

Supporting Online Material for

Computational Social Science

David Lazer,* Alex Pentland, Lada Adamic, Sinan Aral, Albert-László Barabási, Devon Brewer, Nicholas Christakis, Noshir Contractor, James Fowler, Myron Gutmann, Tony Jebara, Gary King, Michael Macy, Deb Roy, Marshall Van Alstyne

*E-mail: david_lazer@harvard.edu

Published 6 February 2009, *Science* **323**, 721 (2009) DOI: 10.1126/science.1167742

This PDF file includes:

Complete list of author affiliations References Online resources

Supplementary Online Materials

"Computational Social Science" Science 323: 721-723 (6 February 2009)

Contact Information

David Lazer

Director, Program on Networked Governance Associate Professor of Public Policy Harvard Kennedy School Harvard University Cambridge, MA 02138 david_lazer@harvard.edu http://www.davidlazer.com

Alex Pentland

Professor MIT Media Laboratory 20 Ames Street Cambridge, MA 02142, USA pentland@media.mit.edu http://web.media.mit.edu/~sandy/

Lada Adamic

Assistant Professor
School of Information and Center for the Study of Complex Systems
University of Michigan
1085 S. University Ave.
Ann Arbor, MI 48109
ladamic@umich.edu
http://www-personal.umich.edu/~ladamic/

Sinan Aral

Assistant Professor
NYU Stern School of Business
44 West 4 Street Room 8-81
New York, NY, 10012
Research Affiliate
MIT Sloan School of Management.
saral@nyu.edu
Personal Webpage: http://pages.stern.nyu.edu/~saral
SSRN Page: http://ssrn.com/author=110270

Albert-László Barabási

Professor

Center for Complex Network Research
Departments of Physics, Biology and Computer Science
Northeastern University, Boston, MA 02115
Department of Medicine
Harvard Medical School
Center for Cancer Systems Biology
Dana Farber Cancer Institute, Boston, MA 02115
alb@neu.edu
http://www.barabasi.com/

Devon D. Brewer

Interdisciplinary Scientific Research P.O. Box 15110 Seattle, WA 98115 interscientific@yahoo.com http://www.interscientific.net

Nicholas A. Christakis

Professor
Department of Health Care Policy, Harvard Medical School
Department of Sociology, Harvard University
180 Longwood Avenue
Boston, MA 02115-5899
christak@hcp.med.harvard.edu
http://christakis.med.harvard.edu/

Noshir Contractor

Jane S. & William J. White Professor of Behavioral Sciences, Northwestern University Professor of Industrial Engineering & Management Science, McCormick School of Engineering Professor of Communication Studies, School of Communication Professor of Management & Organizations, Kellogg School of Management Director, Science of Networks in Communities (SONIC) Research Laboratory Affiliate, National Center for Supercomputing Applications, University of Illinois at Urbana-Champaign 2145 Sheridan Road, TECH D241 Evanston, Illinois 60208-3119 nosh@northwestern.edu http://nosh.northwestern.edu

James H. Fowler

Associate Professor Political Science Department University of California, San Diego Social Science Building 383 9500 Gilman Drive #0521 La Jolla, CA 92093-0521 jhfowler@ucsd.edu http://jhfowler.ucsd.edu

Myron P. Gutmann

Professor of History and Information
Director, Inter-university Consortium for Political and Social Research
University of Michigan
PO Box 1248, Ann Arbor, MI 48106-1248
gutmann@umich.edu
http://www.icpsr.org/ICPSR/staff/gutmann.html

Tony Jebara

Associate Professor
Department of Computer Science
Columbia University
1214 Amsterdam Avenue, Mail Code 0401
New York, NY 10027
jebara@cs.columbia.edu
http://www1.cs.columbia.edu/~jebara/

Gary King

Professor
Director, Institute of Quantitative Social Science
Harvard University
Cambridge, MA 02138
king@harvard.edu
http://gking.harvard.edu/

Michael Macy

Professor
Social Dynamics Laboratory
372 Uris Hall
Cornell University
Ithaca, New York
14853-7601 Cornell University
Mwm14@cornell.edu
http://www.people.cornell.edu/pages/mwm14/

Deb Roy

Associate Professor of Media Arts and Sciences MIT Media Laboratory 20 Ames Street Cambridge, MA 02142, USA dkroy@media.mit.edu http://web.media.mit.edu/~dkroy/

Marshall Van Alstyne

Associate Professor
Boston University School of Management
595 Commonwealth Avenue
Boston, MA 02215
Research Associate
MIT Center for E-Business
mva@bu.edu
http://smgnet.bu.edu/mgmt_new/profiles/VanAlstyneMarshall.html

Acknowledgments

This paper is an outgrowth of a December 7, 2007 conference by the same title. Thanks go to the Institute for Quantitative Social Science and the Program on Networked Governance at Harvard University (the latter supported by National Science Foundation grant # 0131923), and the MIT Legatum Center for sponsorship of that conference. Video of this conference is available at http://www.hks.harvard.edu/netgov/html/computational_social_science.html.

S. Aral acknowledges generous funding support from the Marketing Sciences Institute and the Institute for Innovation and Information Productivity. A.-L.B. is supported by James S. McDonnell Foundation 21st Century Initiative in Studying Complex Systems, the National Science Foundation within the DDDAS (CNS-0540348), ITR (DMR-0426737) and IIS-0513650 programs, the US Office of Naval Research Award N00014-07-C, The Office of Naval Research (ONR), Grant: N00014-07-C-0227 and by the Defense Threat Reduction Agency.

The viewpoints expressed in this article are the authors' alone.

Additional References

- Adamic, L.A., Adar, E. (2005) "How to search a social network." *Social Networks* 27 (3):187-203
- Adamic, L.A., Buyukkokten, O., Adar, E. (2003) "A Social Network Caught in the Web." *First Monday* 8 (6)
- Adamic, L.A., Zhang, J., Bakshy, E., Ackerman, M.S. (2008) "Knowledge sharing and yahoo answers: everyone knows something." *Proceeding of the 17th international Conference on World Wide Web* (Beijing, China, April 21 25, 2008). WWW '08. ACM, New York, NY, 665-674. DOI= http://doi.acm.org/10.1145/1367497.1367587
- Aral, S., Brynjolfsson, E., Van Alstyne, M. (2006) "Information, Technology & Information Worker Productivity: Task Level Evidence." *Proceedings of the 27th Annual International Conference on Information Systems*, December 10-13, Milwaukee, Wisconsin. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=942310
- Aral, S., Brynjolfsson, E., Van Alstyne, M. (2007) "Productivity Effects of Information Diffusion in Networks." *Proceedings of the 28th Annual International Conference on Information Systems*, December 9-12, Montreal, CA. http://ssrn.com/abstract=987499
- Aral, S., M. Van Alstyne (2007) "Network Structure & Information Advantage." *Proceedings of the Academy of Management Conference*, August 3-8, Philadelphia, PA. http://ssrn.com/abstract=958158
- Aral, S., Muchnik, L., Sundararajan, A. (2008). "Economic Influence in Massive Online Social Networks." Workshop on Information Systems Economics, December 13-14, Paris, France
- Bulkley, N., Van Alstyne, M. (2004) "Why Information Should Influence Productivity." in *The Network Society: A Global Perspective*. Ed. Castells, M. Edward Elgar Publishers, 145-173. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=518242
- Burke, D.S., Epstein, J.M., Cummings, D.A.T., Parker, J.I., Cline, K.C., Singa, R., Chakravarty, S. "Individual-based Computational Modeling of Smallpox Epidemic Control Strategies." Academic Emergency Medicine 13 (11): 1142-1149 (2006)
- Christakis, N.A., Fowler, J.H. (2007) "The Spread of Obesity in a Large Social Network Over 32 Years." *New England Journal of Medicine* 357 (4): 370-379 (26 July) http://dx.doi.org/10.1056/NEJMsa066082
- Christakis, N.A., Fowler, J.H. (2008). "The Collective Dynamics of Smoking in a Large Social Network." *New England Journal of Medicine* 358 (21): 2249-58 (22 May) http://dx.doi.org/10.1056/NEJMsa0706154
- Colizza, V., Barrat, A., Barthelemy, M., Vespignani, A. (2006) "Prediction and predictability of global epidemics: the role of the airline transportation network." *Proceedings of the National Academy of Sciences* 103: 2015-2020. http://alexves.googlepages.com/0510525103v1.pdf
- Contractor, N., Wasserman, S., Faust, K. (2006). "Testing multi-theoretical multilevel hypotheses about organizational networks: An analytic framework and empirical

- example." Academy of Management Review 31: 681-703
- Doyle, P., Lane, J.I., Theeuwes, J.J.M., Zayatz, L.V., eds. (2001) Confidentiality, disclosure, and data access: Theory and practical applications for statistical agencies. New York: Elsevier
- Eagle, N. (2005), "Machine Perception and Learning of Complex Social Systems." Ph.D. Thesis, Program in Media Arts and Sciences, Massachusetts Institute of Technology, (June)
- Eagle, N., Pentland, A. (2006) "Reality Mining: Sensing Complex Social Systems." *Personal and Ubiquitous Computing* 10 (4): 255-268
- Epstein, J.M., Goedecke, M., Yu, F., Morris, J., Wagener, D., Bobashev, G. (2007) "Controlling Pandemic Influenza: The Role of International Travel Restrictions." *Public Library of Science One*. (May 12)
- Fowler, J.H. (2006) "Legislative Cosponsorship Networks in the U.S. House and Senate." Social Networks 28 (4): 454-465 (October) http://dx.doi.org/10.1016/j.socnet.2005.11.003
- Fowler, J.H. (2006) Connecting the Congress: A Study of Cosponsorship Networks." *Political Analysis* 14 (4): 456-487 (Fall) http://dx.doi.org/10.1093/pan/mpl002
- Fowler, J.H., Christakis, N.A. (2008) "Dynamic Spread of Happiness in a Large Social Network: Longitudinal Analysis Over 20 Years in the Framingham Heart Study." *British Medical Journal* 337: a2338 (4 December) http://dx.doi.org/10.1136/bmj.a2338
- Fowler, J.H., Dawes, C.T., Christakis, N.A. "Model of Genetic Variation in Human Social Networks." *Proceedings of the National Academy of Sciences*, http://dx.doi.org/10.1073/pnas.0806746106
- Gutmann, M.P., Witkowski, K., Colyer, C., O'Rourke, J.M., McNally, J. (2008) "Providing Spatial Data for Secondary Analysis. Issues and Current Practices relating to Confidentiality." *Population Research and Policy Review* 27: 639-665. http://dx.doi.org/10.1007/s11113-008-9095-4
- Huang, B., Jebara, T. (2007) "Loopy Belief Propagation for Bipartite Maximum Weight b-Matching." *Proceedings of the 2007 Conference on Artificial Intelligence and Statistics*, AISTATS, (March)
- Leskovec, J., Adamic, L.A., Huberman, B.A. (2006) "The dynamics of viral marketing." *Proceedings of the 7th ACM Conference on Electronic Commerce* (Ann Arbor, Michigan, USA, June 11 15, 2006). EC '06. ACM, New York, NY, 228-237. http://doi.acm.org/10.1145/1134707.1134732
- Liben-Nowell, D., Novak, J., Kumar, R., Raghavan P., Tomkins, A. (2005) "Geographic routing in social networks." *Proceedings of the National Academy of Sciences* 102. (August)
- Monge, P.R., Contractor, N. (2003). *Theories of communication networks*. New York: Oxford University Press
- Nathan Eagle (2008), "Behavioral Inference Across Cultures: Using Telephones as a Cultural Lens." *IEEE Intelligent Systems* 23: 4, 62-64

- National Research Council. (2007) Putting People on the Map: Protecting Confidentiality with Linked Social-Spatial Data. Ed. Gutmann, M.P., Stern, P. Washington: National Academy Press
- National Research Council. (2004) Protecting Participants and Facilitating Social and Behavioral Science Research. Washington: National Academies Press
- Reynolds, M., Van Alstyne, M. Aral, S. (2009) "Functions that Preserve Privacy but Permit Analysis of Text." MIT Center for Digital Business Working Paper # 246, Cambridge, MA
- Roy, D., Patel, R., DeCamp, P., Kubat, R., Fleischman, M., Roy, B., Mavridis, N., Tellex, S., Salata, A., Guiness, J., Levit, M., Gorniak, P. (2006) "The Human Speechome Project." *Proceedings of the Twenty-eighth Annual Meeting of the Cognitive Science Society*
- Salganik, M.J., Dodds, P.S., Watts, D.J. (2006) "Experimental study of inequality and unpredictability in an artificial cultural market." *Science* 311:854–56
- Shaw, B., Jebara, T. (2007) "Minimum Volume Embedding." *Proceedings of the 2007 Conference on Artificial Intelligence and Statistics*, AISTATS, (March)
- Van Wey, L., Rindfuss, R., Gutmann, M.P., Entwisle, B., Balk, D. (2005) "Confidentiality and Spatially Explicit Data: Concerns and Challenges." *Proceedings of the National Academy of Science* 102(43): 15337-15342
- Wu, F., Huberman, B.A. (2007) "Novelty and collective attention." *Proceedings of the National Academy of Sciences* 104:17599–17601
- Wu, L., Waber, B., Aral, S., Brynjolfsson, E., Pentland, S. (2008). "Mining Face to Face Interaction Networks Using Sociometric Badges: Predicting Productivity in an IT Configuration Task." Proceedings of the 29th Annual International Conference on Information Systems, December 15-18, Paris, France. http://ssrn.com/abstract=1130251

Online resources

http://socdynamics.org http://www.hks.harvard.edu/netgov