Technology-Mediated Social Participation: The Next 25 Years of HCI Challenges

Ben Shneiderman

Dept of Computer Science & Human-Computer Interaction Lab,
University of Maryland, College Park, MD 20742 USA
Email: ben@cs.umd.edu Twitter: @benbendc

Abstract. The dramatic success of social media such as Facebook, Twitter, YouTube, blogs, and traditional discussion groups empowers individuals to become active in local and global communities. Some enthusiasts believe that with modest redesign, these technologies can be harnessed to support national priorities such as healthcare/wellness, disaster response, community safety, energy sustainability, etc. However, accomplishing these ambitious goals will require long-term research to develop validated scientific theories and reliable, secure, and scalable technology strategies. The enduring questions of how to motivate participation, increase social trust, and promote collaboration remain grand challenges even as the technology rapidly evolves. This talk invites researchers across multiple disciplines to participate in redefining our discipline of Human-Computer Interaction (HCI) along more social lines to answer vital research questions while creating inspirational prototypes, conducting innovative evaluations, and developing robust technologies. By placing greater emphasis on social media, the HCI community could constructively influence these historic changes.

Keywords: social media, participation, motivation, social network analysis, user-generated content, Open Government, collective intelligence, collective action, community design, wikis, blogs, discussion groups, reader-to-leader framework

1 Introduction

Generations of philosophers, psychologists, sociologists, and other social scientists have wrestled with deep questions about what motivates people to behave helpfully or harmfully. They also considered how to encourage people, organizations, and nations to resolve conflicts and how to inspire students, citizens, or employees to participate more creatively. Other important questions revolve around how trust grows, respect emerges, responsibility is accepted, and empathy is encouraged.

Contemporary researchers ask questions about what constitutes appropriate respect for privacy, when does online joking becomes bullying, or what constitutes fair use of others' creative work. These researchers also want to serve the growing numbers of community managers and social entrepreneurs who are seeking design guidelines, metrics of success, and strategies for stimulating social participation.

Getting validated guidance is gaining importance as social media enable much more frequent social contacts, contributions, and collaborations among larger numbers of people, covering a wider array of social situations. Advocates see this historical moment as a utopian opportunity that can restore failing economies, hasten business innovation, and accelerate citizen participation in government [1,2 3].

At the same time, critics complain that these technology-mediated relationships are necessarily shallower because they lack the richness of face-to-face contacts and are diffused across a larger number of people [4,5,6,7]. These critics worry about the deterioration of personal relationships, reduced capacity for groups to generate transformative social movements, higher likelihood of contentious public discourse, balkanized scientific communities, and much more. While business coordination, citizen participation, and international collaboration may be facilitated, there is a risk of reduced corporate loyalty, oppressive governments monitoring citizen communications, and destructive cyber-warfare.

2 Defining Technology-Mediated Social Participation (TMSP)

The increased use of social media has taken on new forms from personal blogs that allow lengthy thoughtful, often passionate, commentaries read by those with shared interests to the steady stream of 140-character tweets broadcast to hundreds of diverse followers and possibly retweeted to thousands more. Vigorous participation in social networks encourages awareness, responses, and sometimes serious discussions among "friends", while well-crafted YouTube videos can go viral when the web address is emailed, tweeted, posted to blogs, or mentioned on national television. The remarkable capacity of collaborative tools encourages massive coordinated efforts such as Wikipedia or beneficial collective intelligence projects such as film recommender systems, product review websites, or governmental knowledge sharing such as the U.S. State Department's Diplopedia. User-generated content sites also include photo sharing such as Flickr, music sharing, poetry, political essays, how-to, question-answering, open source software, and much more.

Controversies rage over the volume of benefits and the degree of harm produced by these user-generated content strategies. Utopian visionaries foresee empowered creative individuals, improved family communication, thriving resilient communities, outpouring of business innovation, citizen participation in policy decisions, and resolution of international conflicts.

Fearful critics complain about distracted attention, breakdown of family values, and digital Maoism that requires unpaid labor thus destroying jobs. They worry about increasingly contentious public discourse, uncontrolled spread of harmful cultural norms, and imposition of undesired economic policies on weaker international partners. Some critics disparage these social connections as lightweight and unable to produce committed participation that is necessary for social change [6]. They believe that social media only generate weak ties, while strong ties are needed to transformative activism. These claims may be true, but many respondents believe that large numbers of weak ties are a helpful and maybe necessary precursor to

developing stronger ties among a narrower group of activists who ultimately produce potent changes.

Certainly the story of Jodie Williams is instructive and inspirational. She generated global email and discussion group communities to build strong ties that led to a successful movement to ban land mines, for which she received the Nobel Peace Prize. Another instructive example is the substantial social media response to the December 2009 Haitian earthquake. Not only did relief groups coordinate by way of social media, but millions of people texted a $10 contribution to the Red Cross in support of emergency responses. Never before had such a large amount of money been collected so quickly. Another form of social response was the rapid formation of Crisis Camp software marathons to generate software that helped map the disaster in areas where there had not been detailed street maps and software that produced translations from Haitian dialects for which there were no existing tools.

The benefits and harms from general social media are of broad interest and will produce extensive research from companies and e-commerce researchers, plus entertainment and social analysts who value these playful and discretionary technologies. At the same time there are important questions when these same social media are applied to national priorities and life-critical activities such as disaster response, community safety, health/wellness, energy sustainability, and environmental protection. These applications and contexts should become the focus of Technology-Mediated Social Participation (TMSP) research agendas.

An even larger circle of applications is included when the Open Government movement in many countries becomes part of the research agenda. In the United States, President Obama's Open Government Directive covering transparency, collaboration, and participation [8]. Data sharing at U.S. government web sites such as data.gov and recovery.gov have already changed agency practices and public discourse in many areas, but greater changes will come as participation is solicited through contests, challenges, volunteer invitations, expert review of proposed regulations, and national, state, and local service projects.

3 Setting a Research Agenda

Resolving the differing impressions about the benefits or harm of TMSP is more than an important challenge for community, business, and national leaders. It also leads human-computer interaction researchers to deal with profound scientific questions about individual behavior, collaborative strategies, community engagement, and international cooperation. By embracing these challenges, we can redefine HCI more broadly, maybe even signaling the change which a fresh name such as "human-community interaction" or even "human-social interaction (HSI)."

These shifts and name changes would refresh our research community with compelling research challenges that would lead us toward more profound questions. By embracing ambitious interface design goals and integrating new social science research questions, we would gain the chance to influence the still unfolding design of social media technologies and their applications. These opportunities bring trillion-dollar business possibilities and social transformation potentials that will shape

civilization for centuries. Entrepreneurs will rush towards these possibilities, while scientific researchers from many disciplines will have a remarkable historic opportunity to develop profound theories about foundational aspects of individual, family, group, organizational, and national behaviors.

These questions have been studied for centuries, but the unique possibilities are that for the first time in history massive data about actual human activity is easily available for analysis. This information-abundant environment enables statistical analysis of billions of data points representing actual behavior, rather than a small sample survey of biased perceptions, constructed attitudes, or filtered reports of remembered activities.

The availability of abundant data is good news, but the algorithms for statistical, data mining, and machine learning methods, visualization tools, and methods for visual analytics are yet to be developed so as to study these compelling and deep science questions. Several research communities have identified this opportunity, most notably the promoters of web science [9]. Other sources include early efforts at social network analysis that go back almost a century, but only now are the software tools becoming available to do complex analysis and produce meaningful visualizations that show important patterns, clusters, relationships, anomalies, and outliers. A century of research is needed to develop novel mathematical methods and efficient algorithms to handle these new challenges, when data sets include millions and billions of vertices and edges.

Efficient algorithms are essential, but they may not be sufficient to give the rapid results that promote exploration. Just as specialized computer chips, known as Graphic Processing Units (GPUs), were needed to enable rapid manipulation of 3D environments represented by triangular meshes and enriched by visually compelling texture mapping, specialized computer chips, let's call them Social Processing Units (SPUs), may be necessary to handle network analysis computations. The algorithms for computing network metrics such as betweenness centrality, PageRank, or eigenvector centrality are difficult to implement on standard parallel computing architectures because most graphs defy clean data partitioning. Similarly, the growing ensemble of clustering algorithms that identify closely-connected communities require massive computational power as networks grow and linkages become denser. Finally, much greater computational power is needed to run the aggregation methods that simplify graphs so that they can be visualized by the growing family of layout strategies that users chose from to extract varying insights.

Early research by physicists and mathematicians produced attention-grabbing results describing scale-free and small-world networks generated by principles such as preferential attachment [10,11,12,13]. Then a new generation of computer scientists went further in integrating social science questions producing more applicable insights about strong vs. weak ties, sentiment prediction, and degree of participation [14,15,16]. As computational social scientists promote research in massive data sets [17], the community of researchers has grown dramatically, and funding is increasing from defense agencies, as well as national science agencies, national health funders, and an array of corporate sponsors.

There still is resistance to these new topics as entrenched disciplines skillfully lobby for support of their research agendas. They will not yield easily, so the HCI community and others who recognize this historic shift will have to collaborate

effectively to compose a thoughtful and persuasive research agenda with realistic short-term and captivating long-term goals. Our request for massive funding shifts will be most effective if we engage with many disciplines, develop deep scientific theories and describe extreme technology challenges, all with well-documented linkages to societal benefits.

To help promote discussion of research agendas, we (myself, Jennifer Preece, and Peter Pirolli) obtained a U.S. National Science Foundation grant to conduct two 30-person workshops among leading academics, industry researchers, government staffers, and younger graduate students (www.tmsp.umd.edu). The first workshop was held in Palo Alto, CA on December 10-11, 2009 so as to attract West coast researchers and industry researchers and the second workshop was held in Arlington, VA on April 22-23, 2010 to facilitate participation by East coast academics, NSF staff and other government staffers.

The workshops participants identified several themes and formed discussion groups spanning 6-9 months to develop six jointly authored articles, which were published in the November 2010 issue of *IEEE Computer* as the cover feature, with an introduction from the three workshop organizers [18]. The topics of the articles were scientific foundations [19], interface design issues [20], research infrastructure needs [21], health/wellness possibilities [22], open government policies [23], and educational needs from K-12 through life-long learning [24].

In addition to health/wellness and open government applications, these detailed TMSP research plans highlighted applications in disaster response, energy, education, culture and diversity, environment & climate, citizen science, economic health, globalization & development, political participation, local civic involvement, and public safety (Table 1). The article on scientific foundations outlined new directions for theories, giving a sense of the scientific research opportunities that were neatly interwoven with practical problems.

4 New Theories and Innovative Research Methods

The range of TMSP theories needed is staggering, from *descriptive* theories that come from cleaned and aggregated data organized into meaningful insights to *explanatory* theories that present cause and effect patterns. These theories lay the foundations for *prescriptive* theories that provide guidelines and best practices for interface designers, community managers, and policy makers. In some situations *predictive* theories will be precise enough to forecast the evolution of social networks and the outcomes of collective action projects. Occasionally, deeper insights will lead to *generative* theories that suggest new social media strategies, novel methods for limiting malicious behavior, and new goals for collective action and international cooperation. These five flavors of theories are only a starting point, others forms of theories are likely to emerge as well to accommodate the breadth and depth of this vast research frontier.

Domain	Expected Benefit
Healthcare	Unite professionals and citizens in one center to gain information and to support and improve research and policy
Disaster response	Improve emergency response through citizen feedback and better response planning.
Energy	Facilitate creative thinking about energy alternatives and policies to bring new, environmentally friendly sources to the fore.
Education	Help make educational practices and policies more cost-effective.
Culture and diversity	Enhance understanding of the cultural variations both within and between societies.
Environment & climate	Enable broader understanding of the issues involved in the environment and climate change.
Citizen science	Promote the participation of citizens in areas of science where individuals can make useful contributions.
Economic health	Engage a broad base of citizens in thoughtful discussions about economic policies.
Globalization & development	Foster a better understanding of the emerging global economic and political realities.
Political participation	Increase informed political participation at all levels of government.
Local civic involvement	Cultivate increased understanding of ways to engage in local community activities.
Public safety	Encourage citizen participation in sharing information that can make their communities safer.

Table 1: Potential domains of application of TMSP and the expected benefits. Adapted from [21].

Ideally, fresh theories lead to innovative research questions that require novel research methods [25]. The research methods for social media could bring the greatest change. The past 400 years of traditional science research in physics and chemistry has been governed by belief in the reductionist approach and replicable laboratory-controlled experimentation. Scientists would change a small number of independent variable, e.g. temperature or pressure, control other variables, e.g. electrical or magnetic fields, and measure the impact on dependent variables, e.g. resistance or expansion. The reductionist approach also influenced observational methods in botany, geology or astronomy, in which data was collected and analyzed to find relationships among variables that could be verified by independent researchers.

In the world of Technology-Mediated Social Participation, there may be new challenges for these traditional assumptions of reductionism and replicability. The variables of interest in TMSP include trust, empathy, responsibility, and privacy that are still hard to define and difficult to measure. Even frequently-discussed variables such as motivation, persuasion, self-efficacy, technology acceptance, and universal usability defy simple measurement beyond subjective scales that produce volatile and nuanced responses. Shifting to measurement of actual behaviors will be helpful in raising validity, but the tightly intertwined reactions of users means that context matters, familiarity is central, and results may be very different six months later when users are more or less trusting. The impact of privacy policy changes on trust for discretionary playful services such as film rating communities may be very different from life-critical systems such as disaster response or health discussion groups describing cancer treatment experiences.

If reductionism and replicability need to be redefined or replaced, how will journal reviewers revise their definitions of rigorous research? Can case studies move beyond hypothesis generation to become acceptable strategies to gather evidence that supports hypothesis testing? Maybe the examples of medical and business researchers could be useful, as they have developed standards for rigorous case study research that when repeated helps collect evidence in support of hypotheses [26]. Already, strategies such as Multi-dimensional Long-term In-depth Case studies (MILCs) are being applied to exploratory and discovery tools, such as in information visualization [27].

New forms of theories based on novel mathematics could emerge as they did in the early 20th century for quantum physics and statistical mechanics. Strange entanglements, maybe different from the quantum kind, are common in human experiences and statistical methods may nicely account for aggregated human behaviors, even as the actions of an individual are unpredictable.

The enduring questions of raising human motivation have taken on new importance in the age of social media. Wikipedia is a great success story because of its innovative strategies for motivating users to contribute their knowledge and to collaborate with others. But even in this success story, only one in a 1000 readers become registered contributors, and even fewer become regular collaborators who work together over weeks and months. Similarly, while there are billions of viewers of YouTube the numbers of contributors of content is small. Motivation or persuasion is an ancient human notion, but the capacity to study it on a global scale is just becoming a reality. The move from controlled laboratory experiments to interventions in working systems is happening because designers and researchers have enabled the capture of usage patterns on a scale never before possible.

The Reader-to-Leader Framework [1] (Fig. 1) provides an orderly way of discussing motivational strategies and conducting research [28]. It suggests that users become readers by way of recommendations from friends, news media reports, web searches, and a hundred other techniques. Then readers may see contributions made by others and register so as to edit existing information or add new content, reviews, or ratings. The occasional contributor might evolve into a frequent contributor or go to the next step which is collaborating with others to plan new content. Some contributors become increasingly committed to the project and can develop strong

relationships with other contributors. Then some contributors become engaged in governance, setting policy, dealing with problems, or mentoring newcomers. At each stage innovative entrepreneurs and researchers have developed interface design and motivational strategies such as showing the number of views of a video, enabling ratings of contributions, honoring richer collaborations, and empowering leaders.

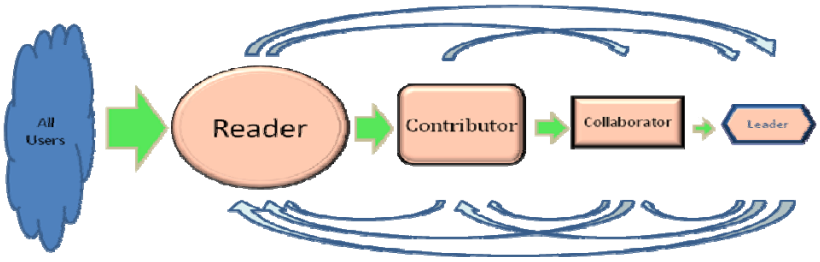

Fig. 1. The Reader-to-Leader Framework suggests that the typical path for social media participation moves from reading online content to making contributions, initially small edits, but growing into more substantive contributions. The user-generated content can be edits to a wiki, comments in a discussion group, ratings of movies, photos, music, animations, or videos. Collaborators work together over periods of weeks or months to make more substantial contributions, and leaders act to set policies, deal with problems, and mentor new users [28].

Many other theories and frameworks are being proposed as commercial, government, and academic researchers rapidly expand their efforts. Traditional social science theories are being adapted to understand, predict, and guide designers who seek to increase trust, empathy, responsibility, and privacy in the online world [29, 30, 31]. Similarly, mathematical theories of network analysis are being enhanced to accommodate the distinctly human dynamics of online social systems. The shift from descriptive and explanatory theories that are based on statistical analyses and data mining to predictive and prescriptive theories that provide guidance for community managers is happening rapidly, but much work remains to be done.

5 Pursuing Reliable, Secure, and Scalable Technology

The past 40 years of computing technology have produced remarkable progress. Strong credit goes to the chip developers who made the rapid and sustained strides characterized by Moore's Law – doubling of chip density, speed, capacity every 18 months. Equal credit goes to the user interface designers who opened the doors to billions of users by creating direct manipulation interfaces based on carefully designed menus, effective graphical interfaces, convenient input devices, and comprehensible visual presentations.

The current agenda is rapidly moving to encompass the large-scale social media communities, such as the half billion users of Facebook and the four billion users of cell phones. Newer services such as Twitter have acquired more than 100 million

users with billions of exchanges per month, but that is just the beginning. As individuals, organizations, companies, and governments increase their usage, the volume and pace of activity will grow bringing benefits to many users, but so will the impacts of service outages, privacy violations, and malicious attacks.

Developers now recognize the primacy of the user interface in determining outcomes, so there is increased research, training, and exploratory design. Simultaneously, there is a growth in tools for community managers to track, analyze, and intervene in social media networks to as to promote more positive outcomes. These tools will also be useful to researchers as they develop predictive models of network evolution, detect regions or growing or declining activity, and formulate theories of what motivates participation.

One such effort is the free, open source NodeXL Project (Network Overview for Discovery and Exploration in Excel), which is supported by Microsoft Research (www.codeplex.com/nodexl). This tool enables importing of social media networks from Outlook, Twitter, YouTube, Flickr, WWW, etc. into Excel 2007/2010, and then gives users powerful analysis tools, plus rich visualization support [32,33] (Fig. 2).

NodeXL was designed to speed learning by social-media savvy community managers and business professionals who already use Excel, as well as by undergraduate and graduate students who are learning social network analysis. By providing easy import of data from important social media tools, NodeXL dramatically expands the community of users who can carry out analyses that lead to actionable business insights and research studies. NodeXL provides a rich set of visualization controls to select color, size, opacity, and other attributes of vertices and edges. The variety of layout algorithms and dynamic query filters allows users to tune the display to their needs. Varied centrality metrics for directed and undirected graphs, as well as a growing number of clustering algorithms, support exploration and discovery. NodeXL is an ongoing project that will be supported through the emerging Social Media Research Foundation (www.smrfoundation.org).

6 Conclusion

These new TMSP research directions expand the scope of HCI research, shifting the emphasis from psychological to sociological issues, while engaging with new communities of algorithm developers, statistical data analysts who work with huge data sets, privacy protection researchers, and application specialists in new domains, especially e-government. TMSP also bring HCI researchers even more actively into the arena of mobile, ubiquitous, and pervasive technologies, while increasing the importance of attending to universal usability and international development. The possibilities for breakthrough science and transformational applications seem high, so there are a rapidly growing set of conferences and journals to serve these emerging topics [34]. While enthusiasm and optimism for TMSP is warranted, there should also be concern about the dangers of privacy violation, misleading information, malicious attacks, lack of universal usability, and failures during peak loads, such as during disasters. Since there are also dangers of use of this potent technology by

criminals, terrorists, racial hate groups, and oppressive governments, our community will have to develop ethical standards and work to promote positive social values.

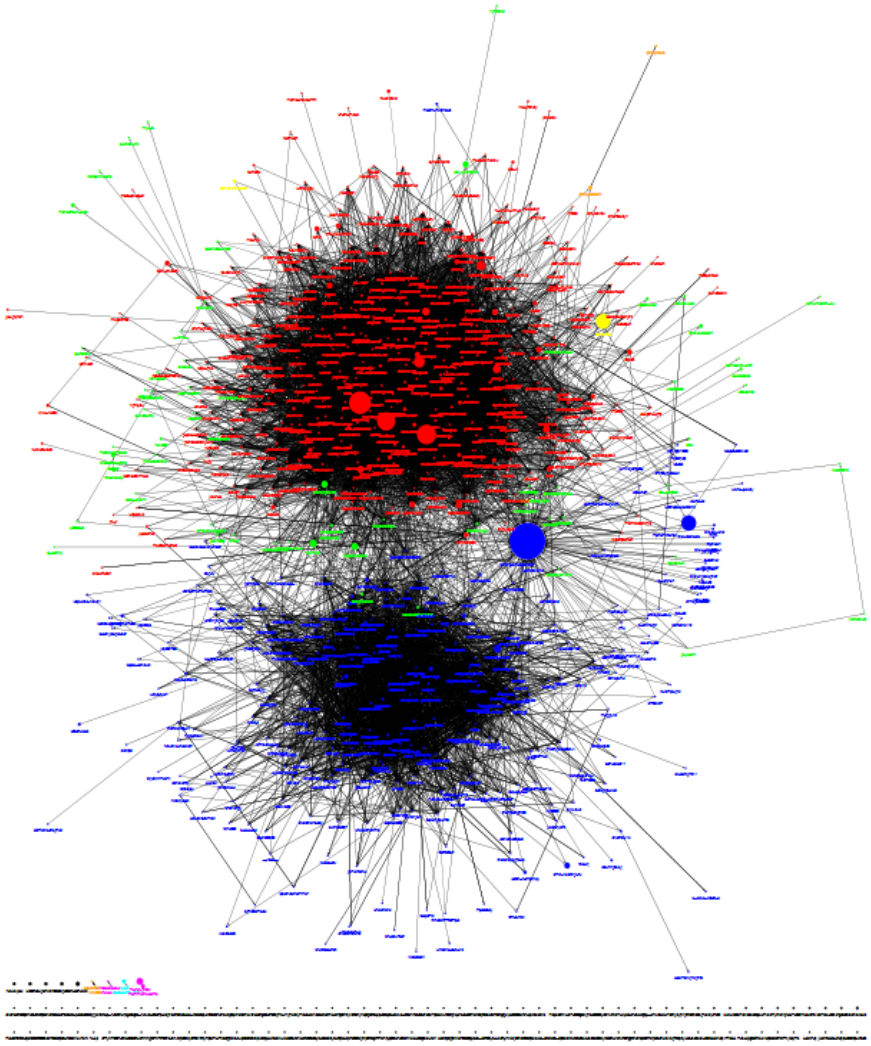

Fig. 2. This network shows connections among the Twitter users who mentioned #GOP when queried on January 8, 2011, with node size proportional to numbers of followers. The clusters are created by the patterns of connections (follows, replies, and mentions) among the authors in the graph. The clusters were based on Newman-Moore algorithmic analysis in which the Red cluster is composed of GOP supporters, while the Blue cluster contains critics and opponents of the GOP as indicated by the content of the tweets from each cluster. Other colored or shaped

nodes are not strongly affiliated with either major cluster. (Created by Marc A. Smith using NodeXL http://www.codeplex.com/nodexl)

Acknowledgments. Thanks to the community of U.S. National Science Foundation workshop participants (www.tmsp.umd.edu) supported by grant IIS-0956571, the NSF Social Computational Systems grant IIS-0968521, the NodeXL team (www.codeplex.com/nodexl) supported by Microsoft External Research, and the University of Maryland Human-Computer Interaction Lab. I appreciate comments on the draft from Constantine Stephanidis, Gavriel Salvendy, and Jennifer Preece.

References

1. Tapscott, D. and Williams, A. D., *MacroWikinomics: Rebooting Business and the World*, Portfolio, New York (2010).
2. Shirky, C., *Cognitive Surplus: Creativity and Generosity in a Connected Age*, Penguin Press, New York (2010).
3. Surowiecki, J. (2004). *The wisdom of the crowds*. New York: Random House.
4. Mozorov, E., *The Net Delusion: The Dark Side of Internet Freedom*, Public Affairs, New York, NY (2011)
5. Carr, N., *The Shallows: What the Internet is Doing to Our Brains*, Norton, New York, NY (2010).
6. Gladwell, M., Small change: Why the revolution will not be tweeted, The New Yorker (October 4, 2010)
7. Lanier, J., *You Are Not a Gadget: A Manifesto*, Knopf Publishers, New York, (2010).
8. U.S. White House, Open Government Directive (December 9, 2009), Available at: http://www.whitehouse.gov/open/documents/open-government-directive
9. Hendler, J., Shadbolt, N., Hall, W., Berners-Lee, T., and Weitzner, D., Web Science: An interdisciplinary approach to understanding the Web, *Communications of ACM 51*, 7 (July 2008), 62-69.
10. Watts, D. J. (2002). A simple model of global cascades on random networks. *Proceedings of the National Academy of Sciences of the United States of America, 99*(9), 5766-5771.
11. Watts, D. J., & Strogatz, S. H. (1998). Collective dynamics of 'small-world' networks. *Nature, 393*(4), 440-442.
12. Newman, M., Barabasi, A.-L., & Watts, D. J. (Eds.). (2006). *The structure and dynamics of networks*. Princeton, NJ: Princeton University Press.
13. Newman, M. E. J., & Watts, D. J. (1999). Scaling and percolation in the small-world network model. *Physical Review E, 60*, 7332-7342.
14. Easley, D. and Kleinberg, J., *Networks, Crowds, and Markets: Reasoning about a Highly Connected World*, Cambridge University Press, New York (2010).
15. Leskovec, J., Huttenlocher, D., and Kleinberg, J., Predicting positive and negative Links in online social networks, *International Conference on World Wide Web (WWW)*, 2010, available in ACM Digital Library.
16. Kleinberg, J., The convergence of social and technological networks. *Commun. ACM, 51*, 11 (2008)., 66-72.
17. Lazer, D., Pentland, A., Adamic, L., Aral, S., Barabasi, A.-L., Brewer, D., et al., Computational Social Science. *Science, 323*, 5915 (2009), 721-723.

18. Pirolli, P., Preece, J., and Shneiderman, B., Editors, Technology-Mediated Social Participation (Cover Feature with 7 articles), *IEEE Computer 43*, 11 (November 2010), 20-67.
19. Kraut, R., Maher, M. L., Olson, J., Malone, T. W., Pirolli, P., and Thomas, J. C., Scientific foundations: A case for Technology-Mediated Social Participation theory, *IEEE Computer 43*, 11 (November 2010), 22-28.
20. Chi, E. H., Munson, S., Fischer, G., Vieweg, S., and Parr, C., Advancing the design of social participation systems, *IEEE Computer 43*, 11 (November 2010), 29-35.
21. Olson, G., Mark, G., Churchill, E., and Rotman, D., Visions of what is possible with sharable socio-technical infrastructure, *IEEE Computer 43*, 11 (November 2010), 37-43.
22. Hesse, B., Hansen, D., Finholt, T., Kellogg, W., and Thomas, J. C., Social participation in Health 2.0, *IEEE Computer 43*, 11 (November 2010), 45-52.
23. Bertot, J. C., Jaeger, P. T., Munson, S. and Glaisyer, T., Engaging the public in open government: Social media technology and policy for government transparency, *IEEE Computer 43*, 11 (November 2010), 60-67.
24. Lampe, C., Resnick, P., Forte, A., Yardi, S., Rotman, D., Marshall, T., and Lutters, W., Educational priorities for Technology-Mediated Social Participation, *IEEE Computer 43*, 11 (November 2010), 53-59.
25. Shneiderman, B., Science 2.0, *Science 319* (March 7, 2008), 1349-1350. http://www.sciencemag.org/cgi/content/full/319/5868/1349
26. Yin, R. K., *Case Study Research: Design and Methods: 4th Edition*, Sage, Thousand Oaks, CA, (2008).
27. Shneiderman, B. and Plaisant, C., Strategies for evaluating information visualization tools: Multi-dimensional In-depth Long-term Case Studies, In *Proc. Beyond time and errors: novel evaluation methods for Information Visualization, Workshop of the Advanced Visual Interfaces Conference*, Available in ACM Digital Library (2006), 1-7.
28. Preece, J. and Shneiderman, B., The Reader-to-Leader Framework: Motivating technology-mediated social participation, *AIS Transactions on Human-Computer Interaction 1*, 1 (March 2009), 13-32, available at http://aisel.aisnet.org/thci/vol1/iss1/5/
29. Golbeck, J. (2008). Weaving a Web of Trust. *Science*, *321*(5896), 1640-1641.
30. Preece, J., *Online Communities: Designing Usability, Supporting Sociability*, Chichester, UK: John Wiley and Sons (2000).
31. Maloney-Krichmar, D. and J. Preece, A multilevel analysis of sociability, usability and community dynamics in an online health community, *ACM Transactions on Computer Human Interaction 12*, 2 (2005), 1-32.
32. Hansen, D., Shneiderman, B., and Smith, M. A., *Analyzing Social Media Networks with NodeXL: Insights from a Connected World*, Morgan Kaufmann Publishers, San Francisco (2011).
33. Smith, M., Shneiderman, B., Milic-Frayling, N., Mendes-Rodrigues, E., Barash, V., Dunne, C., Capone, T., Perer, A., and Gleave, E., Analyzing (social media) networks with NodeXL, *Proc. Communities & Technologies Conference* (2009).
34. Center for Advanced Study of Communities and Information, Publication Venues, Accessed on February 19, 2011, http://casci.umd.edu/Publication_Venues