficient was 0.37. The strongest co-occurring relationships were between attribution theory and cognitive dissonance theory and between attribution theory and priming theory. In terms of degree, betweenness, and eigenvector centrality, attribution theory, uncertainty reduction theory, and agenda-setting theory were the top three theories (Fig. 5).



**Fig. 4** The network of language and linguistics theories (nodes represent theories; nodes, betweenness centrality; links, co-occurrences; and link width, the strength of co-occurrences)

**Table 14** Theories in terms of degree centrality

No.	Degree	Betweenness	Eigenvector
1	Coordinated management of meaning	Coordinated management of meaningd	Coordinated management of meaning
2	Altercasting	Altercasting	Altercasting
3	Psycho-linguistic theory	Psycho-linguistic theory	Psycho-linguistic theory
4	Model of text comprehension	Model of text comprehension	Model of text comprehension
5	Speech act	Speech act	Speech act
6	Language expectancy theory	Language expectancy theory	Language expectancy theory
7	Classical rhetoric	Classical rhetoric	Classical rhetoric
8	Argumentation theory	Argumentation theory	Argumentation theory

**Table 15** Top-level domains of webpages for the whole strand

TLD	Domains	%
com	21	58.3
org	10	27.8
kr	3	8.3
net	2	5.6

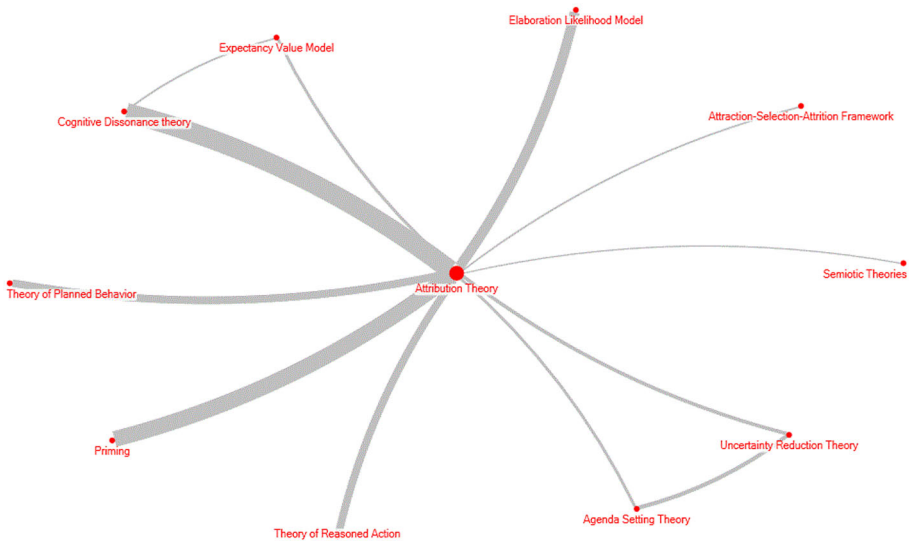
*Web visibility*

The results for the web visibility of theories in strand 5 suggest that a majority of the theories in strand 5 co-occurred in the.com domain (70.6 %), followed by the.org domain (17.4 %) and the.net domain (5.5 %). Among the.org URLs, a majority of co-occurrences



**Table 16** Sites of webpages for the whole strand

Site	URLs	%
blogfa.com	7	14.9
scribd.com	6	12.8
wordpress.com	4	8.5
komunikasi-indonesia.org	2	4.3
academypublisher.com	2	4.3
about.com	1	2.1
compfaqs.org	1	2.1
wikipedia.org	1	2.1
jaonlinejournal.com	1	2.1
jstor.org	1	2.1



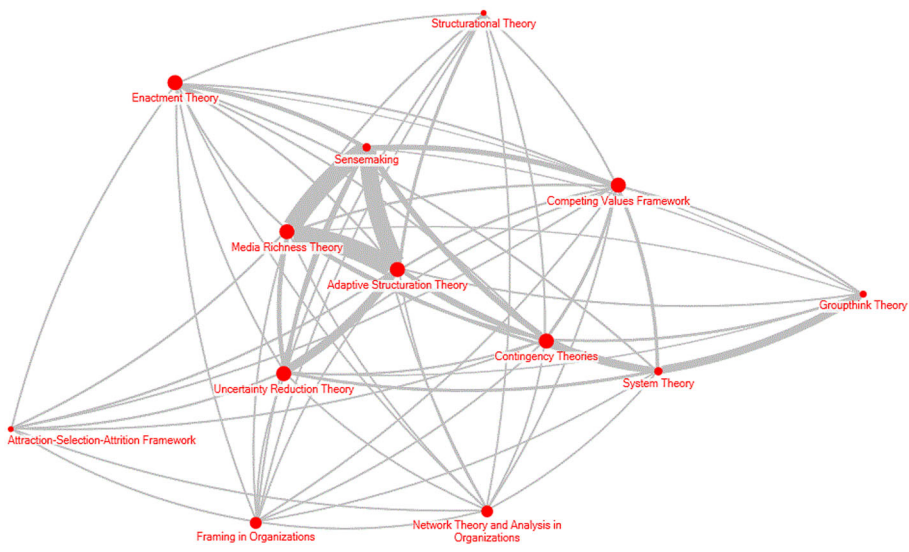
**Fig. 5** The network of public relations, advertising, marketing, and consumer behavior theories (nodes represent theories; node size, betweenness centrality; links, co-occurrences; and link width, the strength of co-occurrences)

(8.3 %) were for cios.org, and among the.com URLs, a majority were for sagepub.com. Social media sites played an important role in the web visibility of theories responsible for 28 % of all co-occurrences in strand 5.

**Strand 6: Organizational communication theories**

*Network properties*

Strand 6 included 13 organizational communication theories (OCTs). The OCT strand was composed of 13 nodes with 56 links. The average degree centrality was 10.46, the density of the network was 0.87, and the clustering coefficient was 0.90. Sensemaking, adaptive



**Fig. 6** The network of organizational communication theories (nodes represent theories; node size, betweenness centrality; links, co-occurrences; and link width, the strength of co-occurrences)

structuration, and media richness theory co-occurred frequently. Adaptive structuration theory co-occurred more strongly with uncertainty reduction theory. In terms of network properties (i.e., degree, betweenness, and eigenvector centrality), the top three theories were media richness theory, enactment theory, and contingency theory (Fig. 6).

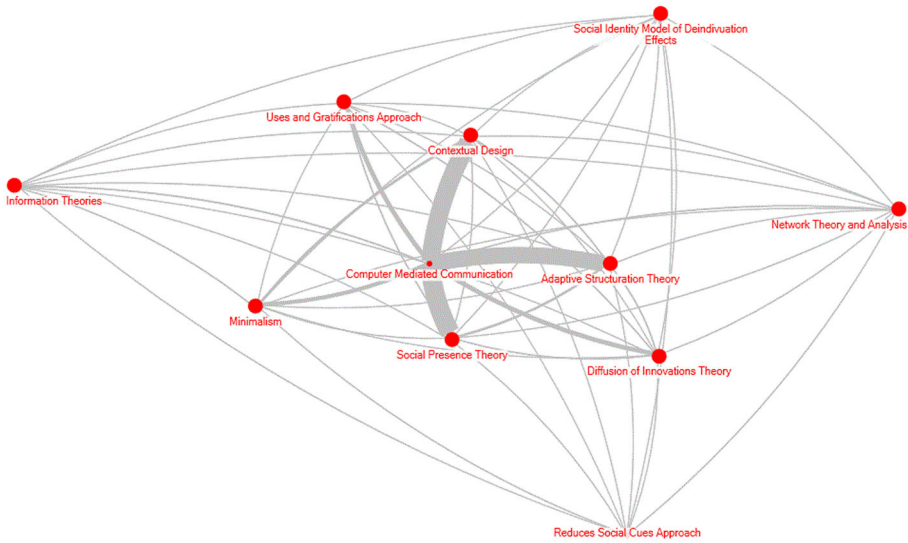
*Web visibility*

Based on the results for web visibility, a majority of the theories in strand 6 co-occurred in the.com domain (76.9 %), followed by the.kr domain (11.5 %). According to an analysis of sites of webpages for strand 6, the largest number of.com URLs was for afirstlook.com (43.0 %), followed by wordpress.com (21.0 %) and mcgraw-hill.com (10.0 %).

**Strand 7: Communication and information technology theories**

*Network properties*

Strand 7 included 11 communication and information technology theories (CITTs). The CITT strand had 108 links with 11 nodes. The average degree centrality was 9.82, the density of the network was 0.98, and the clustering coefficient was 0.98. Computer-mediated communication theory strongly co-occurred with contextual design, social presence theory, and adaptive structuration theory. In terms of network properties (i.e., degree, betweenness, and eigenvector centrality), the top three theories were the uses and gratifications approach, social presence theory, and the social identity model of deindividuation effects (Fig. 7).



**Fig. 7** The network of communication and information technology theories (nodes represent theories; node size, betweenness centrality; links, co-occurrences; and link width, the strength of co-occurrences)

*Web visibility*

As in the other strands, the theories in strand 7 co-occurred mainly in the.com domain (65.4 %), followed by the.org domain (11.5 %). According to an analysis of sites of webpages for strand 7, the largest number of.com URLs was for blogfa.com (16.7 %), followed by wordpress.com (11.1 %) and igi-global.com (8.3 %).

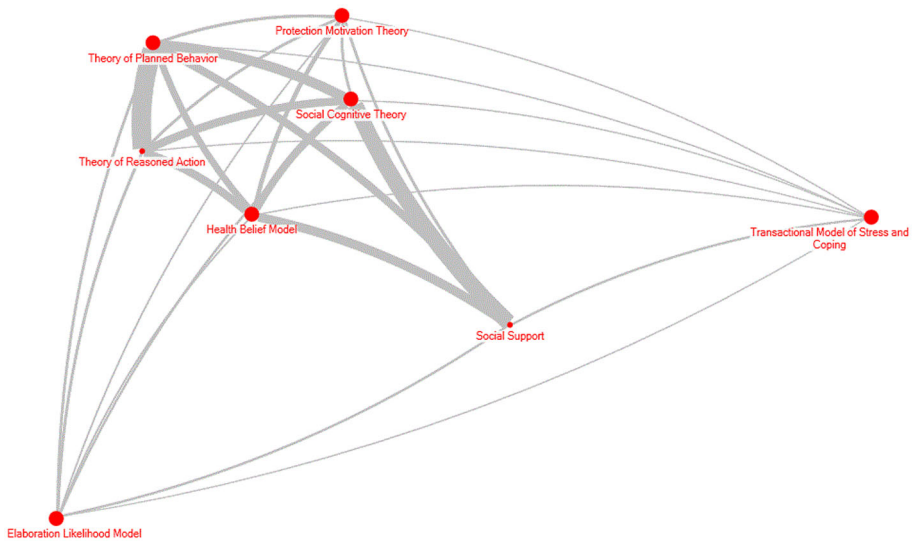
**Strand 8: Health communication theories**

*Network properties*

Strand 8 was composed of 8 health communication theories (HCTs). In the HCT strand had 58 links with 8 nodes. The average degree centrality was 6.8 and the clustering coefficient was 0.96. Computer-mediated communication theory strongly co-occurred with contextual design, social presence theory, and adaptive structuration theory. In terms of network properties (i.e., degree, betweenness, and eigenvector centrality), the top three theories were the uses and gratifications approach, social presence theory, and the social identity model of deindividuation effects. The theories that co-occurred strongly included the theory of planned behavior, the theory of reasoned action, social cognitive theory, the health belief model, and social support. In terms of degree, betweenness, and eigenvector centrality, the top three theories were the transactional model of stress and coping, protection motivation theory, and the health belief model (Fig. 8).

*Web visibility*

The theories in strand 8 co-occurred mainly in the.com domain (61.5 %), followed by the.org domain (29.5 %) and the.net domain (3.8 %). According to an analysis of sites of



**Fig. 8** The network of health communications theories (nodes represent theories; node size, betweenness centrality; links, co-occurrences; and link width, the strength of co-occurrences)

webpages for strand 8, the largest number of .com URLs was for sagepub.com (16.1 %), followed by apa.org (4.8 %), acm.org (3.2 %), and oxfordjournals.org (3.2 %). In this strand, the main role in web visibility was played by academic publishers, and social media sites (e.g., WordPress, YouTube, and wikis) played secondary roles.

### Strand 9: Media, culture, and society theories

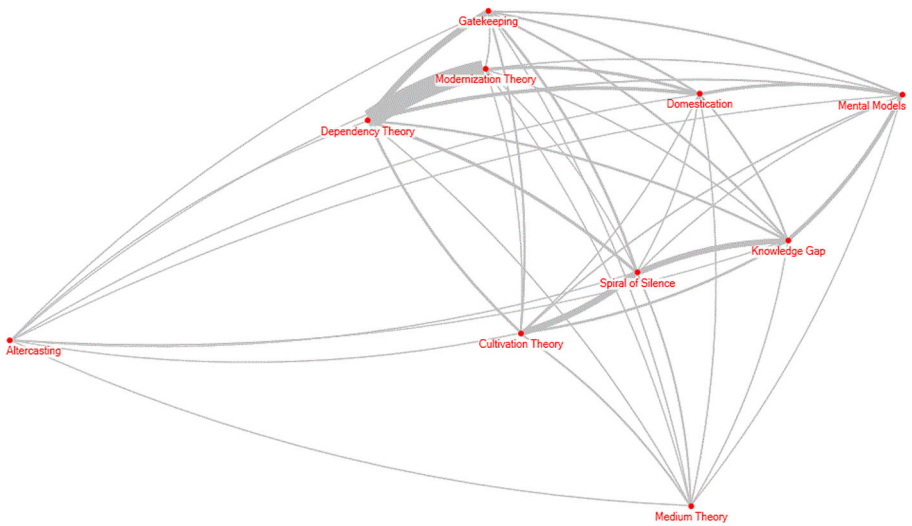
Strand 9 was composed of 10 media, culture, and society theories (MCSTs): altercasting, domestication, cultivation theory, dependency theory, gatekeeping, the knowledge gap, medium theory, mental models, modernization theory, and spiral of silence theory.

#### *Network properties*

The MCST strand had 90 links (i.e., co-occurring relationships) between 8 nodes (i.e., MCSTs). The average degree centrality (co-occurrence) was 9.0 and the clustering coefficient was 1.0. The strongest co-occurrence relationship was between modernization theory and dependency theory. In terms of degree, betweenness, and eigenvector centrality, the top three theories were dependency theory, cultivation theory, and the knowledge gap (Fig. 9).

#### *Web visibility*

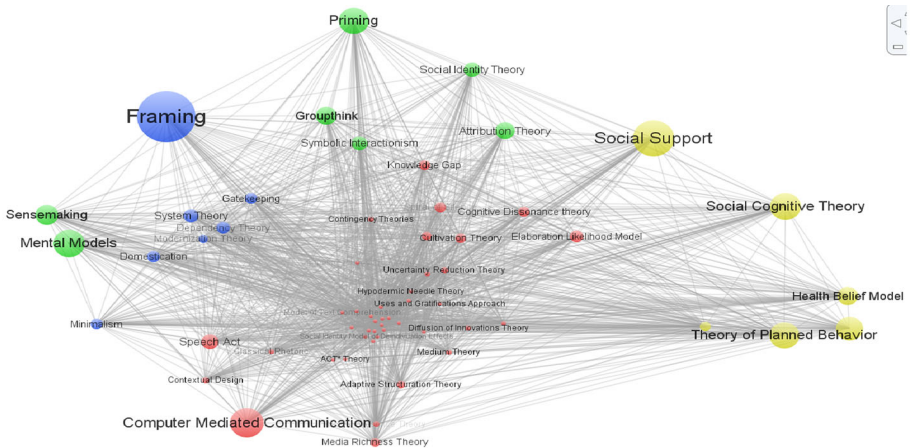
In terms of web visibility, the theories in strand 9 co-occurred mainly in the .com domain (59.2 %), followed the .org domain (25.4 %) and the .net domain (7.0 %). According to an analysis of sites of webpages for strand 9, the largest number of .com URLs was for blogfa.com (7.1 %), followed by sagepub.com, wordpress.com, and scribd.com (6.1 % each). Among the .org domains, acm.org accounted for 11.2 % of all URLs.



**Fig. 9** The network of media, culture, and society theories (nodes represent theories; node size, betweenness centrality; links, co-occurrences; and link width, the strength of co-occurrences)

### The full network: all communication theories

Figure 10 shows a full network of all communication theories. Here the nodes represent theories; node size, occurrences (the larger the size, the more frequent the co-occurrence with other theories); and links, co-occurrence relationships. Overlapping node labels are not shown. Overall, the network was composed of 62 communication theories and 3764 links. The average degree centrality was 60 (i.e., on average, theories co-occurred 60 times) and the clustering coefficient was 1.0. The color of the node represents clustering based on co-occurrences, that is, the same color for frequently co-occurring nodes. Based



**Fig. 10** The network of all communication theories

on this scheme, the theories were grouped into four visible clusters: Cluster 1 (yellow nodes on the right-hand side) consisted of theories related to social support, social cognitive theory, the health belief model, and the theory of planned behavior (other theories not shown for clarity). Some of the main theories in cluster 2 (green nodes) included priming, groupthink, sensemaking, mental models, and social identity theory, among others. Cluster 3 (blue nodes) consisted of framing, gatekeeping, system theory, domestication, and minimalism theory. Finally, cluster 4 (red nodes), the largest cluster, consisted of computer-mediated communication, the speech act, media richness, cultivation, and contextual design, among others.

*Web visibility*

In terms of web visibility, all communication theories co-occurred mainly in 370.com domains (59.2 %), followed by 154.org domains (24.6 %), 53.kr domains (8.5 %), and 39 .net domains (6.2 %) (see Table 17). According to an analysis of sites of webpages, the largest number of .com URLs was for sagepub.com (193 URLs; 5.2 %), followed by scribd.com (73; 5.0 %), afirstlook.com (37; 2.6 %), quizlet.com (32; 2.2 %), and wordpress.com (29; 2.0 %). Among the .org domains, acm.org generated 193 URLs (13.3 %) (Table 18 shows the top 15 sites and the number of URLs). Overall, social media sites played an important role in the web visibility of theories, and in some cases, they played a more important role than academic publishers. For example, wordpress.com and youtube.com together generated 52 URLs, exceeding the number of URLs generated by igi-global.com and wiley.com combined.

**Conclusions**

This study provides a better understanding of social sciences (communication sciences) by proposing another metric to describe and assess their presence and structures on the World Wide Web. Based on theory co-occurrences, communication sciences appear to have a bipolar network structure in which both academic and social websites refer to communication theories. This means that research and innovative methodologies driven by communication theories are not limited to the academic community. In addition, scholarly communication has recently been extended to the web-based communication sphere] (Gruzd et al. 2012). For example, international publishing companies have heavily promoted their papers and books beyond traditional newsletters to the general public through social media. This change in the field of science has sparked a debate on the development

**Table 17** Top-level domains of webpages for the whole strand

TLD	Domains	%
com	370	59.2
org	154	24.6
kr	53	8.5
net	39	6.2
info	7	1.1
hr	1	0.2
gov	1	0.2

**Table 18** Sites of webpages for the whole strand

Site	URLs	%
acm.org	193	13.3
sagepub.com	75	5.2
scribd.com	73	5.0
afirstlook.com	37	2.6
quizlet.com	32	2.2
wordpress.com	29	2.0
google.co.kr	25	1.7
apa.org	25	1.7
youtube.com	23	1.6
igi-global.com	21	1.5
wiley.com	20	1.4
artandculture.com	19	1.3
emeraldinsight.com	17	1.2
blogfa.com	16	1.1
safaribooksonline.com	16	1.1

of new metrics such as altmetrics, influmetrics, and complementary metrics to measure the importance and impact of the academic community (Bornmann 2014).

The results suggest that publishers, blogs, and organizations such as acm.org (.com; .org), not academic domains (.edu), are driving the relative web visibility of communication science theories. What motivates this phenomenon? Why are publishers’ websites and blogs driving most of the web visibly? Is it to sell research and get journals adopted by university libraries? One plausible explanation is that publishers are in the business of selling academic research and thus promote it to the widest possible audience to facilitate adoption and sales. Similarly, blogs appeal to widest possible audiences, and organizations want to attract more members, which motivate them to include all theories in a single website. However, the results do not offer the true rationale behind this phenomenon because the study focuses on the “what,” not “why,” aspect of web traffic. Future research should explore these questions by using appropriate methods.

This study investigates the online status of communication sciences through the lens of theoretical development by using webometric and social network analysis methods. The results show that the full network of theories in communication sciences was clustered into four major groups. Most of the theories in the first group were related to health communication, and those in the second group, to interpersonal and organizational communication, which has the same root as the rhetoric tradition. The third group included theories on communication and information technology (or new media), and the fourth group, those on mass communication. These results have important implications: First, the results indicate a gap between the study of rhetoric (or interpersonal communication) and that of mass communication even from the perspective of the World Wide Web, which is consistent with the findings of previous studies (Bryant and Pribanic-Smith 2009; Craig 1999; Littlejohn and Foss 2009; Rogers and Chaffee 1988) Some scholars (Lee 2008) have argued that the gap between the study of rhetoric and that of mass communication in communication studies is getting blurred because of the wide diffusion of new integrated media (e.g., the Internet and smart devices) and thus that scholars should examine the process of communication in a more integrated manner. For instance, it has been pointed out that “the

Internet is a multifaceted mass medium...its varied forms show the connection between interpersonal and mass communication that has been an object of study since the two-step flow associated the two" (Morris and Ogan 1996, p. 42). However, this study's results suggest that the fragmentation of subspecialties or the interdisciplinary nature of communication studies is likely to continue even if new types of communication technologies are developed and thus that communication sciences are evolving.

Second, communication and information technology has been established as a stand-alone school and emerged as a core subdiscipline. The results provide support for the view that new journals dedicated to examining new communication technologies have emerged, including the *Journal of Computer-Mediated Communication* and *New Media and Society*, in the last few decades (Lee 2008). This implies that "the discourse of the discipline is evolving around the media through which communication mainly occurs at that time" (Lee and Barnett 2006, p. 12) in many aspects. With the incredible rate of access to new communication technologies, scholarly research on the Internet, social media, and mobile phones, among others, has become crucial for examining the way in which contemporary society is organized.

The results also show that *framing theory* is an influential theory that may function as the conceptual nucleus of communication studies. To some extent, the results imply that communication sciences can be represented by studies that focus more on beneficial and detrimental effects of the mass media than those in other disciplines. From another perspective, these results highlight the nature of communication studies as an interdisciplinary discipline synthesizing theories and concepts from other disciplines. Previous research has pointed out that framing is a good example of a *research paradigm*, defining it as "a general theory that informs most scholarship on the operation and outcomes of any particular system of thought and action" (Entman 1993, p. 56) and claiming that framing theory, as a research paradigm, can be applied with similar benefits to the study of public opinion in political science; to cognitive studies in social psychology; and to class, gender, and race research in sociology. Noteworthy is that the clustering coefficient for PRAMCBTs was much lower than that for the other strands. This implies that the theories in PRAMCBTs may have more than one cluster. In other words, it is plausible that the PRAMCBT strand can be further divided into at least two distinct subspecialties (e.g., advertising and public relations and advertising and marketing) within communication studies. This result is consistent with the findings of some studies treating advertising and public relations as two distinct areas (Bryant and Pribanic-Smith 2009; Littlejohn and Foss 2009).

This study has an important limitation. The analysis considered only 95 theories in communication studies to examine the disciplinary boundary. The list of theories adopted from the University of Twente is coherent but not exhaustive and may reflect a European bias, leaving out theories in other parts of the world, including North America and East Asia, among others. In this regard, future research should consider a more comprehensive range of communication theories and employ more robust methods to develop a complete list of communication science theories representing all possible theories in the field. Alternatively, the contingency search strategy (Huang et al. 2015) may be particularly useful for identifying the so-called "sleeping beauties" (Ke et al. 2015) in communication sciences in cyberspace. In this case, caution is required because the academic Web offers a virtual environment. That is, it is more informative but less structured than academic databases such as the Web of Science. In this regard, future research should classify the context of various web content mentioning communication theories per strand. More generally, future research should expand the web presence of network structures of various



social science fields in terms of webometrics approaches and SNA measures and examine how such networks vary over time. Finally, the data were collected only in 2011. The field of communication sciences is rapidly changing as a result of technological innovation, and therefore the results for two points in time (2011 and 2015) may differ. In this regard, future research should investigate any potential changes over time. From an evolutionary and convergence perspective (Barnett and Thayer 1997), however, the latest network is formed through the self-replication of previously existing forms. That is, the structure of communication theory for the Web is not likely to show significant and sudden changes in its network properties.

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