Communication Theory and the Mapping of Ideas in Cyberspace

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Brian H. Spitzberg
School of Communication
S.D.S.U.

The www and the technologies of mapping it are growing faster than the ability to understand their profound and variegated effects. Communication theories are evolving rapidly, but not as rapidly as the technologies themselves. For example, there are increasingly promising developments in the application of online and www-based data-mining in the understanding of social groupings (Chau & Xu, 2008; Li & Wu, 2010; Papacharissi, 2009; Perez et al., 2010; Subrahmanyam, 2008; Sui, 2010; Worboys, 2010; Zook, 2010), disease vectors (e.g., Balcan et al., 2010; Chute, 2008; Collier et al., 2006; Collier et al., 2008; Hu et al., 2008; Madan et al., 2010; Van den Broeck et al., 2011; Vasquez-Prokopec et al., 2010), natural disasters (e.g., Procopio & Procopio, 2007; White, 2010), disaster response (e.g., Comfort, 2010), protest and crowd formation (e.g., Caverlee, 2010; Earl & Kimport, 2008), militias and hate-based groups (e.g., Brown, 2009; Freilich & Pridemore, 2005), and terrorist networks (e.g., Chau & Xu, 2007; Chen et la., 2008; Ellis, 2008; Elovici, et al., 2008; Fienberg, 2008; Qin et al., 2007; Reid, 2011; Reid & Chen, 2007a, 2007b; Seib & Janbek, 2011; Shahar, 2008; Sun et al., 2008; Trujillo et al., 2008; Xu & Chen, 2008; Xu & Zhang, 2008; Yilmazel et al., 2008). Even these developments, however, appear largely method-driven rather than theory-driven. Consequently, there is a need for theories that can be cast at relatively broad conceptual levels to accommodate the rapid changes brought about by changing communication media and the data-mining methods providing insights into these processes. Past theories may provide important bridges to span understanding with technology.

At the macro theoretical level, the primary role of the internet is the diffusion of information, which can be understood by two interrelated sets of theoretical traditions—network theory and diffusion of innovations. *Network theory* is a context-independent approach to understanding interactions at a purely structural level (C. Stohl & M. Stohl, 2007; M. Stohl, 2008). Sources of information (nodes) distribute information to and from other nodes, marking a path (links), which represent *relational-level* data. The greater the number of nodes, and the greater the number of inter-linkages among them, the denser and more integrated the network is.

Social Networks Theory

A host of related laws and principles arise from the self-organizing and systemic processes involved when entities link in through information. Developments in the realm of social networks (Barabási , 2002, 2010) have led to an emerging meta-theory of network dynamics. Some of the core assumptions derive from classic information (e.g., Cherry, 1957; Pierce, 1961; Shannon & Waver, 1964; von Foerster, 1953; Wiener, 1948) and general systems theory (e.g., von Bertalanffy, 1968, 1975; Wilden, 1980). C. Stohl and M. Stohl (2007; M. Stohl, 2008) have articulated certain assumptions about the nature of networks, including: (a) Networks are *message systems*, and as such, function as sense-making, role-identification, and inspiration; (b) networks are multiplex (i.e., multifunctional), historically and situationally grounded message systems that reflect and maintain their developmental roots; (c) networks are multi-level, multi-jurisdictional "temporary, dynamic, emergent, adaptive, entrepreneurial, and flexible structures" (p. 106) that can defy hierarchical and linear top-down organizational structure; (d) Boundary specification needs to distinguish between *networking* (i.e., being able to interact within and between network elements) and *network control* (i.e., executive-level coordination, membership

selection and exclusion, operational activation and direction, etc.); and (d) networks can be local, global, heterogenous or homopholous, or any combination of these facets.

Other axioms of networks can be articulated, including:

- *Structure*: Function follows form, and form is not random.
- *Emergence*: systems evolve toward a state of relative homeostasis ("a network property is emergent if it changes by a factor of 10 as a consequence of a dynamic network achieving stability….This is the impetus behind online social networks that begin with nothing, and end up with millions of subscribers" (Lewis, 2009, p. 19-20).
- *Dynamism*: Structure evolves due to system properties and processes.
- *Autonomy/Self-determination:* Networks emerge from voluntary (bottom-up/horizontal) linkages among elements more than causal (antecedent or distal) or hierarchical (top-down) forces.
- *Entropy & Adaptation*: Initial configurations of systems decay, or must adapt by absorption and utilization of resources from outside the system.
- *Evolution*: The topology (structure) of systems changes through natural selection processes (i.e., "Darwinian" forces).
- *Power*: "The power of a *node* is proportional to its degree (*n* of links connecting it to the network) influence (link values); and *betweeness* or *closeness;* the power of a *network* is proportional to the *n* and strength of its nodes and links" (Lewis, 2009, p. 21).
- *Stability*: The stability of a system can be mapped by rates and directions of change in trajectory or oscillations.
- *Nonsummativity*: Any system produces properties different from the mere sum of its parts.
- *Equifinality*: Any given path may end up in any of many different endpoints.
- *Multifinality*: Many different paths may end up in the same (or a given) end point.

Diffusion of Innovations

As ideas are adopted and spread out across a network over time, it represents a process understood as the *diffusion of innovations* (Rogers, 2003; Thompson et al., 2006). A "diffusion is a special type of communication concerned with the spread of messages that are perceived as new ideas" (Rogers, 2003, p. 35). Such diffusion patterns may yield important insights into their adoption, and the influences such adoptions portend for events as diverse as hate groups and militia, natural disasters and human crises, and the marketing of new products. Such decisions by information users to seek or pass on ideas represent a "process through which an individual (or other decision-making unit) passes from first knowledge of an innovation to forming an attitude toward that innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision" (Rogers, 2003, p. 37).

The theory has demonstrated with unprecedented success the cross-domain generality of basic stages of diffusion of practices and knowledge through social groups, and the roles that are required for people to play in the process of this diffusion (Thompson et al. 2006). Information tends to traverse the stages of *knowledge* (exposure to the idea), *persuasion* (attitude formation), *decision* (activities of choice), *implementation* (application) and *confirmation* (seeking reinforcement for choices), regardless of the scale or group at which such diffusion occurs. Throughout these stages, certain individuals or groups play important functional roles in mobilizing the diffusion through time and space, including *opinion leaders* (those who evaluate initial information and seek group consensus), *facilitators* (those who assist groups in implementation of ideas), *champions* (rhetorical proponents and transformational leaders), *linking agents* (liaisons who facilitate work across divergent groups), and *change agents* (those who facilitate the self-sufficiency of the adopting group).

CMC Competence

In order to understand such processes, ultimately a more micro theoretical approach is also needed, which can be broadly conceptualized through a computer-mediated communication (CMC) model of individual user competence. Computer-mediated communication (CMC) theories and research have been proffered to account for individual and contextual factors affecting the selection (van den Hooff et la., 2005; Walther & Bazarova, 2008) and competence of CMC (e.g., Spitzberg, 2006)

CMC competence refers to the appropriate and effective use of information technologies (Spitzberg, 2000, 2006, 2009a, 2009b; Spitzberg & Cupach, 1984, 2002). The conceptually integrative model of computer-mediated communication (CMC) competence consists of five basic components (Spitzberg, 2006). People are more likely to be competent users of CMC to the extent they are (a) motivated, (b) knowledgeable, and (c) skilled within a given (d) context of usage, which produce relatively favorable or unfavorable (e) outcomes. Specifically, in the context of the spread of influence in the WWW, a person who is (a) more motivated to generate, use, and distribute information, (b) who is more knowledgeable about the technologies and the topic(s) involved, (c) who is more skilled at actually using such technologies in the process of communicating, and (d) has more facile contextual incentives and fewer contextual delimitations, is more likely to (e) succeed in influencing the diffusion of information via the internet.

Motivations for CMC use will vary from user to user, and context to context. Research message processing (e.g., uncertainty reduction theory; Berger, 2010; Roskos-Ewoldsen & Roskos-Ewoldsen 2010) indicates that people are motivated to reduce their uncertainty regarding events in their environments. Research on universal values (e.g., Fontaine et al., 2008; Schwartz, 2007; Schwartz et al., 2001) provides potential linguistic vocabularies for the particular weighting of such events. Knowledge of CMC will depend on educational, socioeconomic, accessibility, exposure, and peer influences. Skills will be honed through modeling, usage and feedback processes, and reinforced by outcomes of such usage. The context of CMC involves a variety of factors, including the need for privacy, velocity, emotional content, persuasiveness, presence, and exposure of messages. The outcome of CMC use will both depend on the motivations, as well as provide an index of the competence (i.e., appropriateness and effectiveness) of the application of messages within the medium.

Seeking ways of integrating these micro and macro theoretical perspectives, in the cause of understanding geospatial and sequential processes of internet diffusion of information, holds promise in revealing the true nature of internet influences. Integration of the more micro theory of CMC competence and the more macro theory of diffusion of innovations will seek a model capable of incorporating other mid-range theories of CMC use (e.g., Walther, 2010) and intergroup communication (e.g., Ellis, 2010; Gupta, 2001; Soliz & Giles, 2010; Turner, 1990). Such a model thereby seeks to accommodate the micro-macro divide of theory construction, and provide a heuristic framework for moving the interdisciplinary study of communication in cyberspace, in real space. To fulfill the potential of such an integrative model will require extensive data across multiple domains, as well as sophisticated methods for their analyses.

Of Methods and Media

The structure of online and www-based communication can be ascertained by various approaches to mining word co-occurrence (e.g., Oshawa et al., 2002), centrality (Corman et al., 2002), sentiment analysis (e.g., Bai, 2011; Chute, 2008; Li & Wu, 2010), as well as the relational forms of data manifest less in the message content itself, and more by the linkages within and across communication networks (e.g., Monge & Contractor, 1998), social networks (e.g., Cupples, 2010; Kempe et al., 2003; Papacharissi, 2009; Perez et al., 2010; Singh et al., 2010), emails (e.g., Matsumura & Sasaki, 2007), and websites (e.g., Elmer, 2006). In particular, algorithms and structural topographical configurations and calculations (e.g., Sen & Davulcu, 2010; Shekhar & Dev Oliver, 2010) are increasingly suggesting patterns that may provide unique geospatial network “fingerprints” that distinguish the evolution of different

social dynamic processes (e.g., Worboys, 2010; Zook, 2010). For example, several scholars have suggested that there may be narrative markers of health-based (Little et al., 2003) and hate-based or terrorist groups (e.g., Brown, 2009; Hoffman, 2005; Leets & Bowers, 1999). Such markers may be discernable through various data-mining techniques.

Future Directions

All sound theory development involves an iterative process of comparing data to theory, and theory back to data. In working with the *Mapping Cyberspace* group at San Diego State University, and by attempting to incorporate data from multiple lines of inquiry currently being pursued across the globe, the intent is to merge conceptual structures of the nascent theoretical concepts identified here with the patterns emerging from the data. Over time, the hope is a general set of conceptual terms, structures, axioms, and predictions that will assist in both understanding the spread of ideas in cyberspace, but the extension of such understandings to practical forms of intervention for the enhancement of social capital and welfare.

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