

Impact of human behavior on information spreading: Viral marketing and social networks

Jos Luis Iribarren[a], Esteban Moro[b]

[a]IBM Corporation, *ibm.com e-Relationship Marketing Europe*, 28002 Madrid

[b]Departamento de Matemáticas, Universidad Carlos III de Madrid, 28911 Legans (Madrid)

The dynamics of information dissemination in social networks is of paramount importance in processes such as rumors or fads propagation [1], spread of product innovations [2], "word-of-mouth" communications [3] or viral marketing [7]. Due to the difficulty in tracking information when transmitted by people, most understanding of information spreading in social networks comes from models [4] or indirect measurements [5]. Using data collected in Viral Marketing campaigns [6] that reached over 31,000 individuals in eleven European markets, we find that information travels mostly by bursty or super-spreading events and at an unexpected low pace (logarithmic in time). This is due to the large variability both in the frequency and intensity of participants' actions, despite them being confronted with the common task of receiving and forwarding the same piece of information. Remarkable accurate description of the results is done through an stochastic branching process [8] which corroborates the importance of heterogeneity and shows

how traditional population-average descriptions fail to describe information diffusion in social networks. The fact that humans show similar degrees of heterogeneity in many other activities [9–14] suggests that our findings are pertinent to other human driven diffusion processes like rumors, fads, innovations or news which has important consequences for business management, communications, marketing and online communities [6, 15]

Acknowledgements: J.L.I. acknowledges IBM Corporation support for the collection of anonymous data of its Viral Marketing campaigns propagation. EM acknowledges partial support from MEC (Spain) through grants FIS2004-01001, MOSAICO and a Ramn y Cajal contract and Comunidad de Madrid through grants UC3M-FI-05-077 and SIMUMAT-CM.

This work has been awarded with Shared University Research grant from IBM Corporation. More information in <http://tinyurl.com/2btdt1>

[a] iribarren@es.ibm.com

[b] esteban.moro@uc3m.es

- [1] Moreno, Y., Nekovee, M., & Pacheco, A.F., Dynamics of rumor spreading in complex networks, *Phys. Rev. E* **69**, 066103, (2004).
- [2] Valente, T.W., Network Models of the Diffusion of Innovations, *Hampton Press*, Cresskill, NJ, (1995).
- [3] Dye, R., The Buzz on Buzz. *Harvard Business Rev.*, vol. 78, No. 6, pp. 139-146 (2000).
- [4] Goldenberg, J., Libai, B. & Solomon, S., Marketing Percolation, *Phys A* **284**, (1-4), 335-347, (2000).
- [5] Hidalgo, C.A., Castro, A., & Rodriguez-Sickert, C., The effect of social interactions in the primary consumption life cycle of motion pictures, *New J. Phys.* **8** 52 (2006).
- [6] Iribarren, J.L., Moro E., Information diffusion epidemics in social networks, arxiv:0706.0641 (2007)
- [7] Jurvetson, S. & Draper, R., Viral Marketing. *Netscape M-Files*, (1997).
- [8] Harris, T.E., The Theory of Branching Processes, *Springer-Verlag*, Berlin, (2002).
- [9] Barabási, A.-L., The origin of bursts and heavy tails in human dynamics, *Nature* **435**, 207, (2005).
- [10] Aiello, W., Chung, F. & Lu, L., A random graph model for power law graphs. In *Proc. of the 32nd Annual ACM Symposium of Theory of Computing*, pp. 171-180, ACM, New York, (2000).
- [11] Gruhl, D., Guha, R., Liben-Nowell, D. & Tomkins, A., Information Diffusion Through Blogspace, In *Proc. of the 13th intl. conf. on WWW*, ACM, New York, (2004).
- [12] Pitkow, J.E., Summary of WWW Characterizations. In *Proc. of the 7th WW Web Conference (WWW7)*, (1997).
- [13] Gladwell, M., The Tipping Point, *Little, Brown and Company*, New York, (2000).
- [14] Liljeros, F., Edling, C.R., Nunes Amaral, L.A., Stanley, H.E. & Aberg, Y., The web of human sexual contacts, *Nature*, **411**, pp. 907-908 (2001).
- [15] Iribarren, J.L., Moro E., The network laws of viral marketing, enviado (2007).