

Interacting agents and Continuous Opinions Dynamics

G rard Weisbuch*

Guillaume Deffuant, Frederic Amblard****

and Jean Pierre Nadal*

***Laboratoire de Physique Statistique^a**

de l'Ecole Normale Sup rieure,

24 rue Lhomond, F 75231 Paris Cedex 5, France.

****Laboratoire d'Ing nierie pour les Syst mes Complexes**

Cemagref - Grpt de Clermont-Ferrand

24 Av. des Landais - BP50085

F-63172 Aubi re Cedex (FRANCE)

email:weisbuch@physique.ens.fr

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Literature on **Social choice**

Information contagion affecting agent choices

Bounded rationality applied to:

- Buyers' choice of brands;
- Voters choices;
- Adoption of new technology or practices.

Herding effects, fads...

Formalism based on the epidemiology paradigm: propagation of a disease.

In most literature binary variables, yes/no, product 1 or 2.

Variants:

- full mixing, all encounters permitted; [FOLMER 74], [ARTHUR 94], [ORLEAN 95]
- social networks, often represented by square lattice;
- inhomogeneity of agents characteristics. [LATANE 97], [WEISBUCH 99]

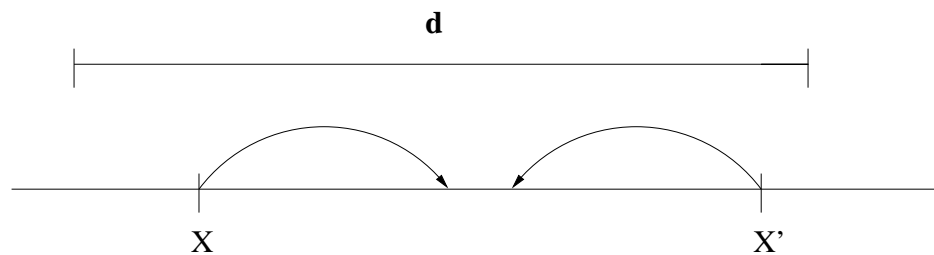
Opinions represented by a **continuous variable + bounded confidence**.

- Right/left political opinions.
- Evaluations.

Take two agents with opinion x and x'

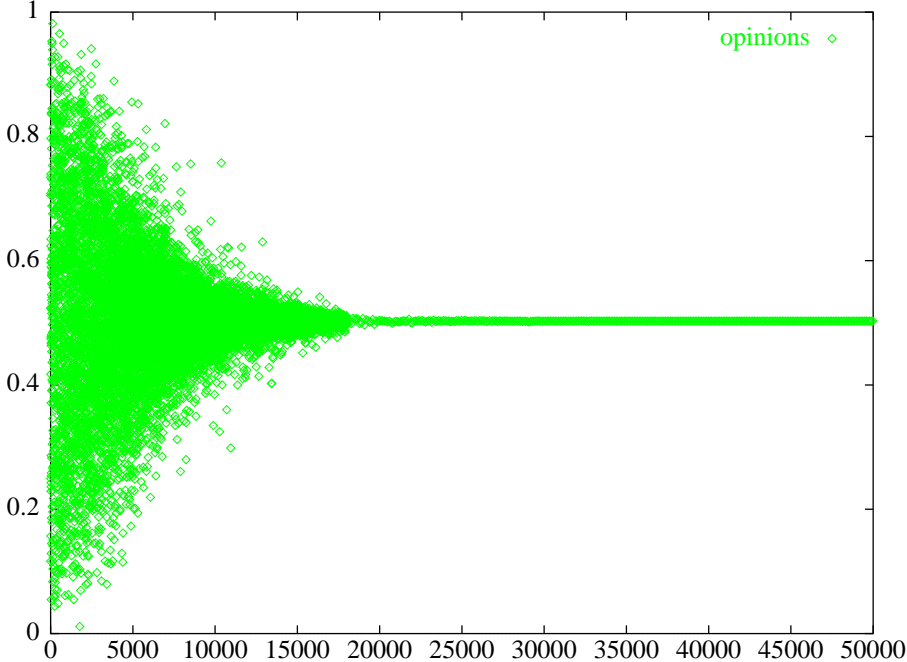
Interaction only if $|x - x'| < d$

$$x = x + \mu \cdot (x' - x)$$
$$x' = x' + \mu \cdot (x - x')$$

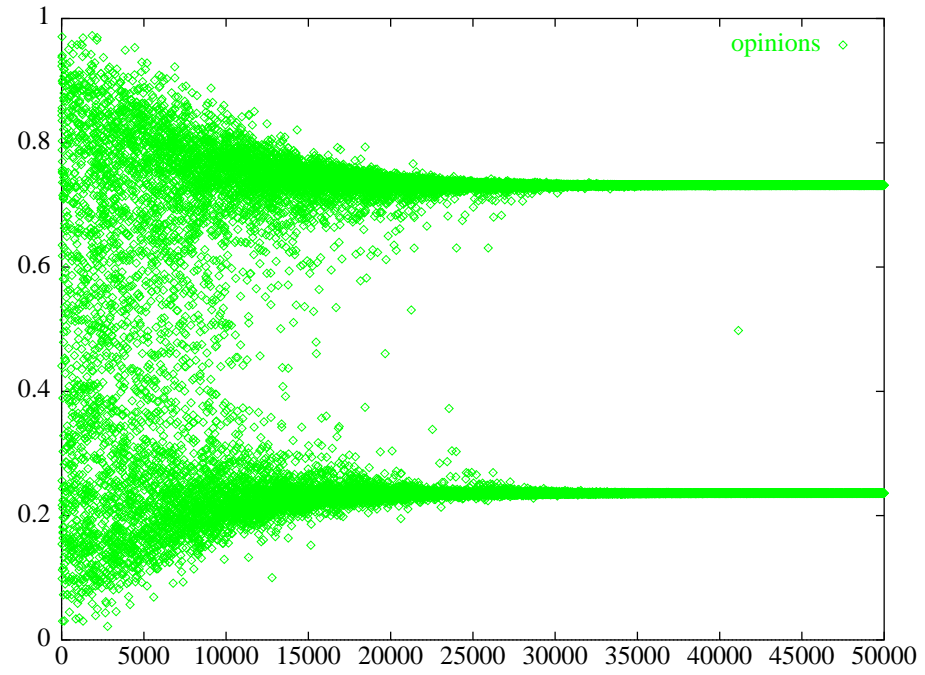


Thresholds: "openness" or rather uncertainty.

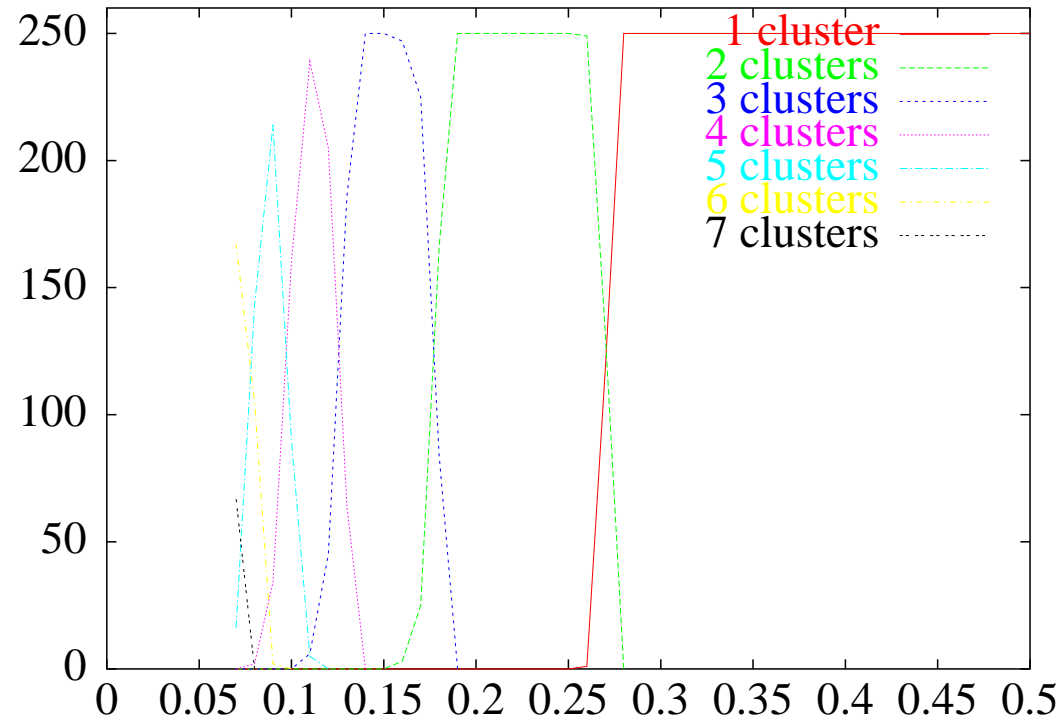
For large threshold values, consensus is observed:



For lower threshold values, several clusters can be observed:



Cluster number scales as the integer part of $1/2d$ (maximum number of clusters compatible with d).



Probabilities of observing 1, 2, 3...clusters as a function of uncertainty d .

Continuous opinion dynamics on a square lattice

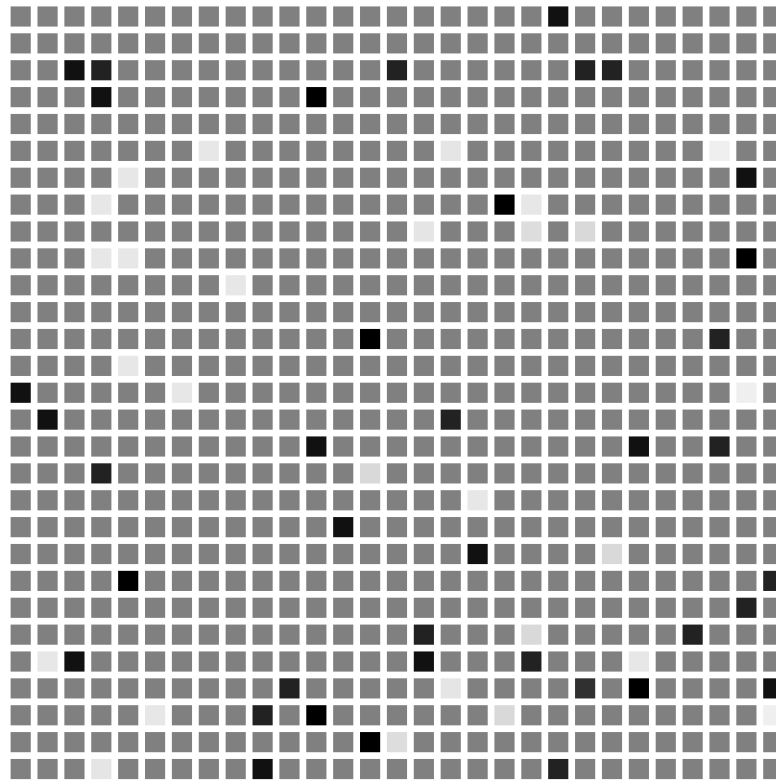


Figure 1: Display of final opinions of agents connected on a square lattice of size 29x29 ($d = 0.3$ $\mu = 0.3$ after 100 000 iterations) . Opinions between 0 and 1 are coded by gray level (0 is black and 1 is white). Note the percolation of the large cluster of homogeneous opinion and the presence of isolated “extremists”.

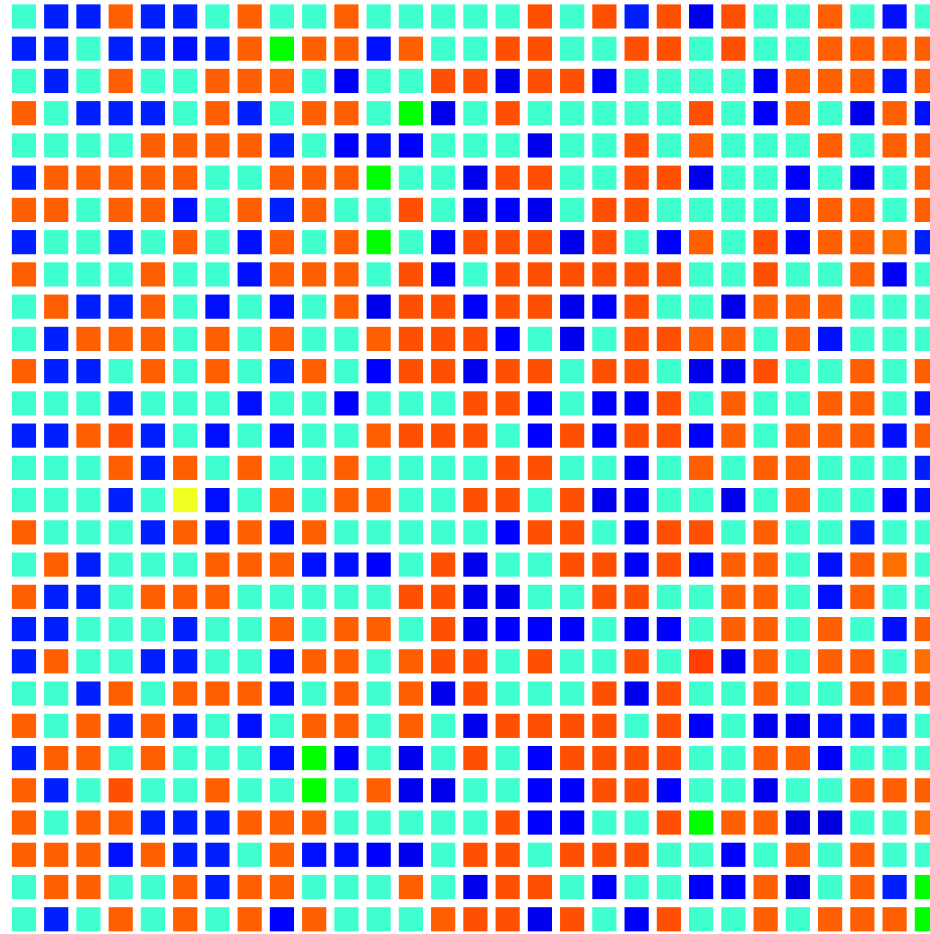


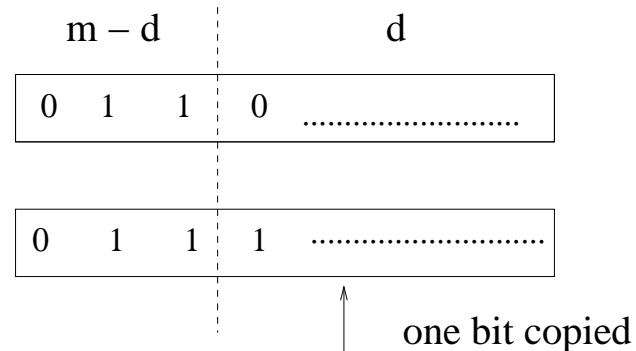
Figure 2: Display of final opinions of agents connected on a square lattice of size 29x29 ($d = 0.15$ $\mu = 0.3$ after 100 000 iterations) . Color code: purple 0.14, light blue 0.42, red 0.81 to 0.87. Note the presence of smaller clusters with similar but not identical opinions.

Bit strings dynamics

Let us think of the cultural or political domains. A culture or a political opinion might be composed of several topics. One opinion is modeled by a bit string where each bit codes for one topic:

Dynamics of opinion exchanges:

At each time step



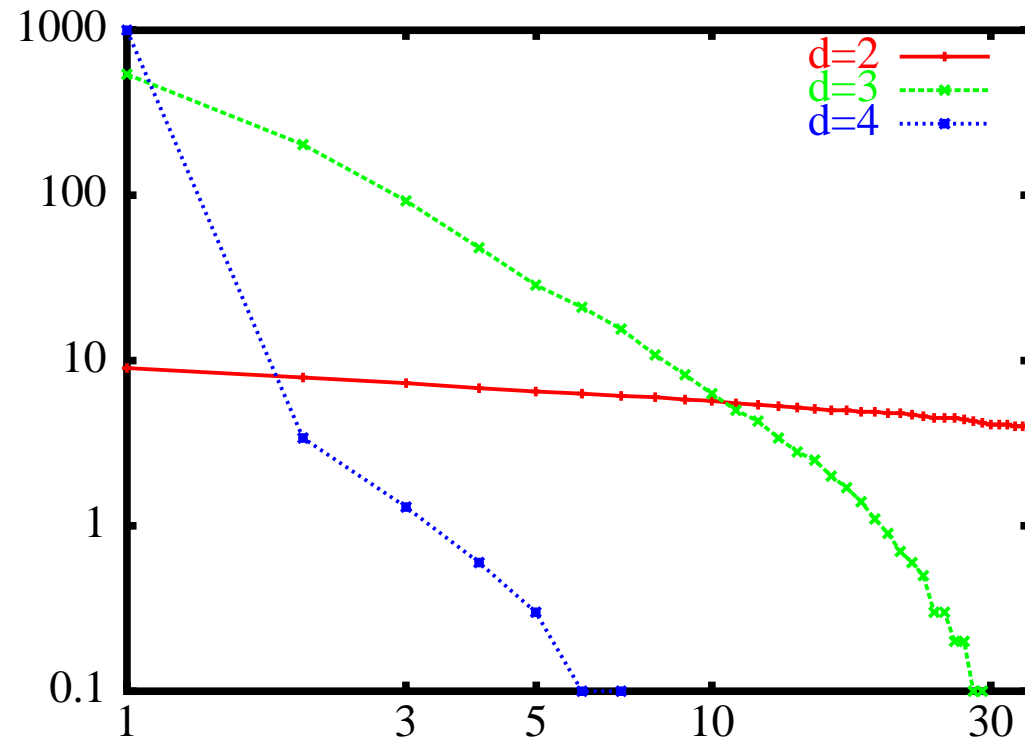
- Random sampling of a pair:
- *iff* $d \leq d_{thres.}$:

One agent, randomly chosen, takes randomly the opinion of the other one on one topic.

What are the attractors of the dynamics?

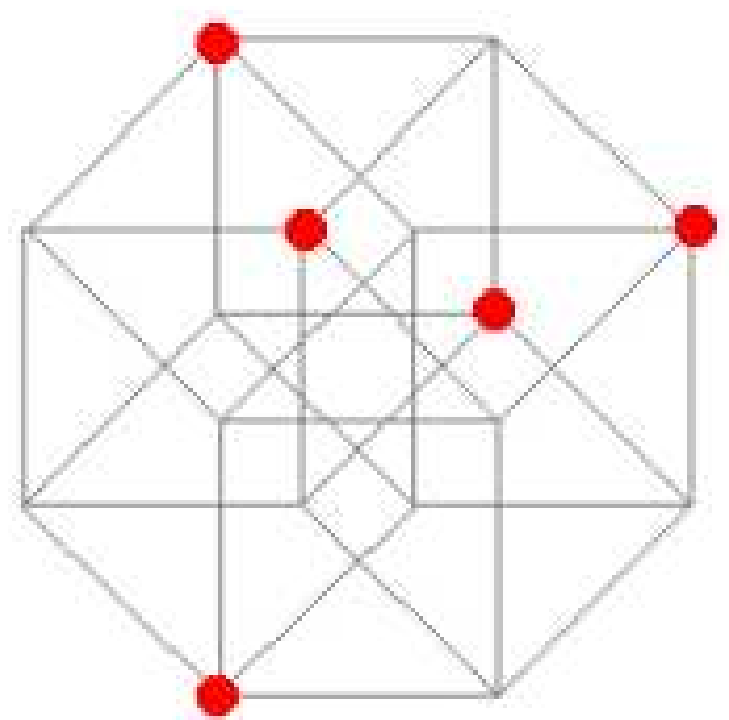
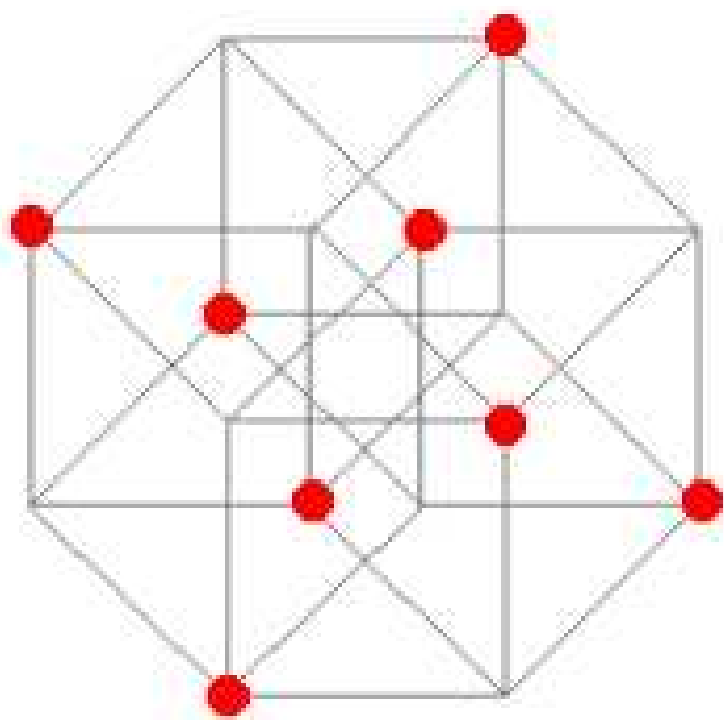
- Two opposed opinions as in the case of ferro-magnetism ?
- Consensus?
- Many clusters?

Compare with species and sexual reproduction



Zipf plot: Attractors sizes arranged by decreasing order (13 bit strings, d , interaction threshold (max number of different bits for interaction), each point is an average over 200 random samples.

- For $d \leq 2$, maximum dispersion on the hypercube.
- For $d \geq 4$, consensus.
- Pour $d = 3$, Zipf distribution ??



Attractor configurations for $m = 4, d = 1$

Extremism

A possible explanation for "extremism", polarisation, strong influence of minorities.

Hypotheses

- Two interacting populations
 - An initial majority of "centrists", with random initial opinions and large tolerance threshold u ;
 - An initial minority of "extremists", with initial opinions close to the extreme +1 or -1 and low tolerance threshold u_e ;
- When encounters occur, not only opinions are adjusted but also tolerance according to the same scheme:

$$u = u + \mu \cdot (u' - u)$$

$$u' = u' + \mu \cdot (u - u')$$

But when because of difference in threshold, most often centrists are influenced by extremists but not the opposite.