

Charles Elkan
University of California, San Diego
elkan@ucsd.edu

Sandy Pentland @ MIT James Fowler @ UCSD Laszlo Barabasi @ Northeastern



HONEST SIGNALS

HOW THEY SHAPE OUR WORLD

ALEX (SANDY) PENTLAND

"Connected could change your life forever."
— DANIEL GILBERT, author of *Stumbling on Happiness*

NICHOLAS A. CHRISTAKIS, MD, PhD
AND JAMES H. FOWLER, PhD



Connected

The Surprising Power of Our Social Networks
and How They Shape Our Lives

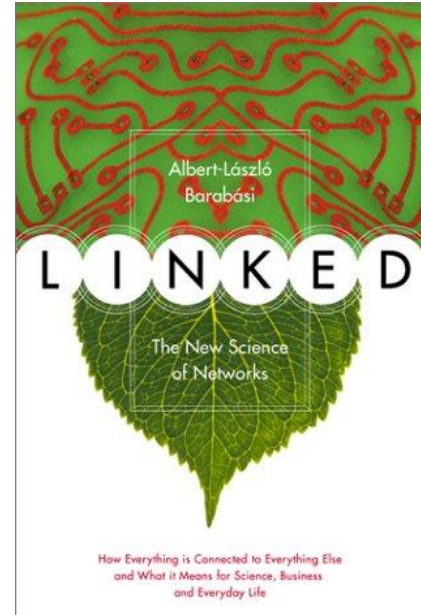


Figure 2. Example recursive incentive-structure process for the MIT team.

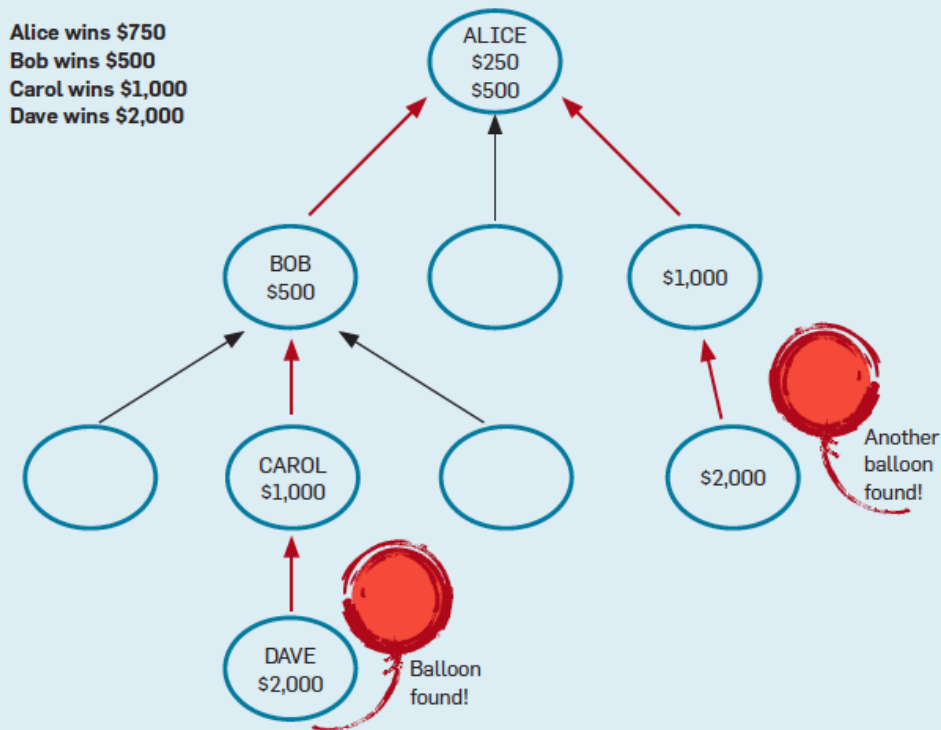


Figure 5. Fabricated photo posted during the challenge (left) (<http://twitpic.com/s9kun>) and photo taken by a pre-recruited observer in Albany, NY (right).



Figure 4. Typical real (left) and contrived (center and right) pictures of balloons.

Pentland, Cebrian et al. The DARPA Network Challenge

Barabasi et al, Collective Response of Human Populations to Large-Scale Emergencies.

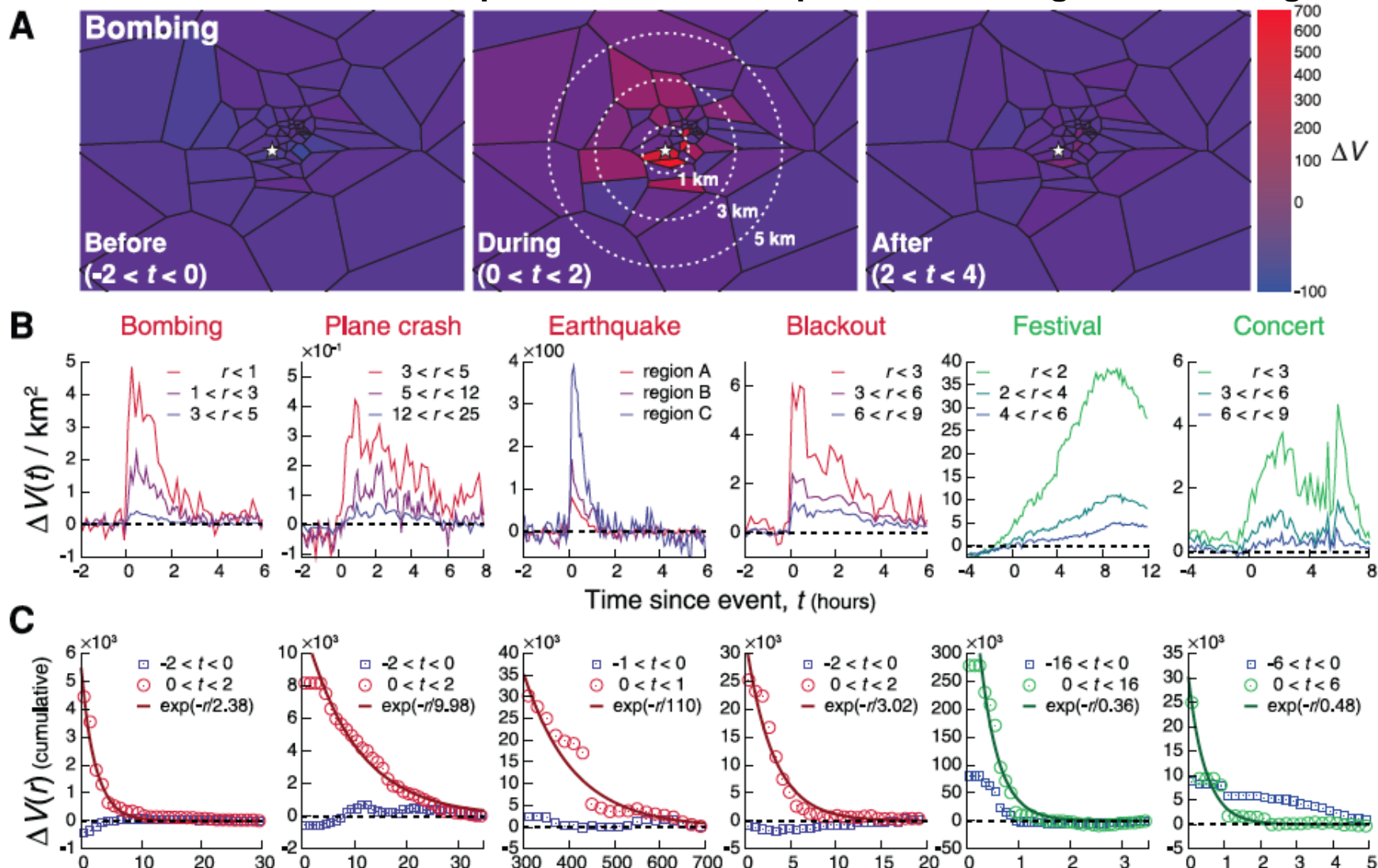
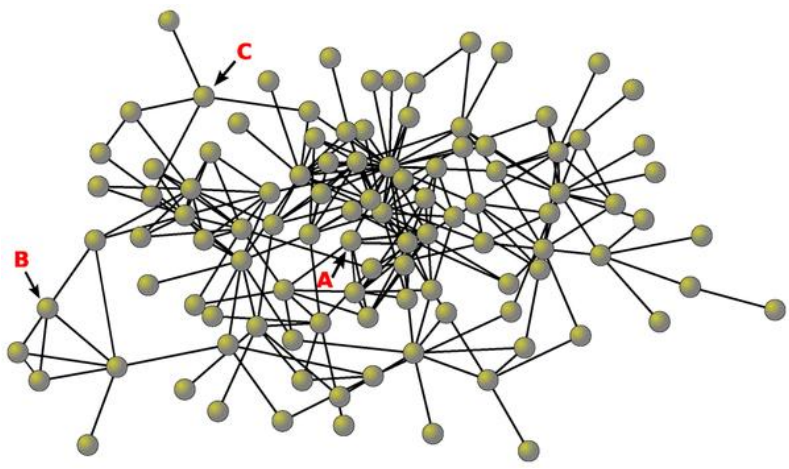
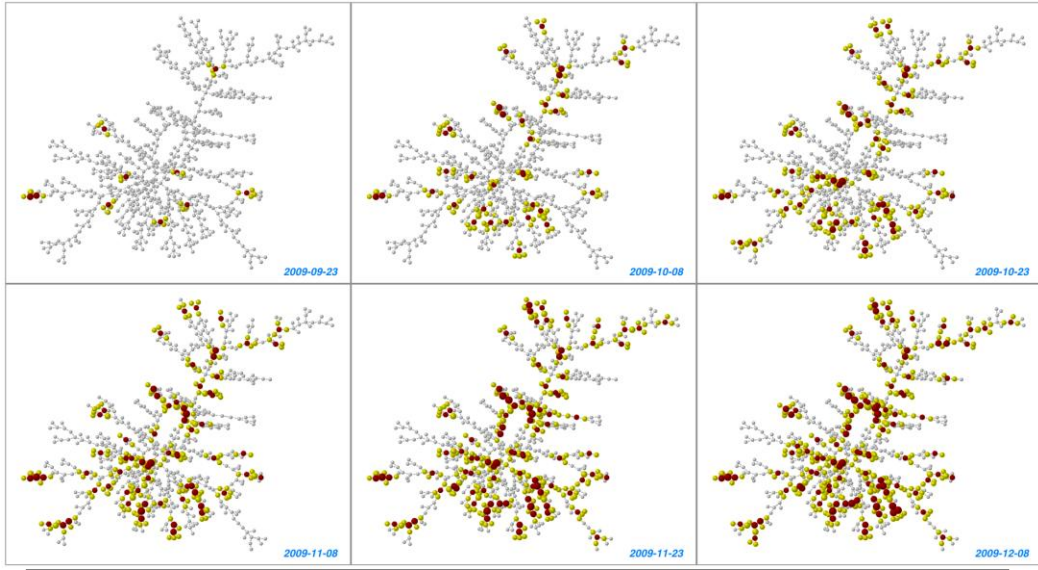


Figure 2. The spatial impact of an emergency. **A**, Maps of total anomalous call activity (activity during the event minus expected normal activity) for two-hour periods before ($-2 < t < 0$), during ($0 < t < 2$), and after ($2 < t < 4$) the bombing. The color code corresponds to the total change $\sum_t \Delta V(t)$, where the sum runs over the particular time period. **B**, Changes in call volume in regions at various distances r from the event epicenter. Note that the peak of the call volume anomaly for the bombing within the observed $1 < r < 5$ km region is delayed by approximately 10 minutes compared to the $r < 1$ km epicenter region. No call anomaly is observed for $r > 10$ km. The earthquake covers a large spatial range so we instead choose three event regions A–C, at distances of 310 km, 340 km, and 425 km from the seismic epicenter (which was outside the studied region). **C**, To measure the distance dependence of the anomaly, we computed the total anomalous call volume in **B** before ($\Delta t < t < 0$) and after ($0 < t < \Delta t$) each event as a function of the distance r , revealing approximately exponential decay, $\Delta V(r) \sim \exp(-r/r_c)$. Non-emergencies are spatially localized, with $r_c < 2$ km.

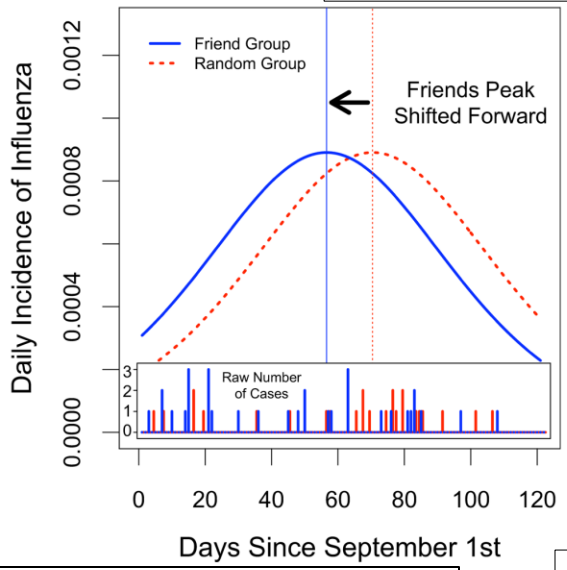
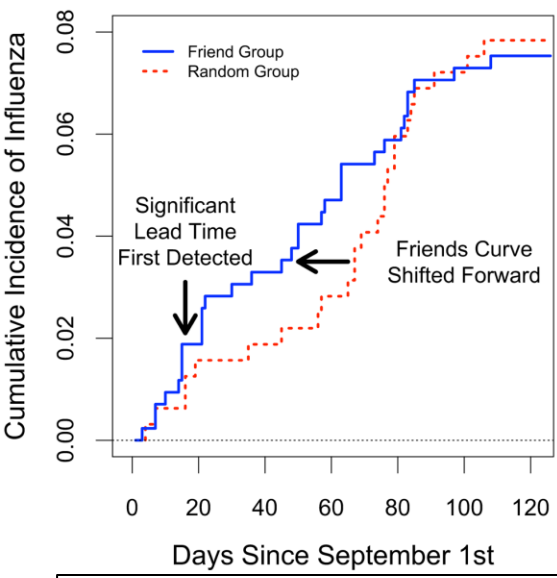
Fowler et al. Social Network Sensors for Early Detection of Contagious Outbreaks.



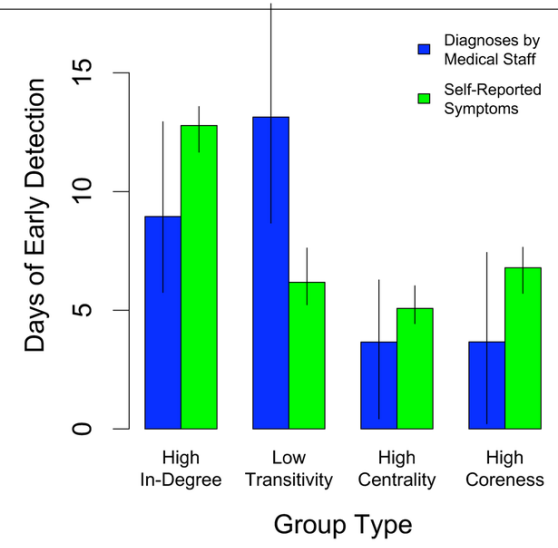
This real network of 105 students shows variation in structural attributes and topological position



Progression of flu contagion in the friendship network over time.



Progression of flu contagion in the friendship network over time.



Estimated days of advance detection of a flu outbreak when following specific groups.

Team members

- **Charles Elkan**, Dept. Computer Science & Engineering, *University of California, San Diego*
Contact: elkan@ucsd.edu,
Office (858) 534-8897
9500 Gilman Dr., La Jolla CA 92093
Faculty assist.: Sheila Manalo, (858) 534-8873
- **Manuel Cebrian**, Dept. of Computer Science and Engineering, *University of California, San Diego*
- **James Fowler**, Division of Social Sciences, *University of California, San Diego*
- **Sandy Pentland**, Media Laboratory, *MIT*
- **Laszlo Barabasi**, Center for Complex Networks Research, *Northeastern University*