

Philip Ball

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Utopia Theory

Towards a physics
of society

“The centre of politics has shifted.... The neoliberal thinking that has dominated the industrial world for nearly 30 years has led to a financial crisis, which in turn caused the global downturn.... Clearly, there can be no turning back to the failed and discredited politics of old. Instead, we need to use this time of emergency to aim for a different future and to get there by different means.... this is not a crisis of capitalism, but a crisis of a society and democracy that have failed to regulate the market.”

Neal Lawson & John Harris, *New Statesman* 9 March 2009

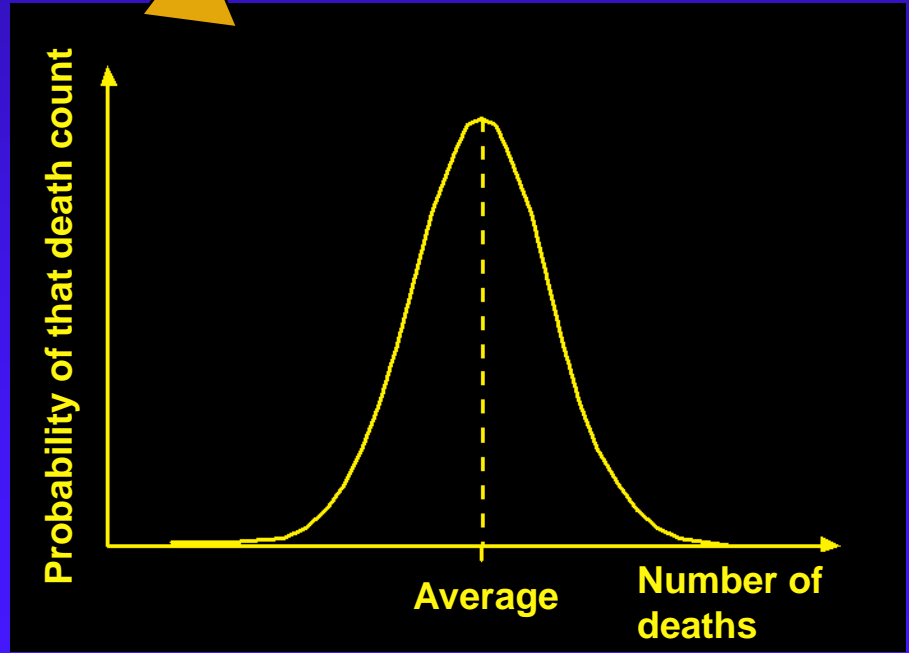
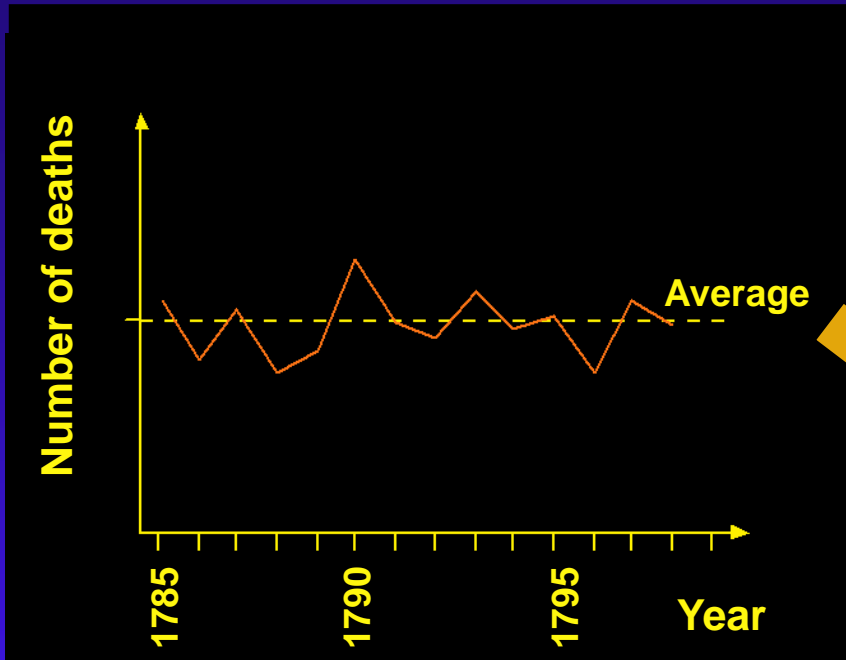
“Many of the problems our economy faces are the result of the use of misguided models. Unfortunately, too many [economic policy-makers] took the overly simplistic models of courses in the principles of economics (which typically assume perfect information) and assumed they could use them as a basis for economic policy... We need a new balance between market and government.”

Joseph Stiglitz, *New Statesman* 16 October 2008

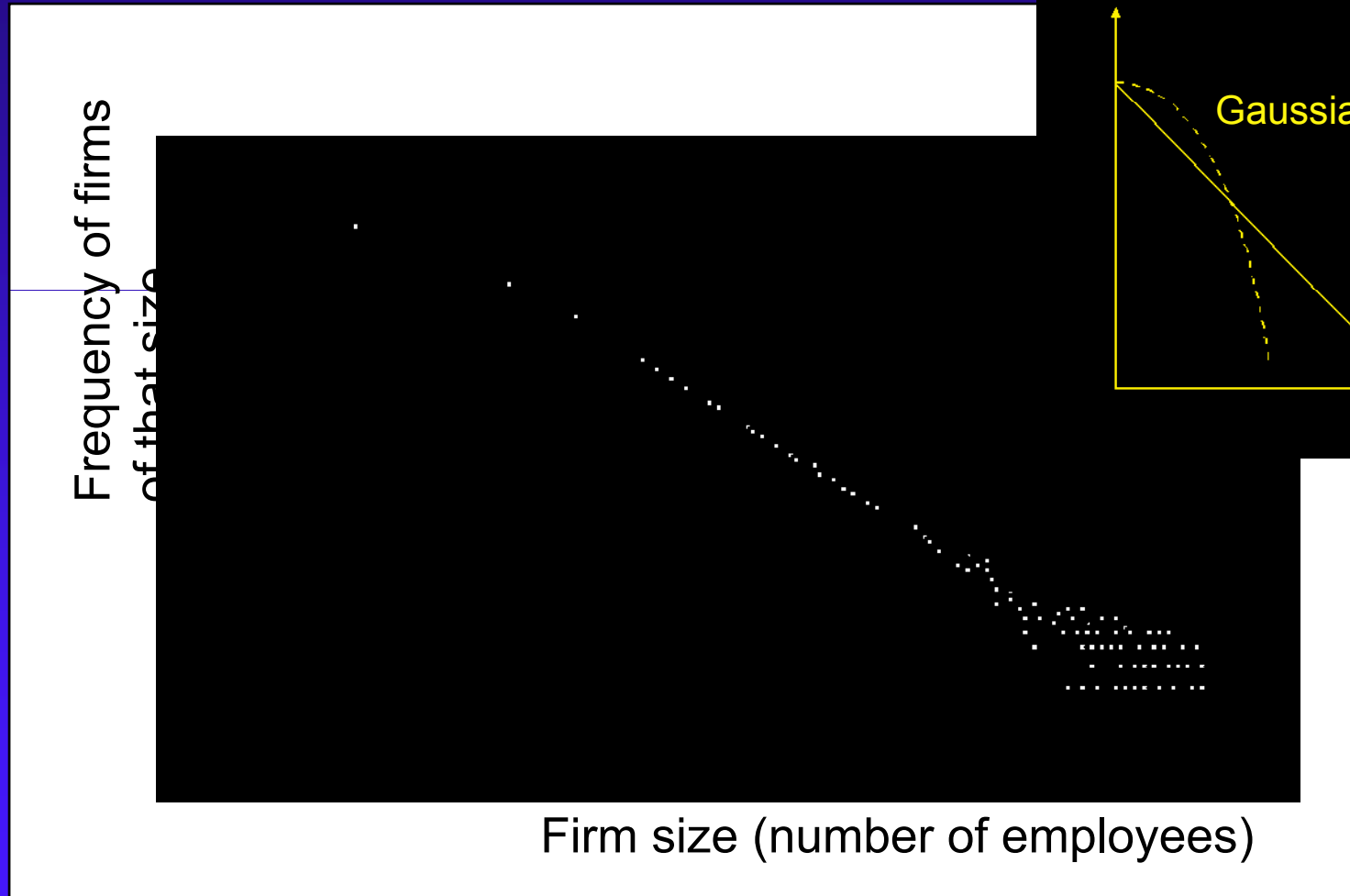
Social Physics and the Complex Systems of Human Social Dynamics

- N. Johnson, *Two's Company, Three Is Complexity* (OneWorld, 2007)
- M. Buchanan, *The Social Atom* (Bloomsbury, 2007);
Ubiquity (Weidenfeld & Nicolson, 2000)
- P. Ball, *Critical Mass* (Heinemann, 2004)
- C. Castellano & S. Fortunato, *Rev. Mod. Phys.* **81**
(Jan-Mar 2009)
- J. H. Miller & S. E. Page, *Complex Adaptive Systems*
(Princeton University Press, 2007)
- J. M. Epstein, *Generative Social Science* (Princeton
University Press, 2006)

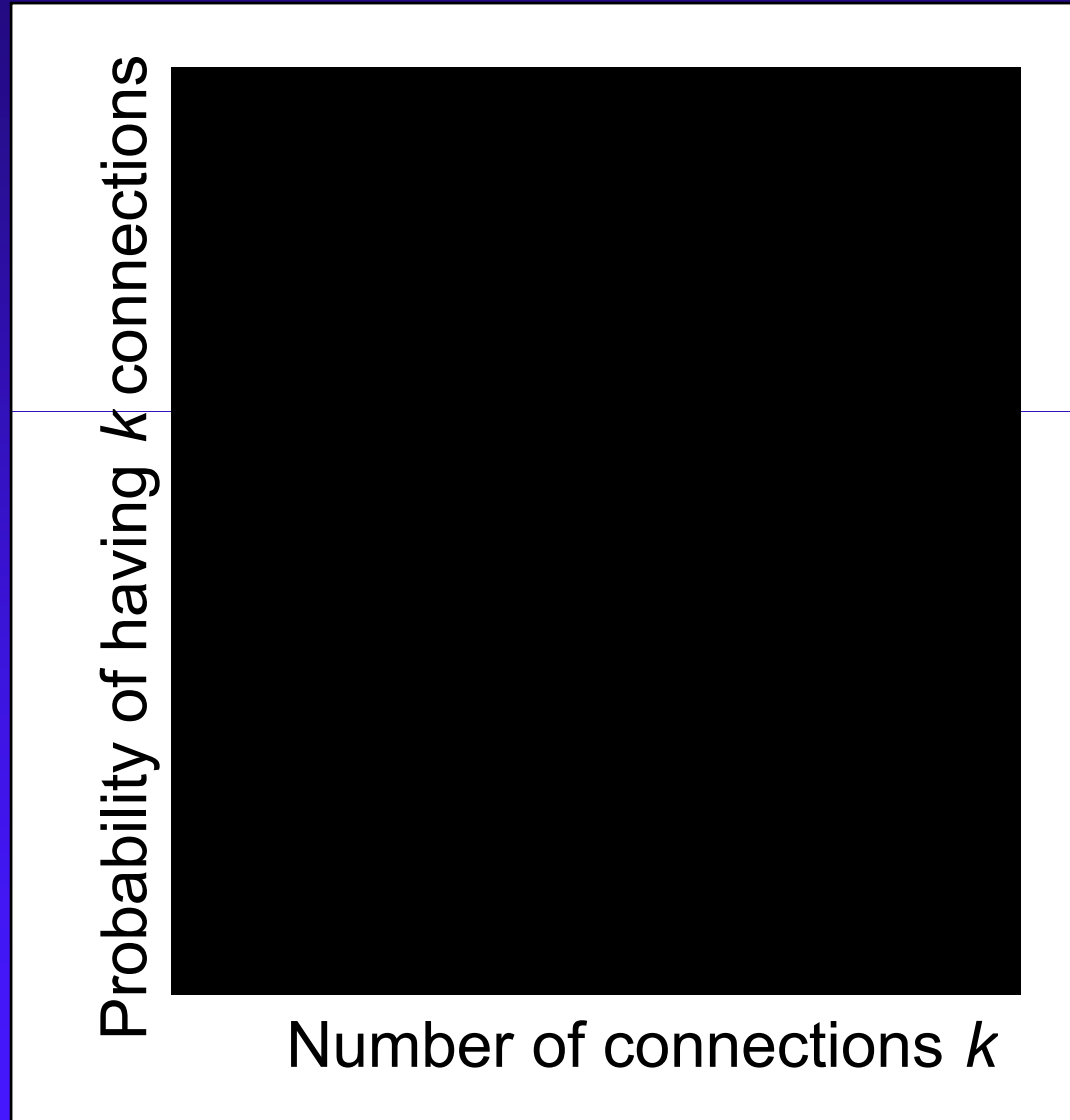
Death statistics



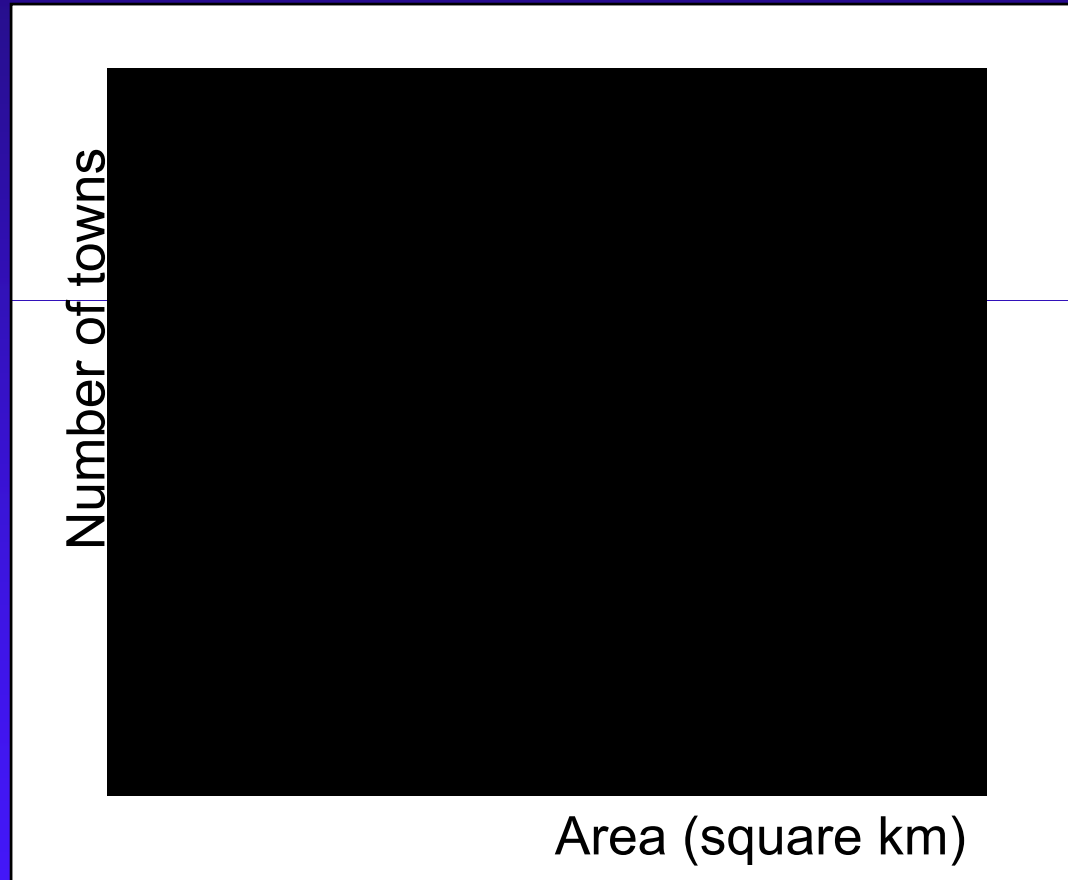
US firms in 1997



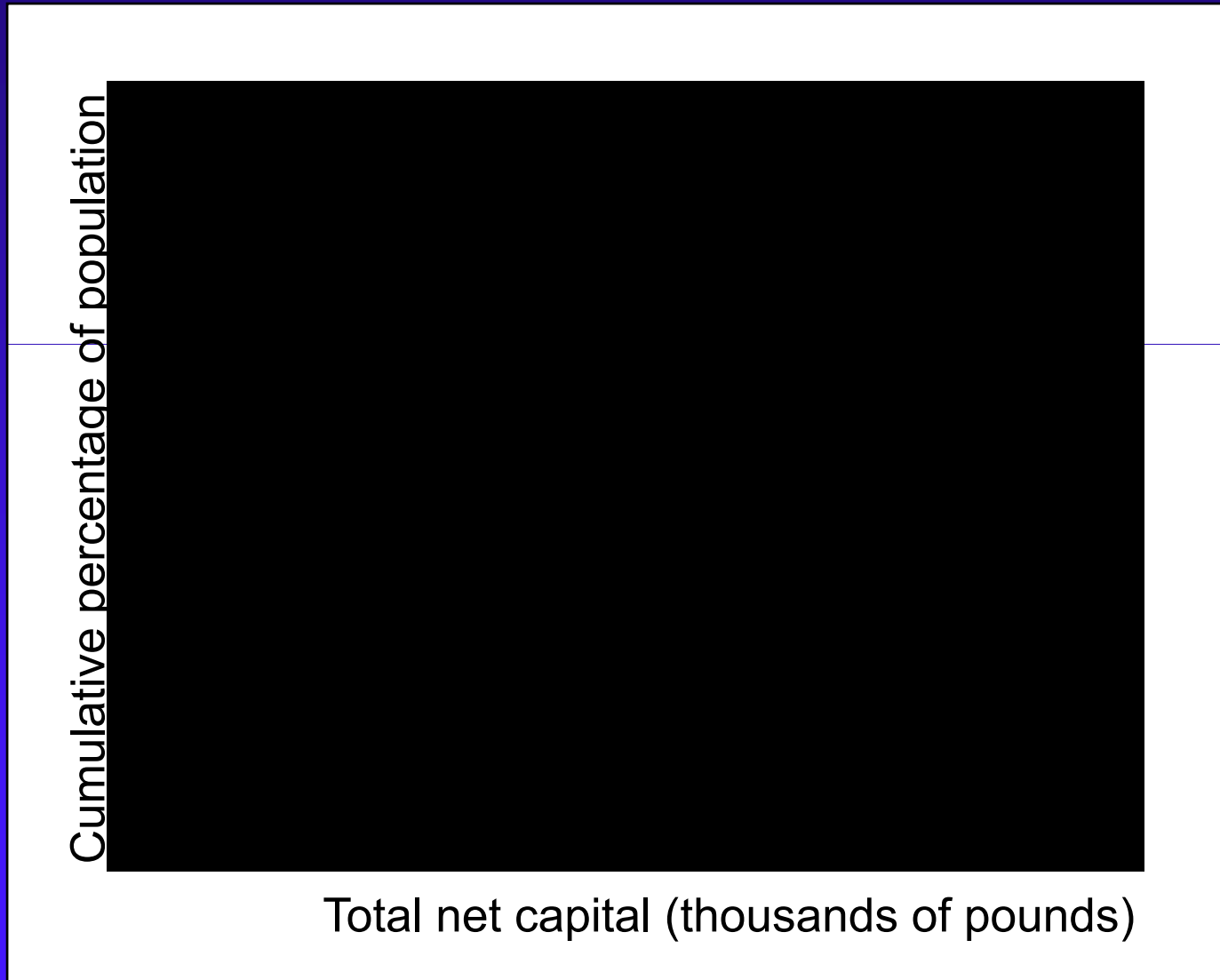
Connections of pages on the WWW



Probability distribution of towns around London



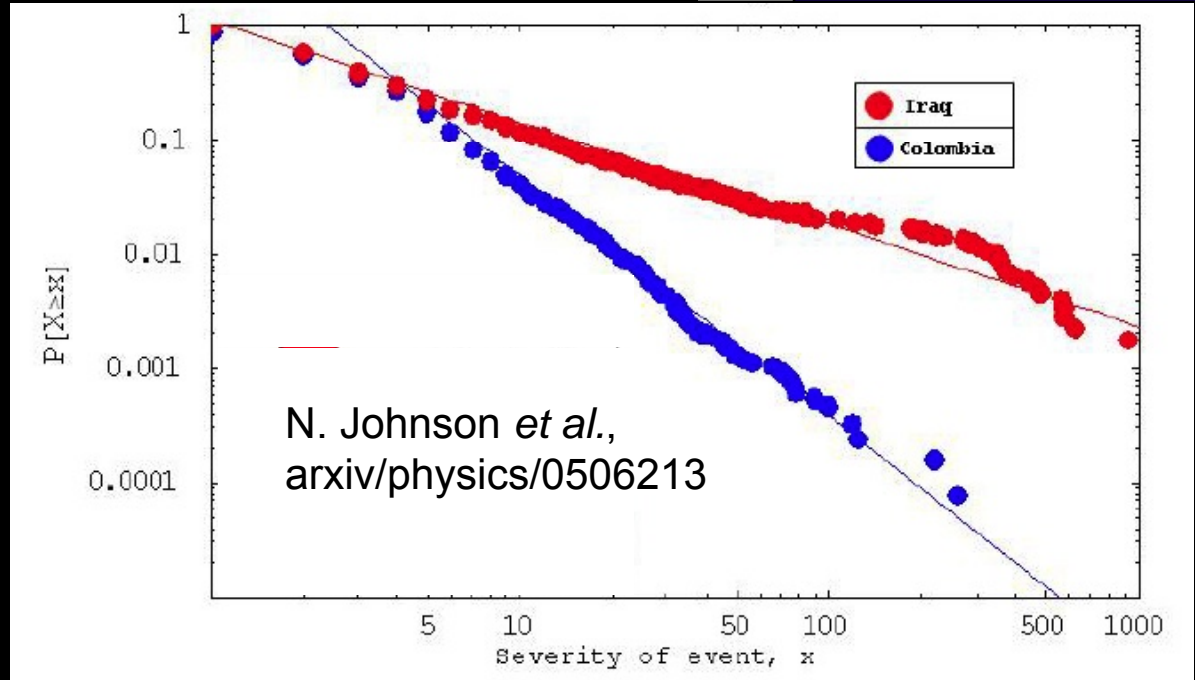
Wealth distribution in the UK, 1996



Statistics of fatal conflicts

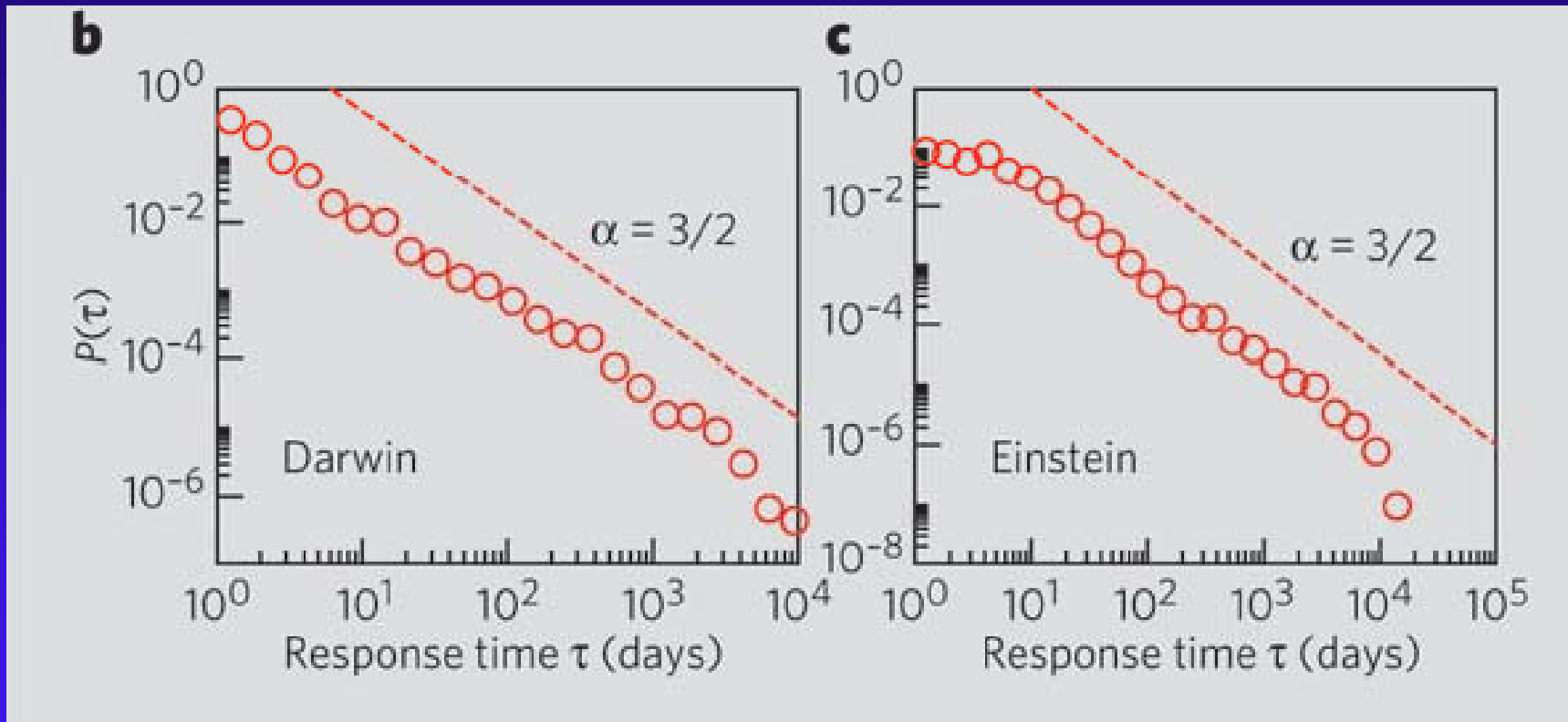


Statistics of fatal conflicts



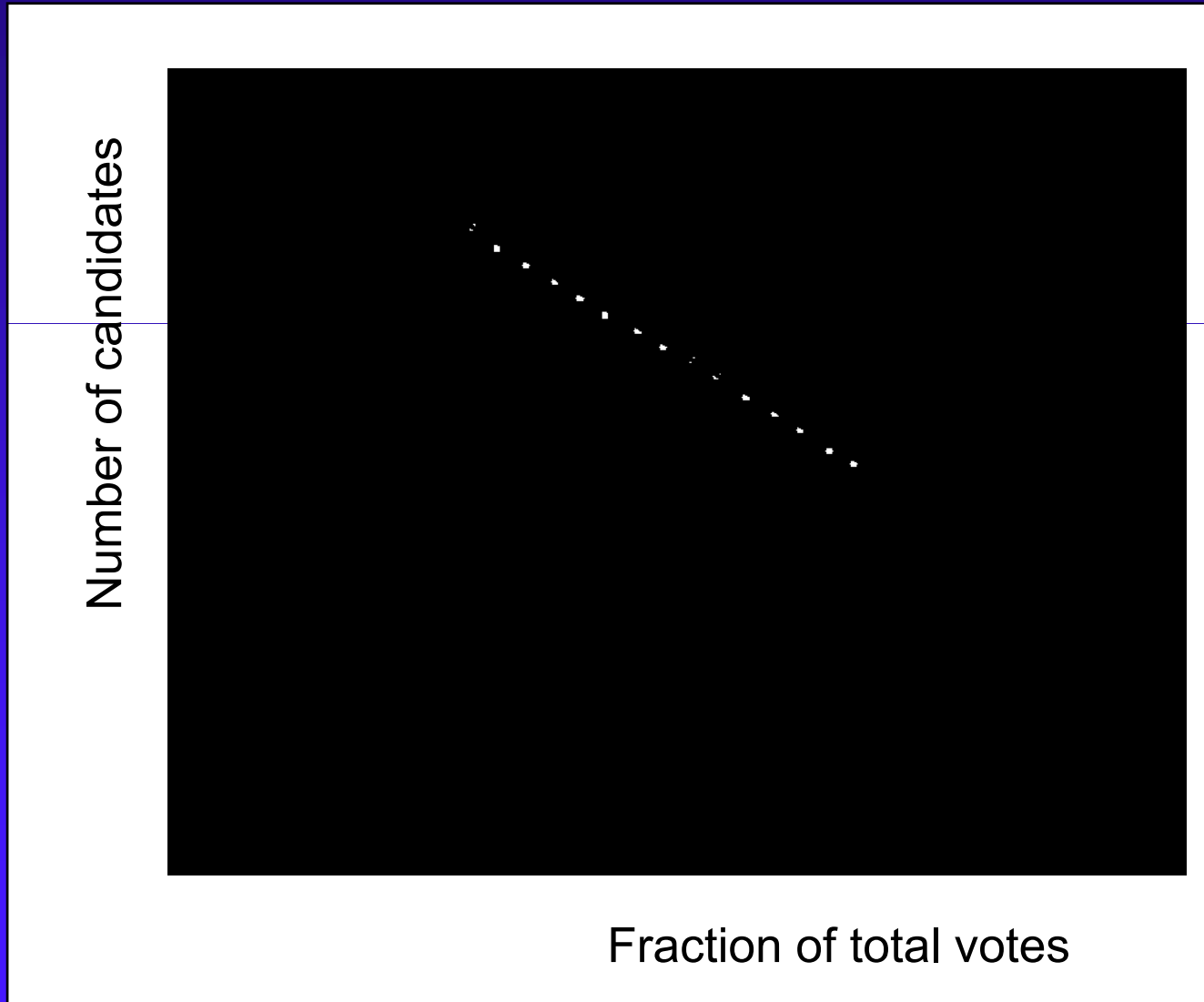
Fatalities

Queuing and task allocation



J. G. Oliveira & A.-L. Barabási,
Nature **437**, 1251 (2005)

Voting statistics in the Brazilian elections, 1998

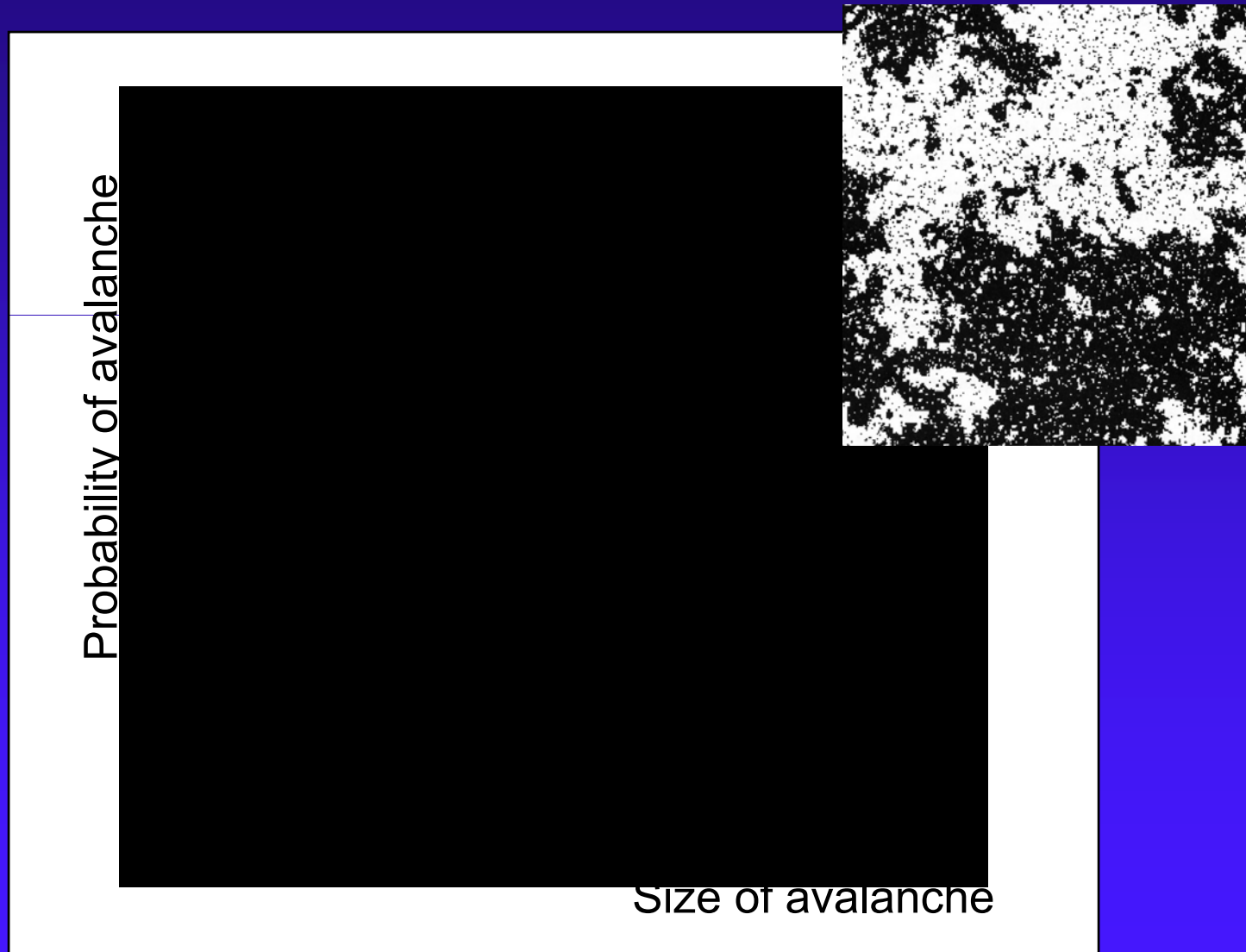


Social power laws and self-organized criticality

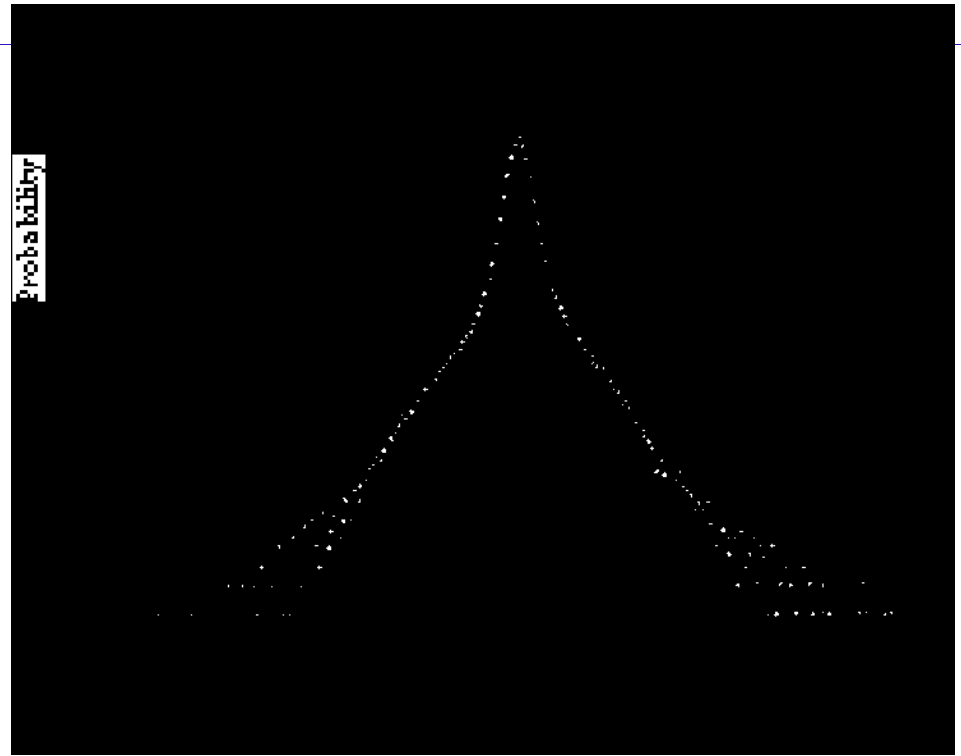
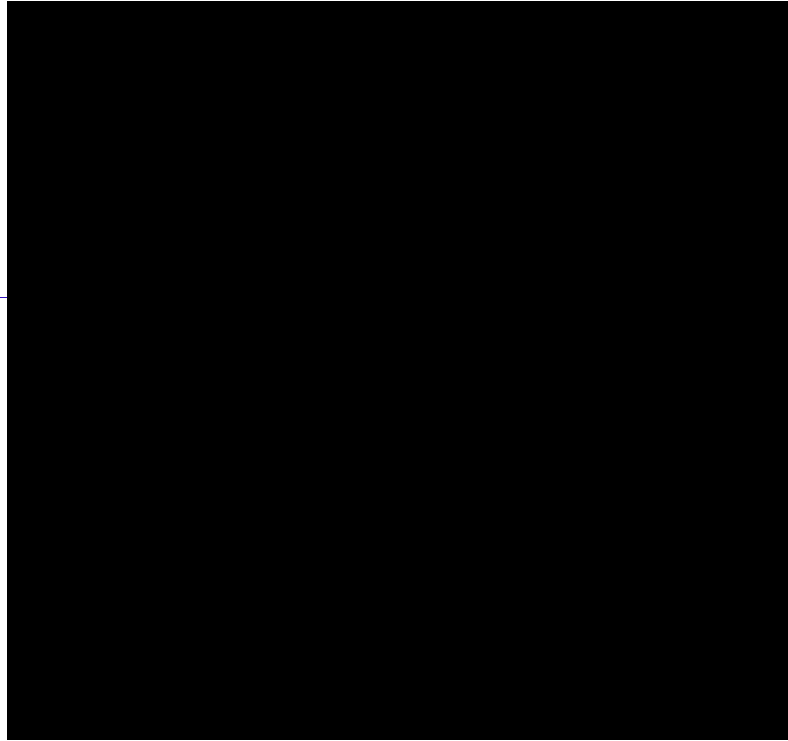
G. K. Zipf, *Human Behavior and the Principle of Least Effort* (Addison-Wesley, Reading, MA, 1949)

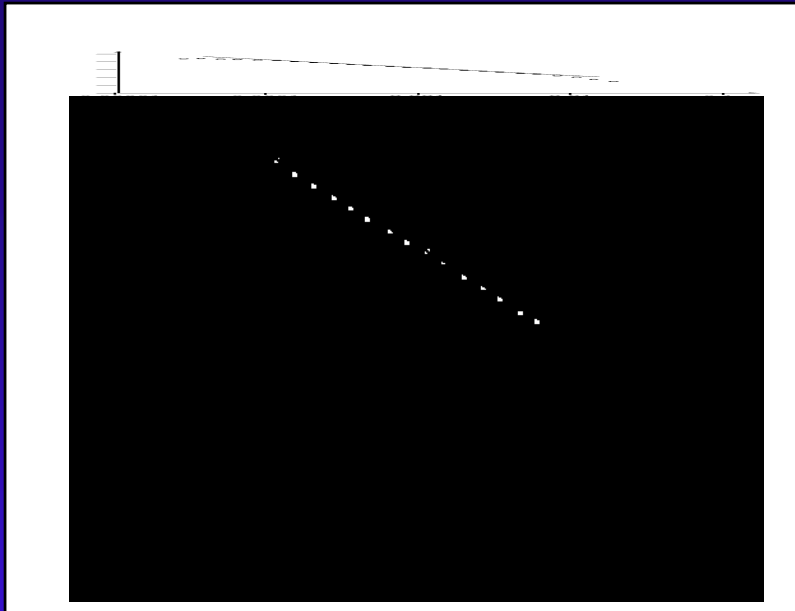


Self-organized criticality and the sandpile



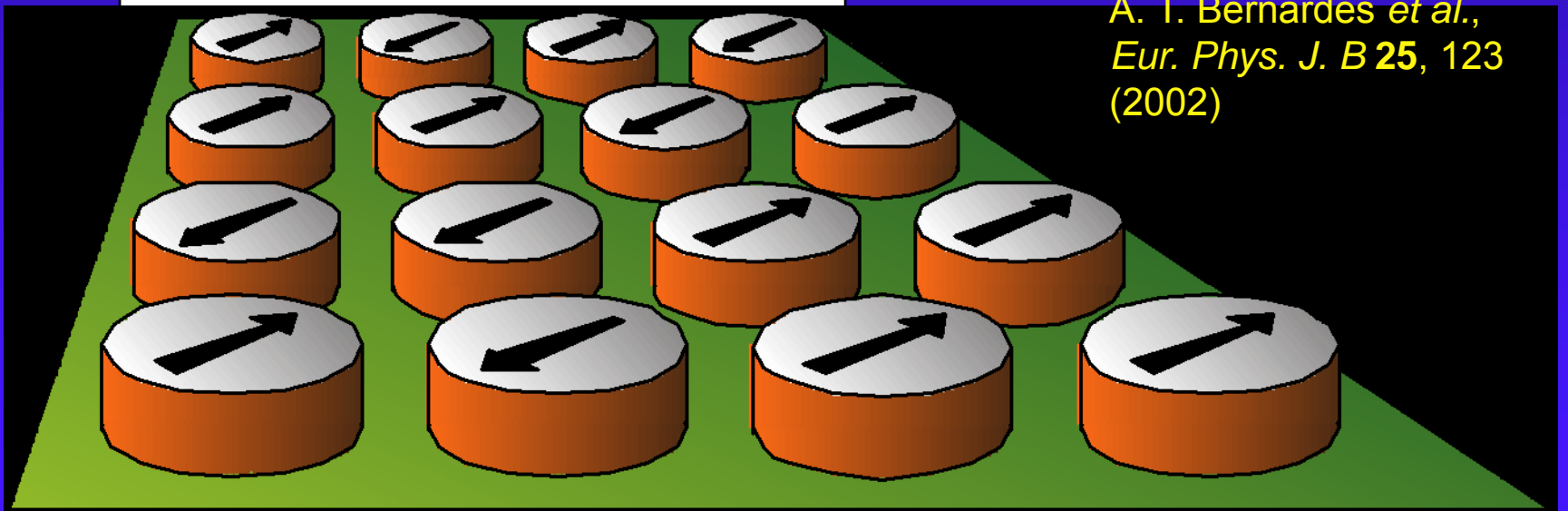
Economic fluctuations





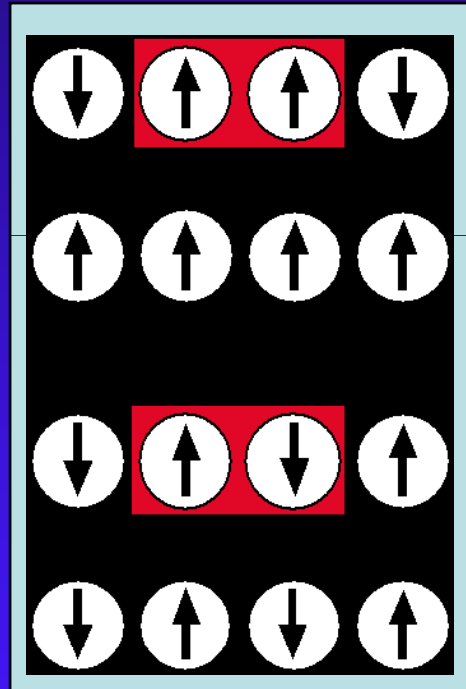
The magnetism of voting

A. T. Bernardes *et al.*,
Eur. Phys. J. B **25**, 123
(2002)



Opinion dynamics

The rules of opinion formation (Sznajd model)



K. Sznajd-Weron & J. Sznajd, *Int. J. Mod. Phys. C* 11, 1157 (2000)

W. Weidlich, *Sociodynamics* (Taylor & Francis, 2002)

S. Galam *et al.*, *J. Math. Sociol.* 9, 1 (1982)

“...there is an unbridgeable gap between the ‘behaviour’ of [subatomic particles] and those of the human beings who constitute the objects of study of social science... aside from pure physical reflexes, human behaviour cannot be understood without the concept of volition—the unpredictable capacity to change our minds up to the very last moment. By way of contrast, the elements of nature ‘behave’ as they do for reasons of which we know only one thing: the particles of physics do not ‘choose’ to behave as they do.”

Robert

Heilbroner

Feedback in social interactions

A rare example of 'turning the dial'
experimentally: M. J. Salganik *et al.*, *Science* **311**,
854 (2006)

The 'Broken Windows' effect: K. Keizer *et al.*,
Science **322**, 1681 (2008)

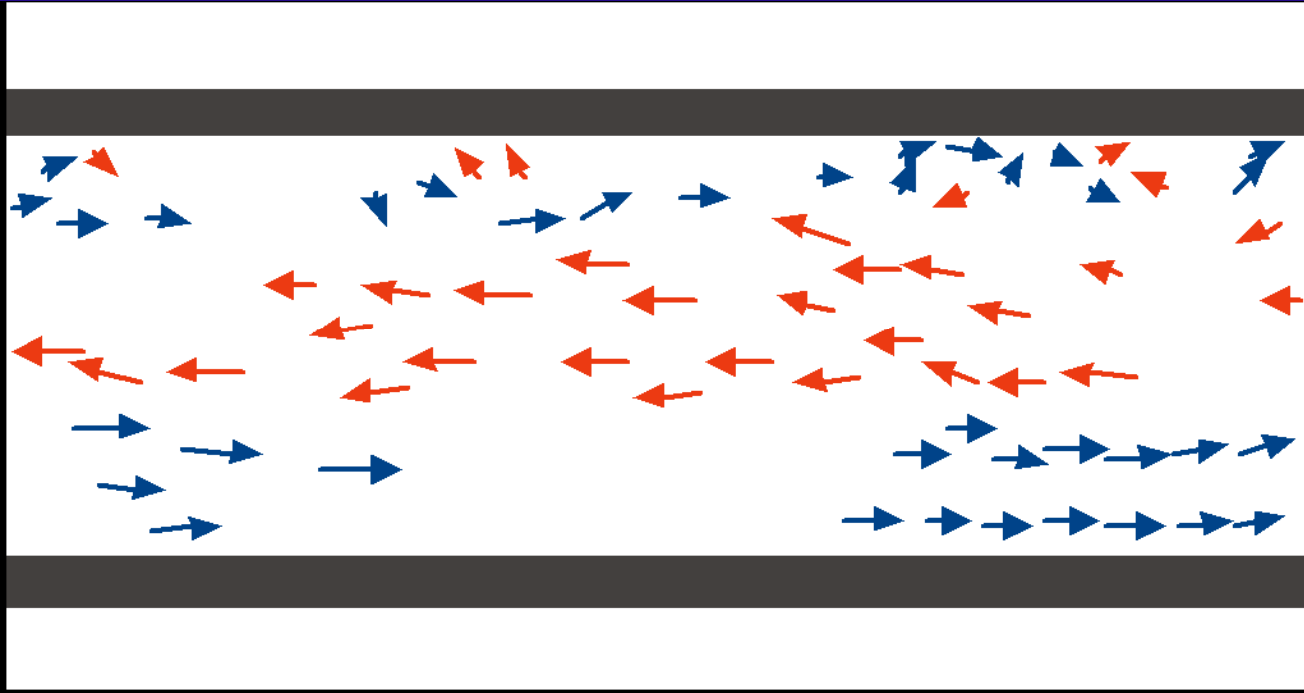


Attraction and repulsion in human interaction



D. Helbing & P. Molnar, *Phys. Rev. E* **51**, 4282 (1995)

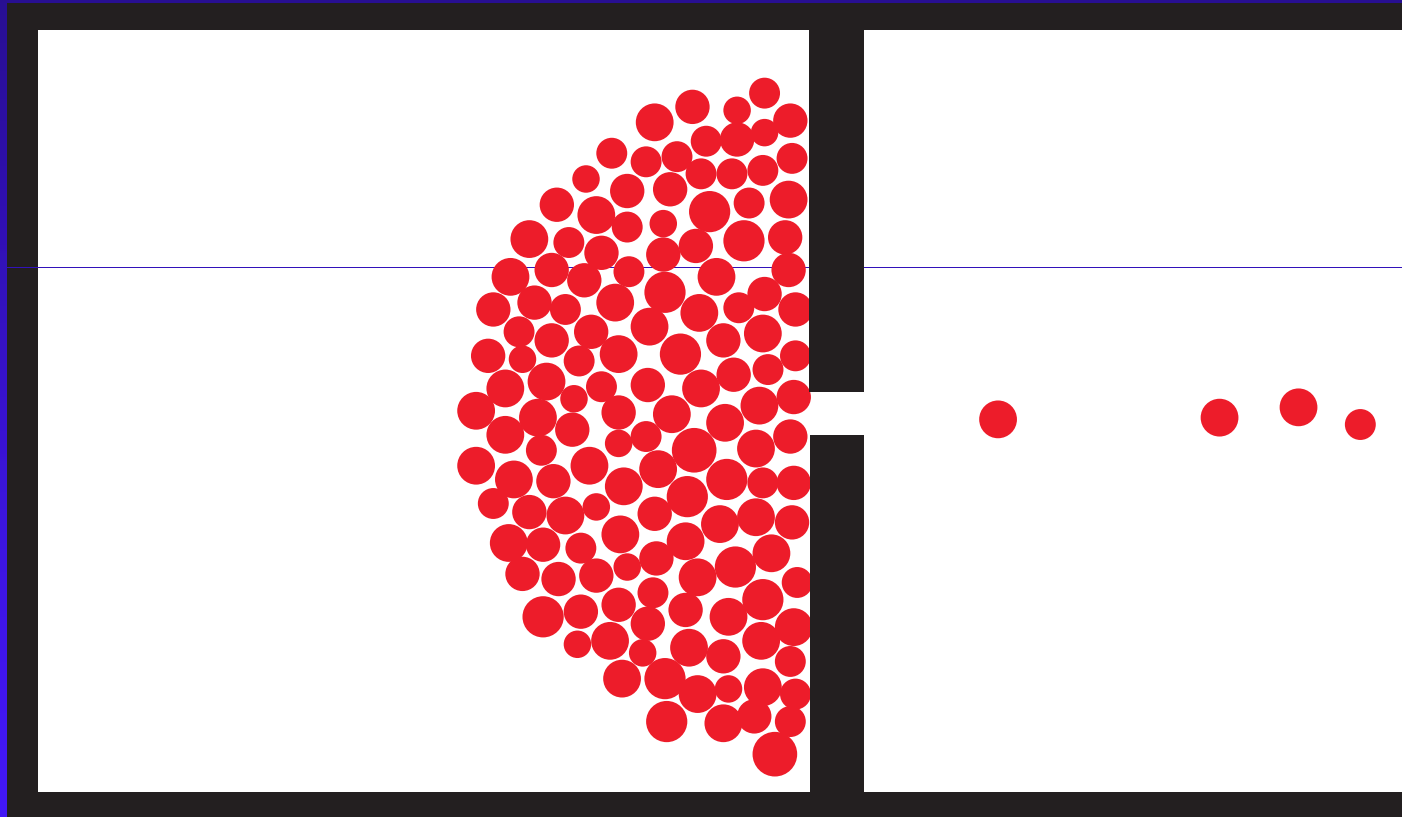
Interacting walkers in a corridor



<http://www.helbing.org/Pedestrians/Corridor.html>

D. Helbing *et al.*,
Environment & Planning
B, **28**, 361 (2001).

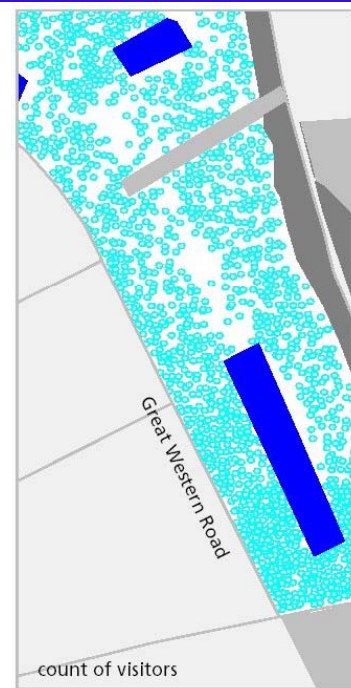
Interacting walkers in a panic



<http://angel.elte.hu/~panic/>

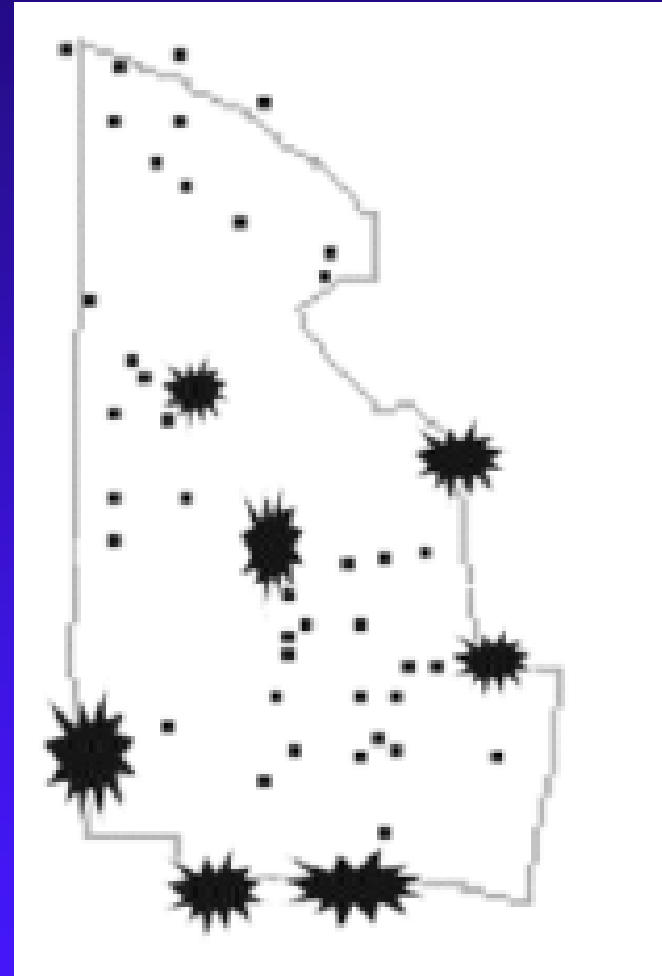
D. Helbing *et al.*, *Nature* **407**, 487 (2000).

Interacting walkers at the Notting Hill Carnival



M. Batty et al., *Urban Studies* 40, 1573 (2003).

Interacting walkers at the Notting Hill Carnival



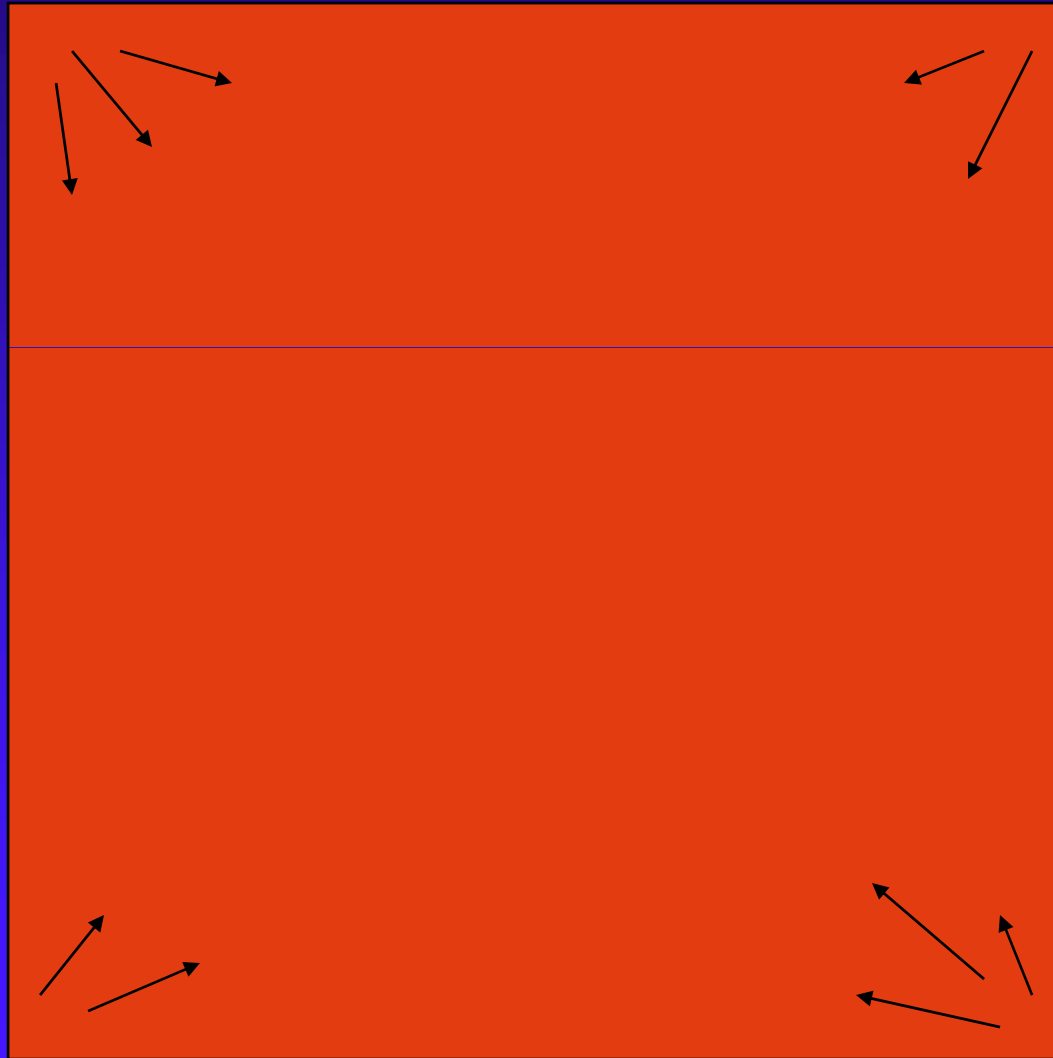
M. Batty *et al.*, *Urban Studies* **40**, 1573 (2003).

The formation of human trails

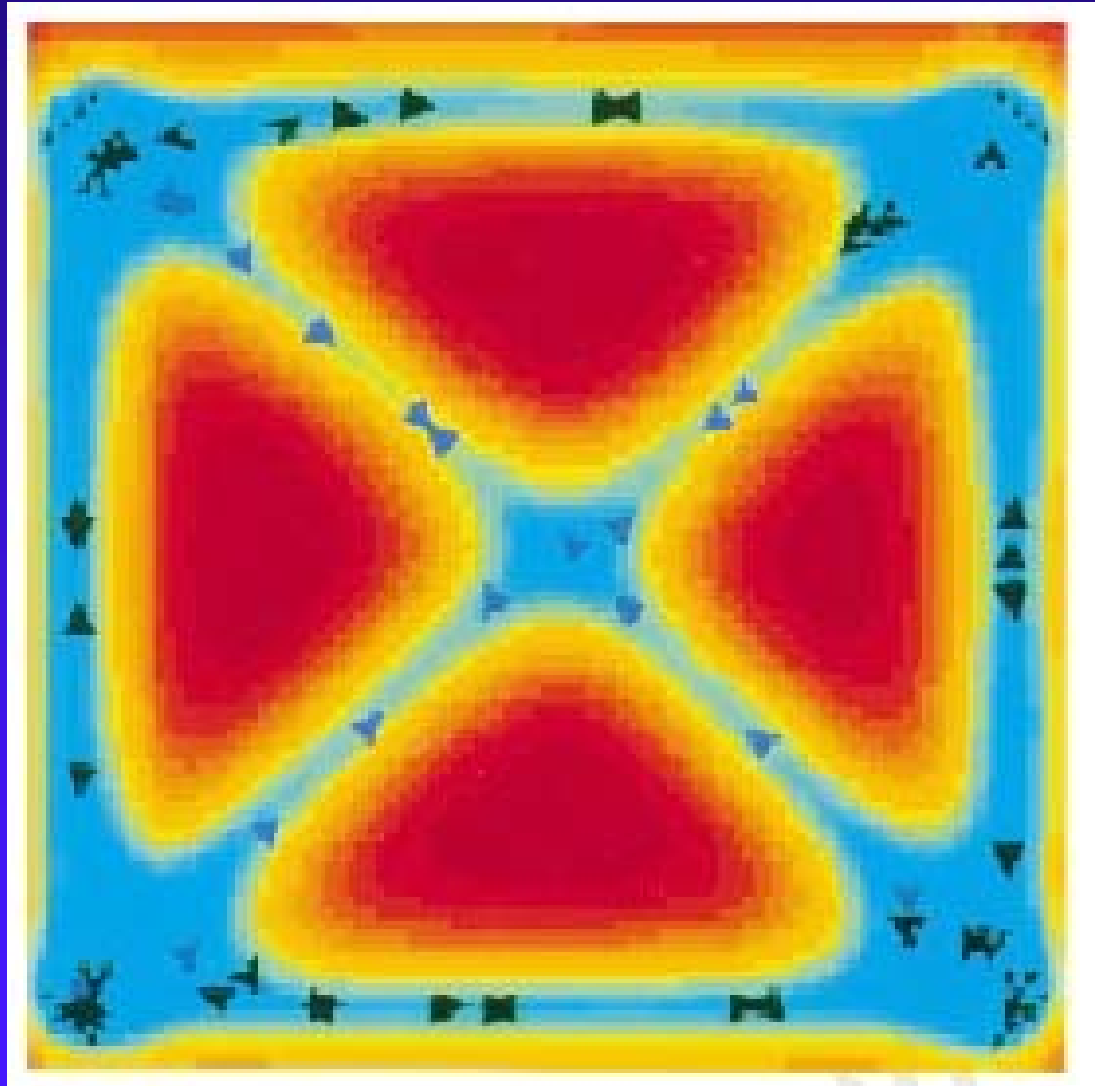
D. Helbing *et al.*, *Nature* **388**, 47 (1997)



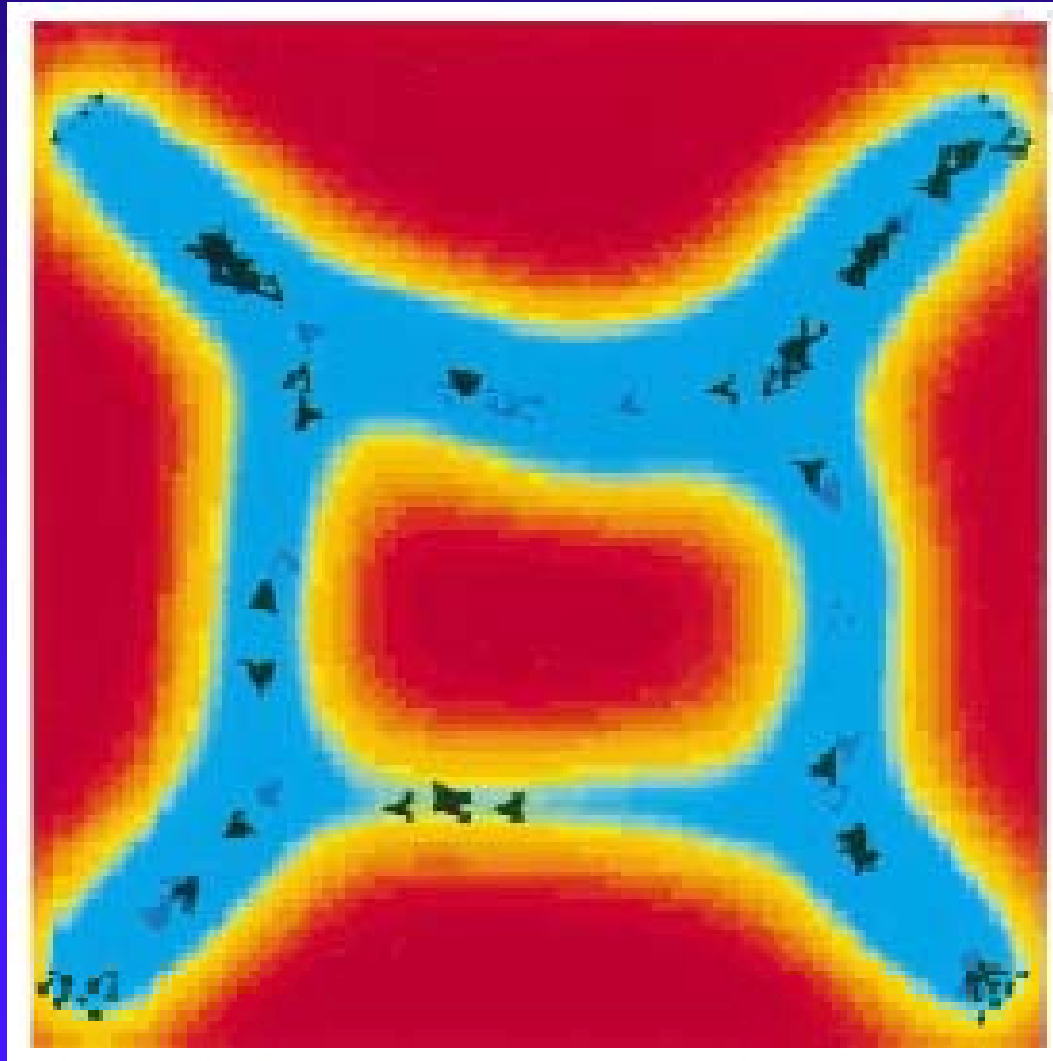
The formation of human trails



The formation of human trails



The formation of human trails



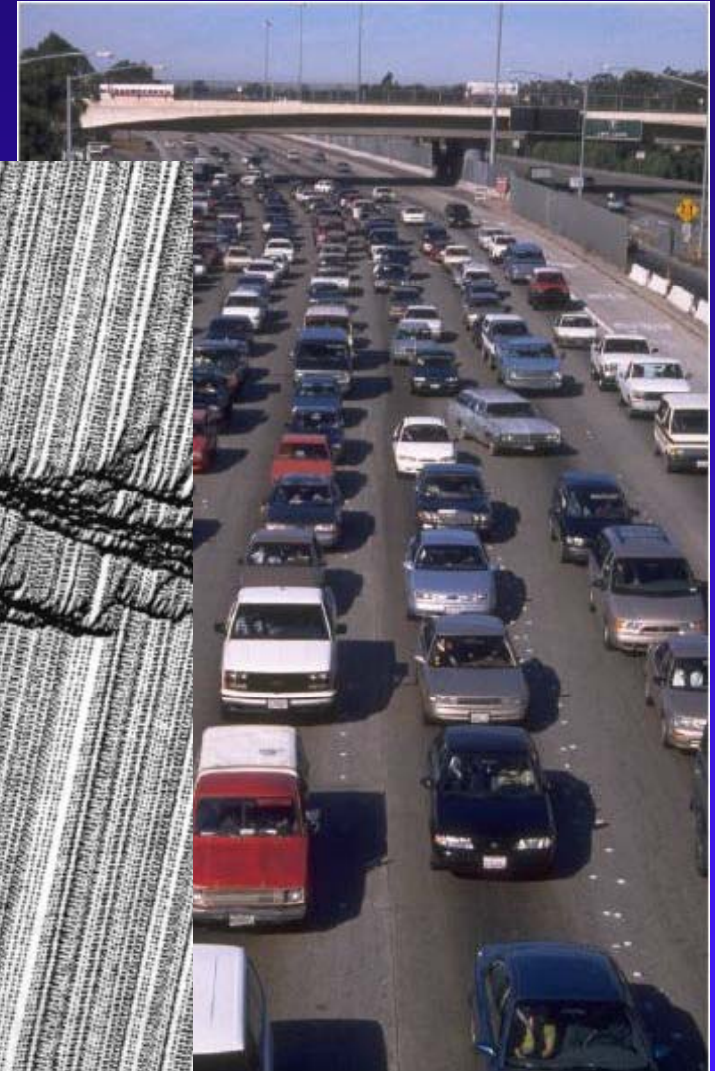
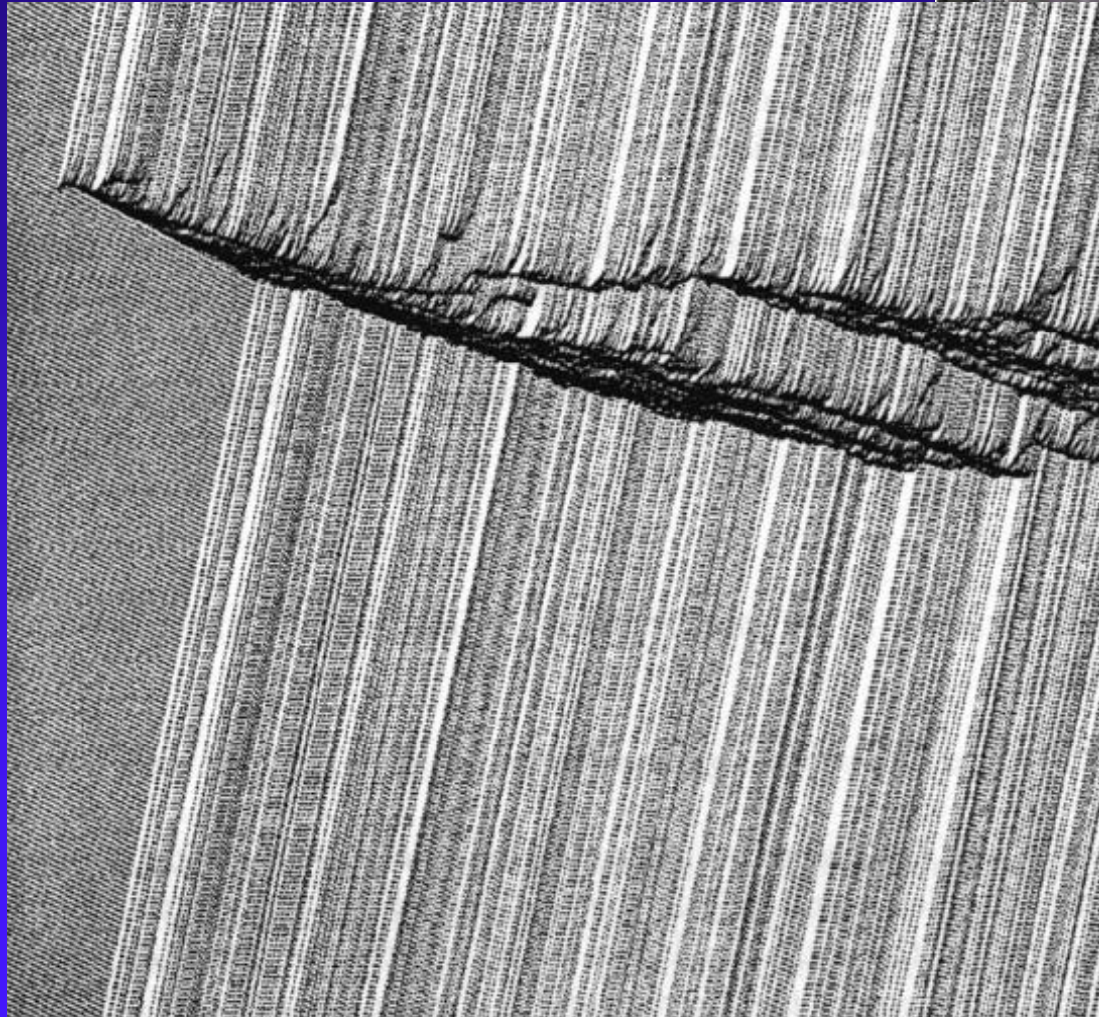
Modelling traffic



D. Helbing, *Rev. Mod. Phys.* **73**, 1067 (2001)
B. S. Kerner, *The Physics of Traffic* (Springer, 2004)

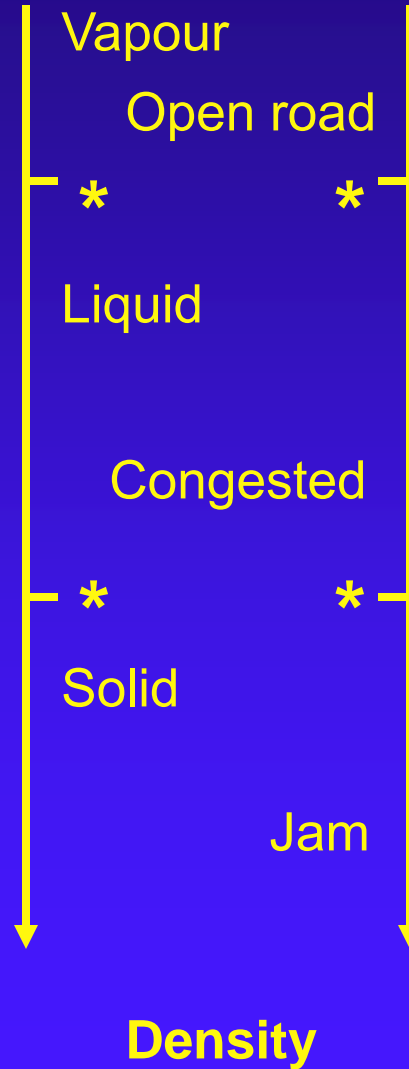
Phantom traffic jams?

Distance along road 



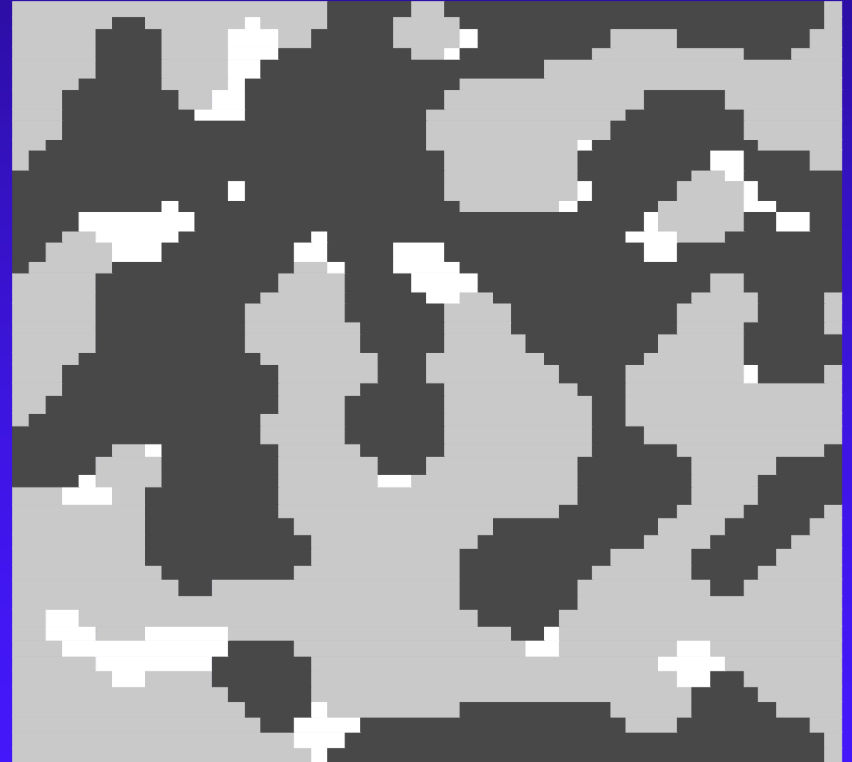
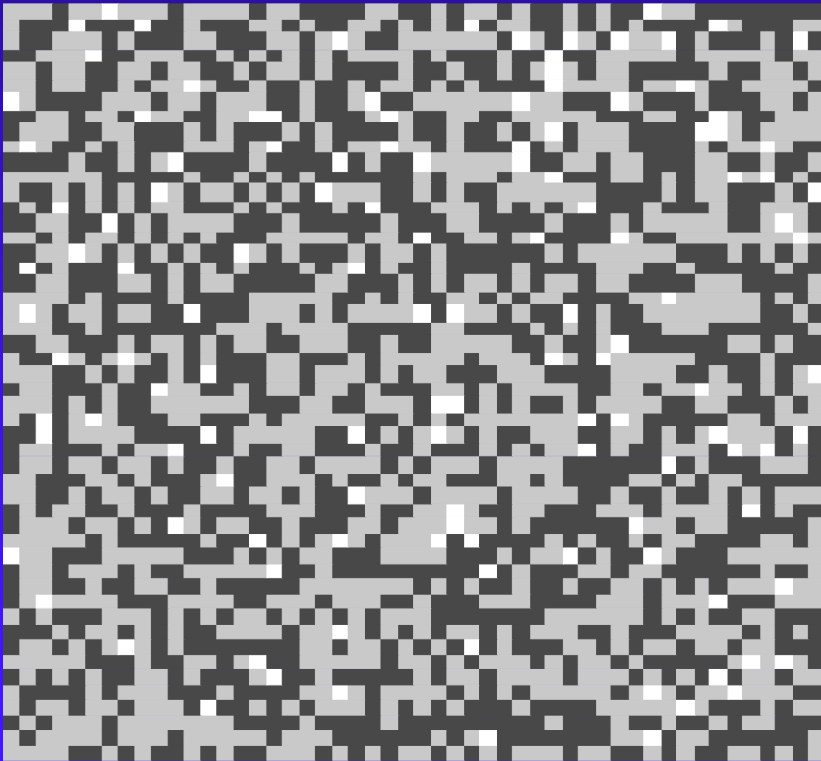
Time 

Phase transitions



Why do societies segregate?

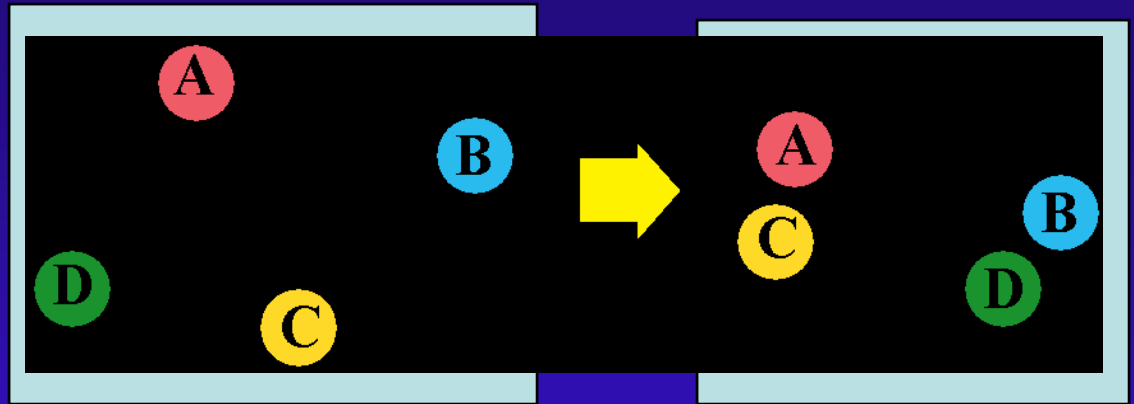
T. C. Schelling, *Micromotives and
Macrobehavior* (W. W. Norton, New York,
1978)



Alliance formation

R. Axelrod *et al.*,
Management Sci. **41**,
1493 (1995)

R. Axelrod & D. S.
Bennett, *Brit. J. Polit.
Sci.* **23**, 211 (1993)



Alliance 1

Sun
AT&T
Prime
IBM

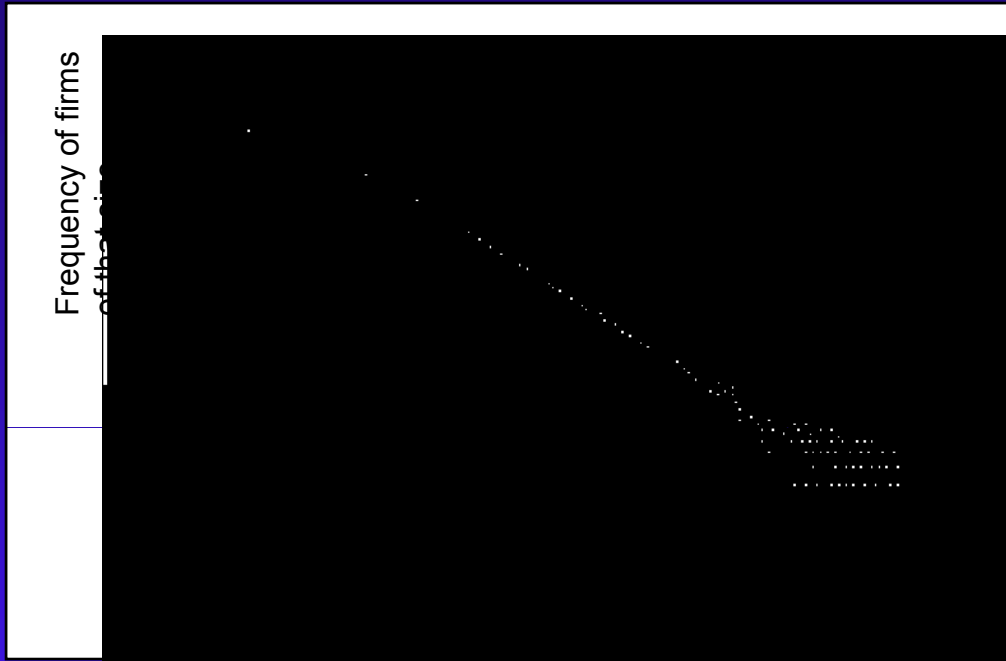
≈ UNIX International
(+IBM)

Alliance 2

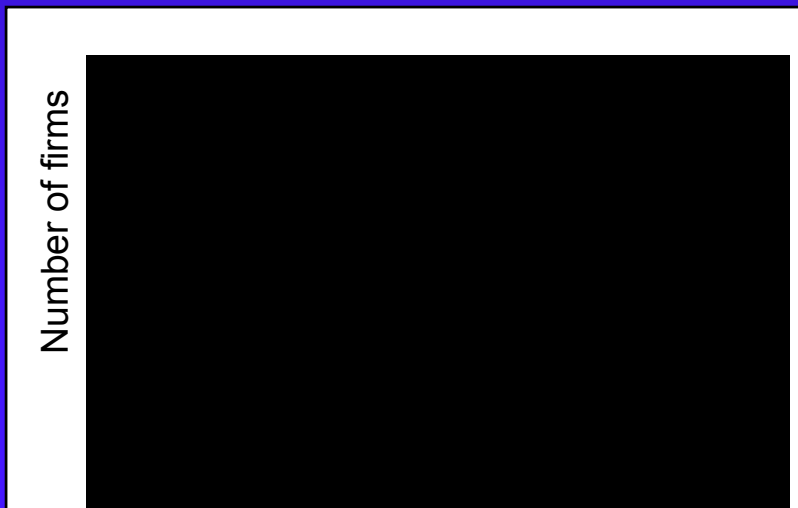
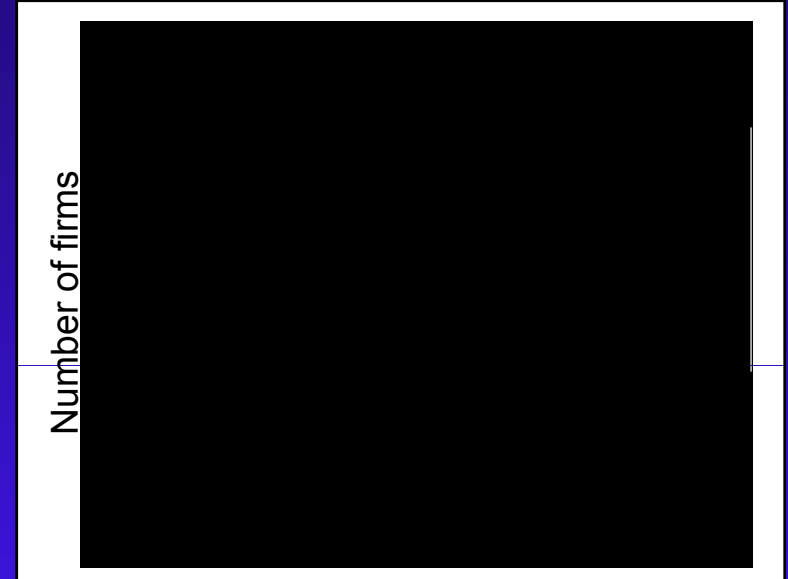
DEC
Hewlett-Packard
Apollo
Intergraph
SGI

≈ Open Software
Foundation
(-IBM)

Firm growth



Firm turnover



R. Axtell, Working Paper No. 3,
Brookings Institution, Washington
(1999)

Simulated distribution
from agent-based model

Game theory

e.g. the Minority Game: D. Challet, M. Marsili & Y.-C. Zhang, *Minority Games* (Oxford University Press, 2005)

Econophysics

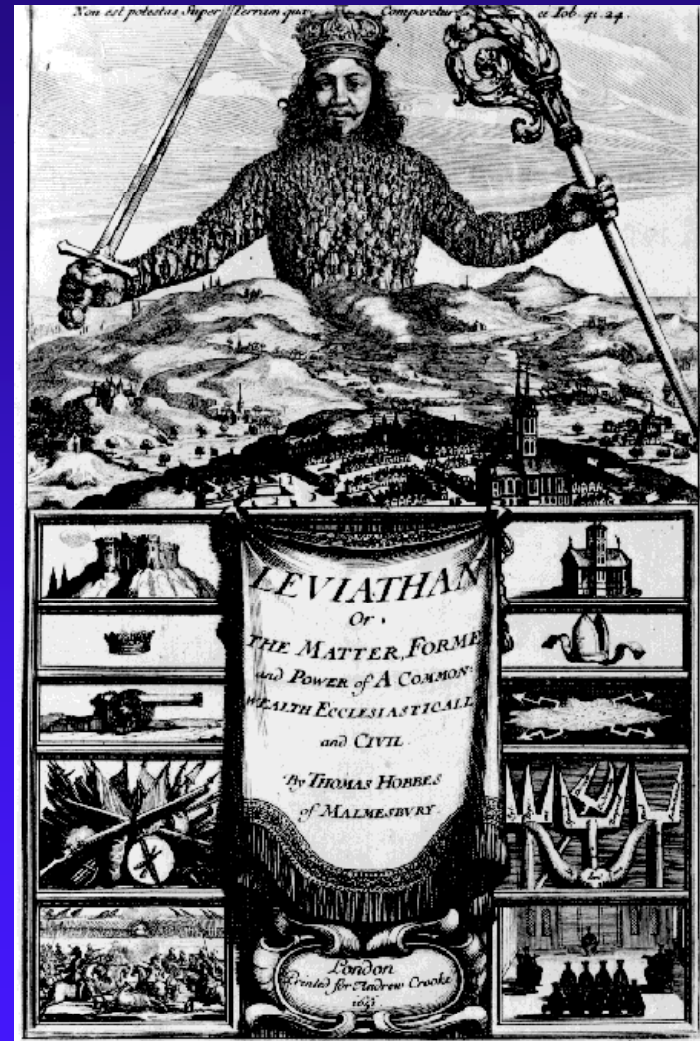
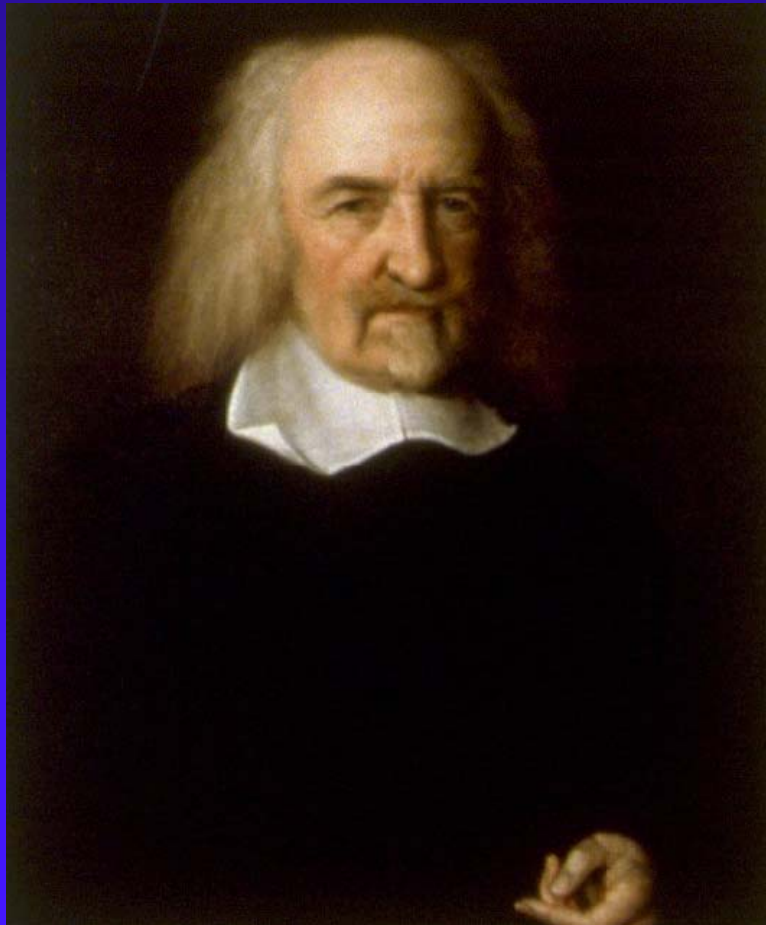
R. N. Mantegna & H. E. Stanley, *Introduction to Econophysics* (Cambridge University Press, 2000)

J. L. McCauley, *Dynamics of Markets* (Cambridge University Press, 2004)

J. D. Farmer & J. Geanakoplos, arxiv:0803.2996

The first 'social physicist'?

Thomas Hobbes
(1588-1679)



Leviathan (1651)

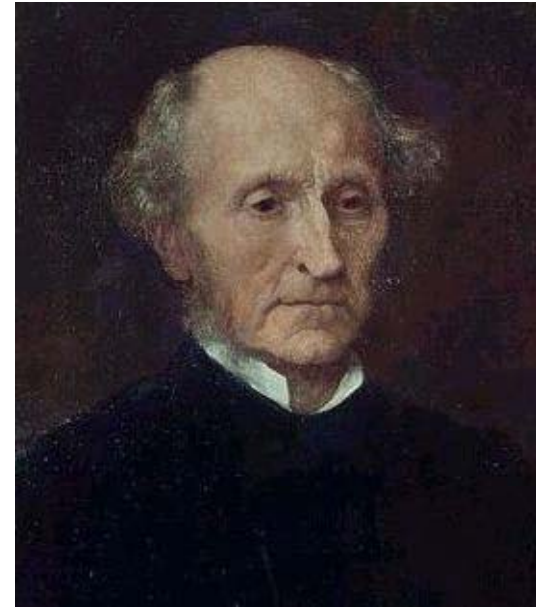
The emergence of social physics



Pierre-
Simon
Laplace
(1749-1827)



Auguste Comte
(1798-1857)



John Stuart Mill
(1806-73)