Online Social Networks: The Structure of Emotional Dialogs

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Outline

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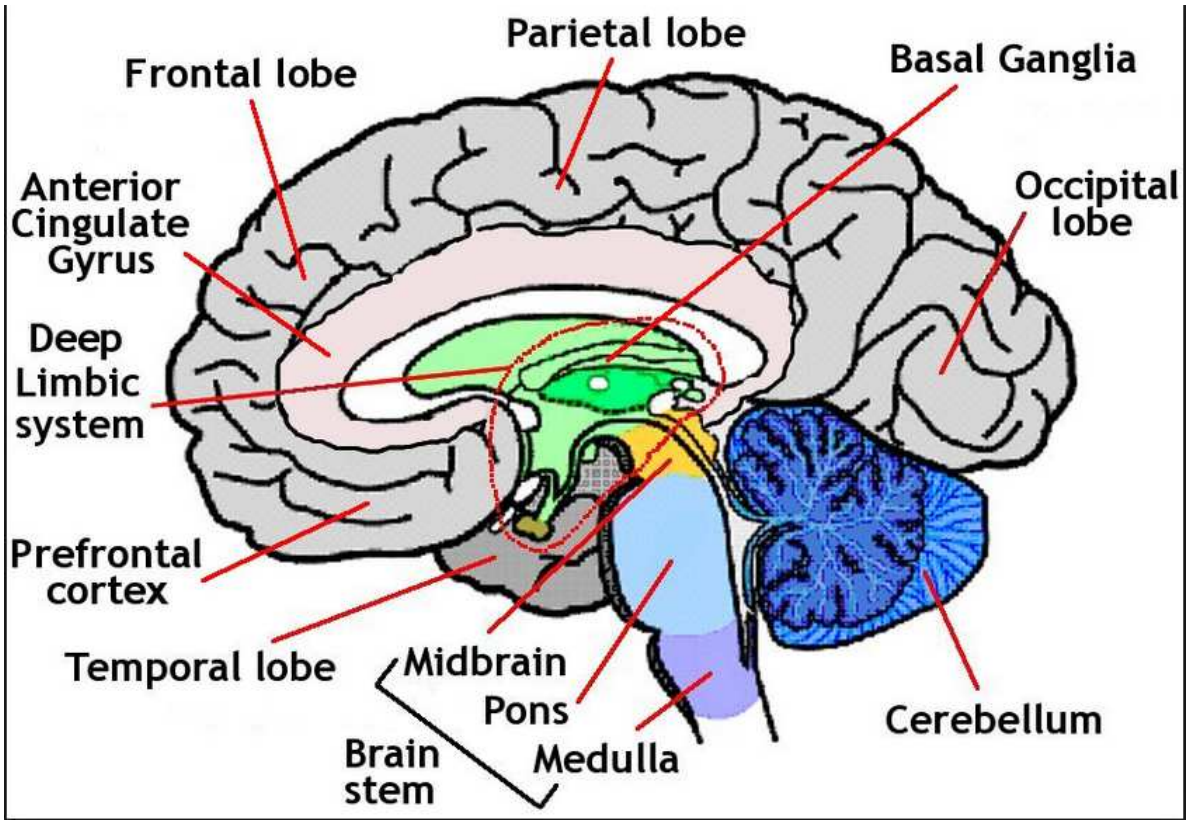
Link: http://www-f1.ijs.si/∼tadic/projects/cybere_.html

PROJECTS:
P1-0044 (Slovenia); CYBEREMOTIONS (EC FP7)

Outline

Brain: The Center of Emotions

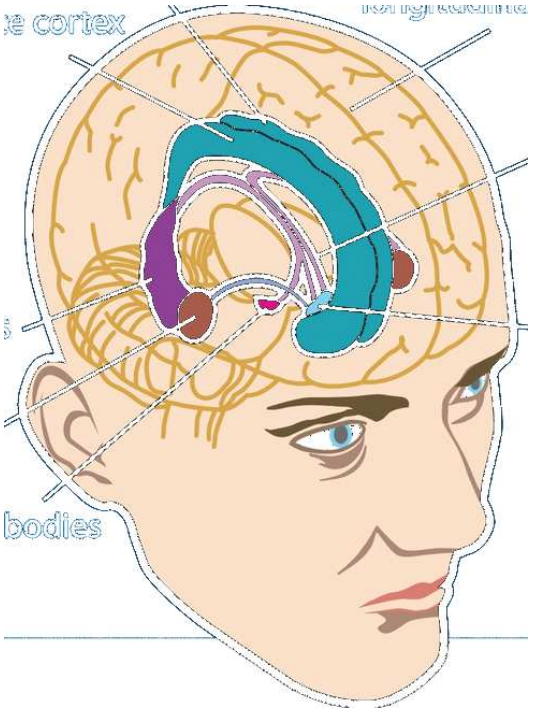


Bio-chemical processes in Limbic system; Connections to other parts of brain;

Individual: Emotion Dynamics

Brain is constantly active; emotions produced; type and strength of emotion fluctuate over time, depending on brain

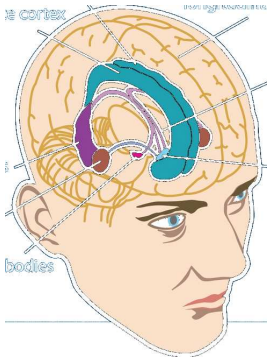
processes and external events...



...ready to communicate

Write about it...

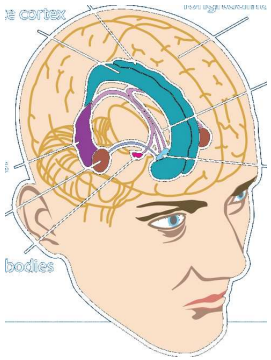
Brain is constantly active; emotions produced; fluctuate, depending on events...



add a keyboard and time:

Write about it...

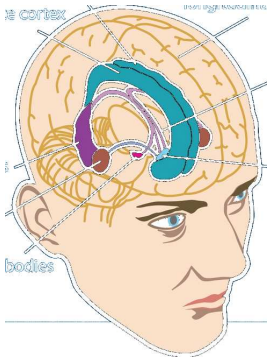
Brain is constantly active; emotions produced; fluctuate, depending on events...



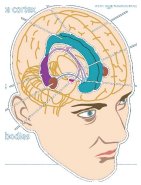
add a keyboard and time:

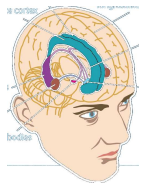
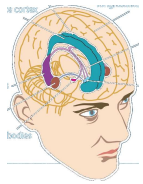
Add Communications

Brain is constantly active; emotions produced; fluctuate, depending on events...



... (social) connections may appear:



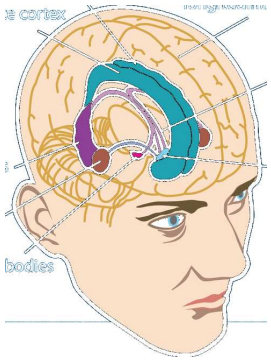
add a keyboard and time:

generate a `text message...`

send it via communication systems...

Add Communications

Brain is constantly active; emotions produced; fluctuate, depending on events...



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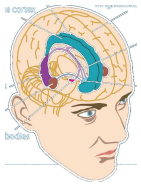


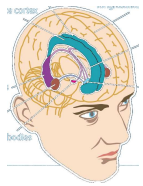
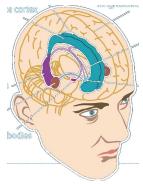

add a keyboard and time:

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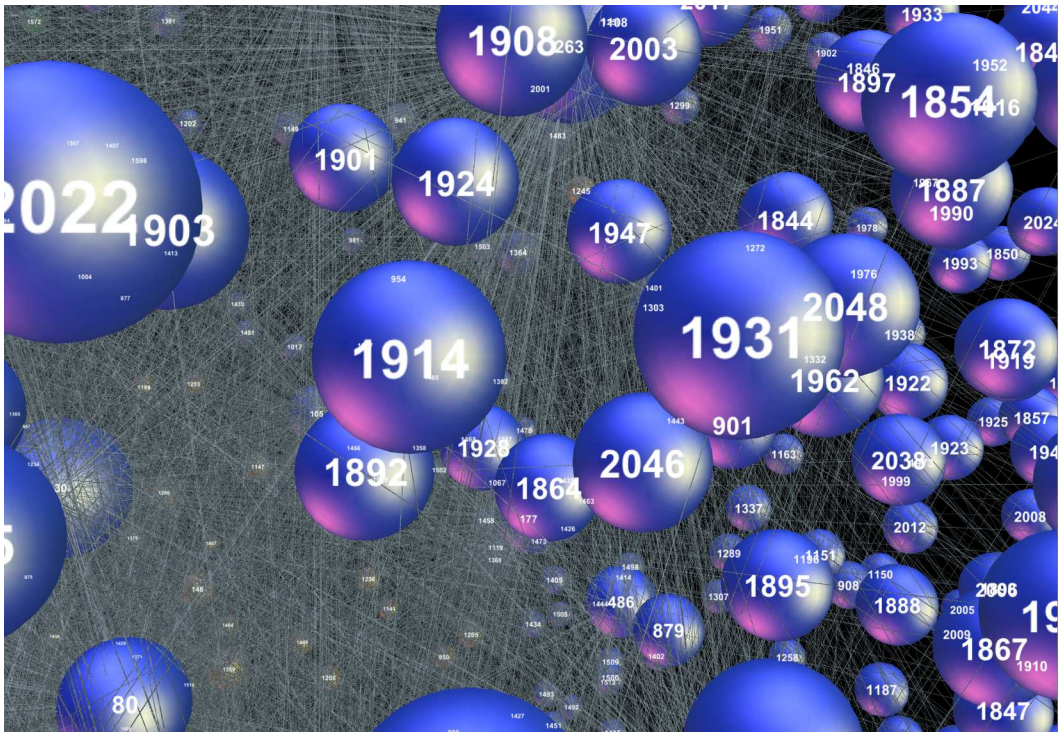
Social Networking in Online Communications

DATA from Web platforms: Users (anonymized) & their interactions ($time, i \rightarrow j, text, ...$) over time are available;

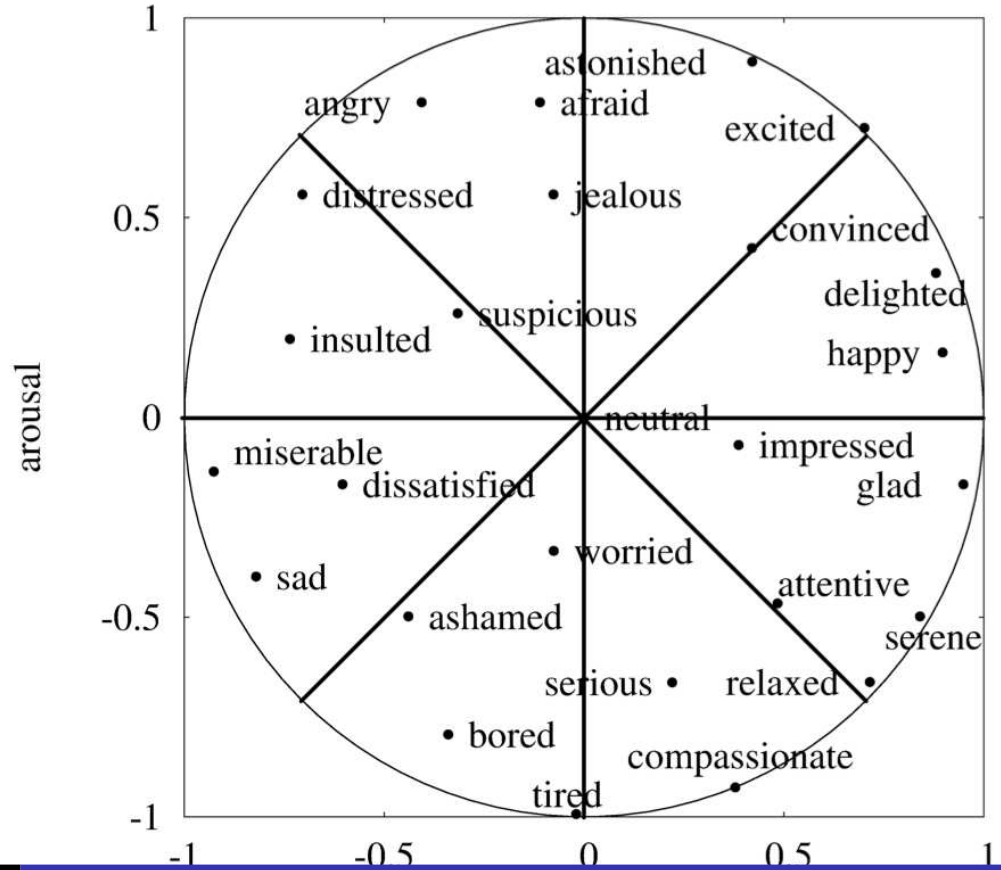


mapped onto mathematical graph (interaction.network); analysed by using graph theory and statistical physics;

Emotions can be retreaved from text of messages

- Lexicon methods (ANEW) Affective Norms for English Words (1–4,5,5–9)

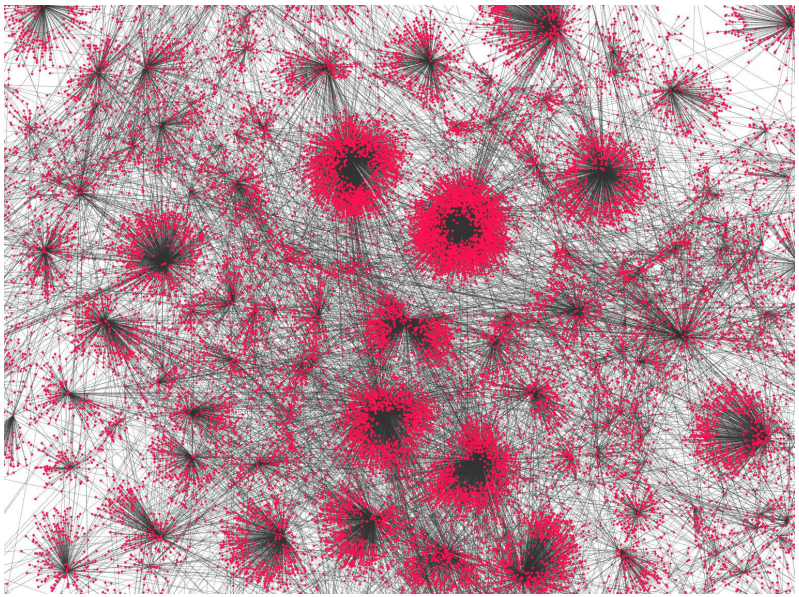
annoy	2.74	6.49	5.09
answer	6.63	5.41	5.85
applause	7.50	5.80	6.48
arm	5.34	3.59	5.07
army	4.72	5.03	5.03
aroused	7.97	6.63	6.14
art	6.68	4.86	5.30
bastard	3.36	6.07	4.17
bomb	2.10	7.15	4.54
book	5.72	4.17	5.30
bored	2.95	2.83	4.11

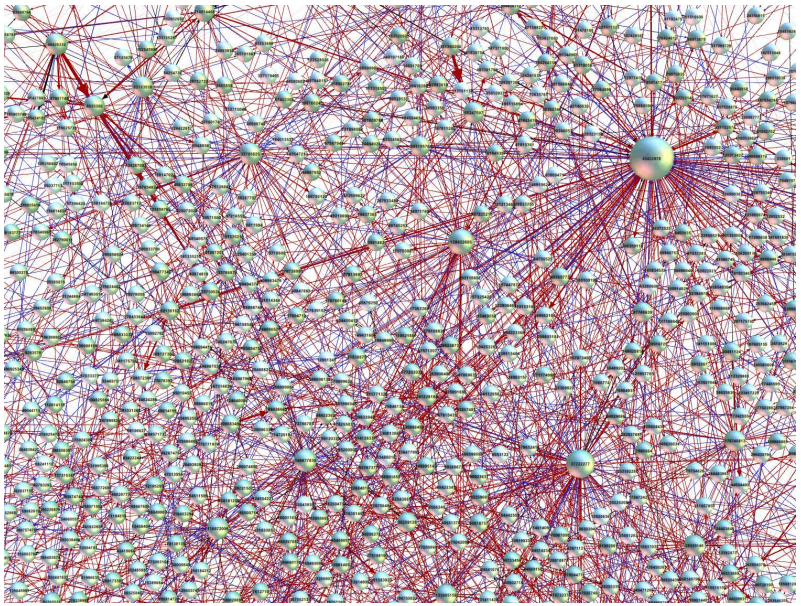


Outline

MySpace Network Organization

Online-Social-Networks: Users connected by “friendship” links; Interaction along directed w.links; nnn-visibility; Communities:



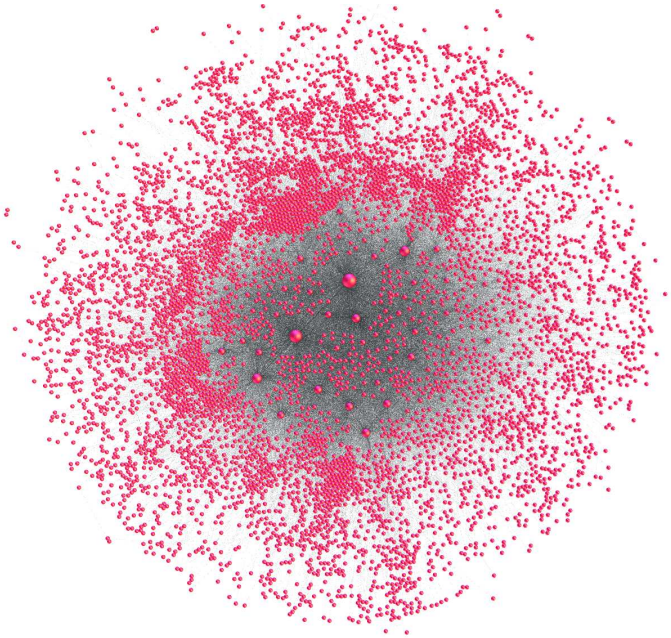


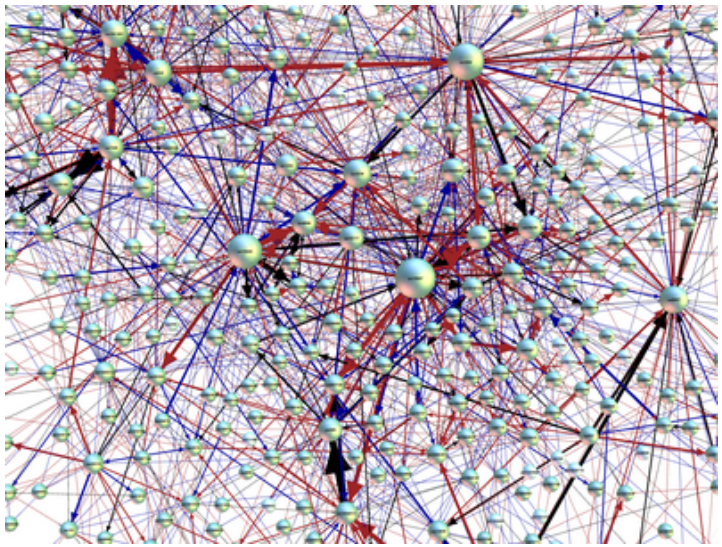
Use of the links makes the dynamical structure! Different from conventional social networks [Ref.]; *weights & emotions*

[Šuvakov et al., J. Roy. Soc. Interface Vol.10, 20120819 (2013)]

Online Chats Network: Ubuntu channel

Sharing knowledge; Self-organized dynamics: no *a priori* associations among users; Links used over long time: Persistent networks



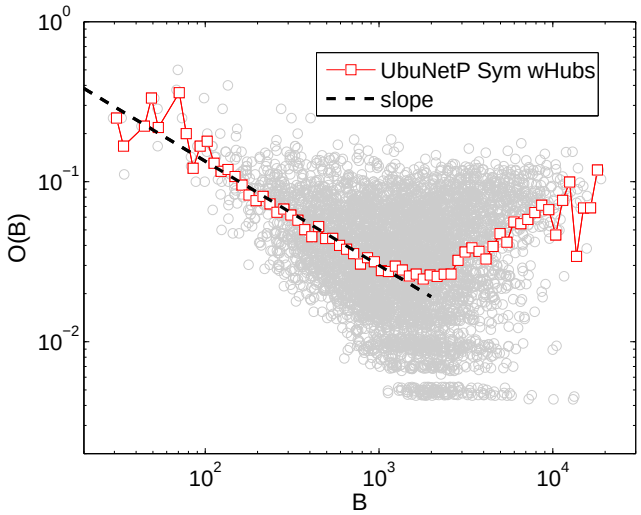


Central core: Robot and Moderators (knowledgeable users);
Emotional arousal over links related with network resilience [Ref.]

[Gligorijević, Skowron, Tadić: IEEE (2012),Physica A (2013)]

Remove the core: “Social chats?”

Structure of the remaining network is similar to online social networks:

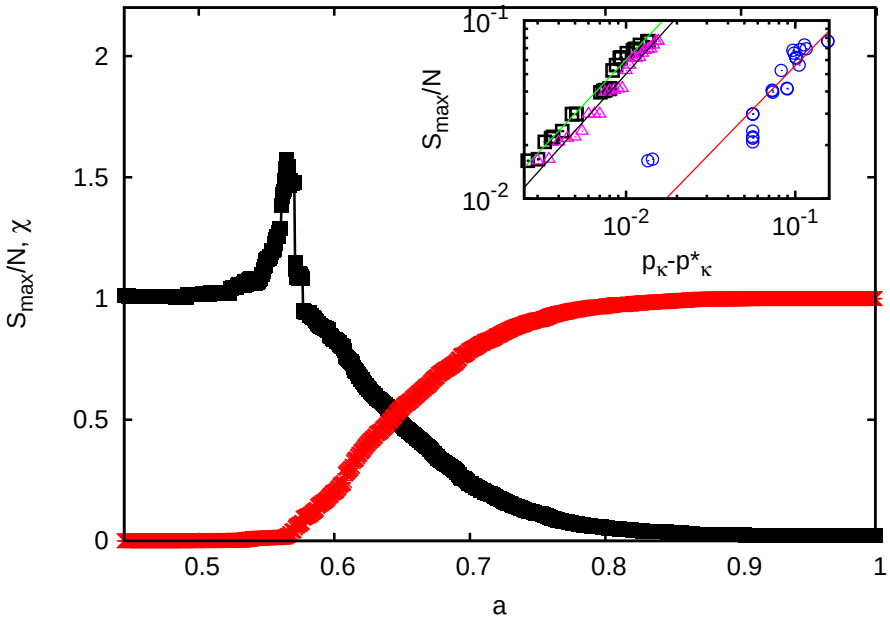


Occurrence of *communities* as in online social networks;
Testing “weak-tie” hypothesis: chats without ’core”: social (?)

For how long the giant cluster persists?

Hysteresis in the percolation on networks $a_c \in [0.56, 0.8]$: inside–out or vv.

:largest arousal first:....

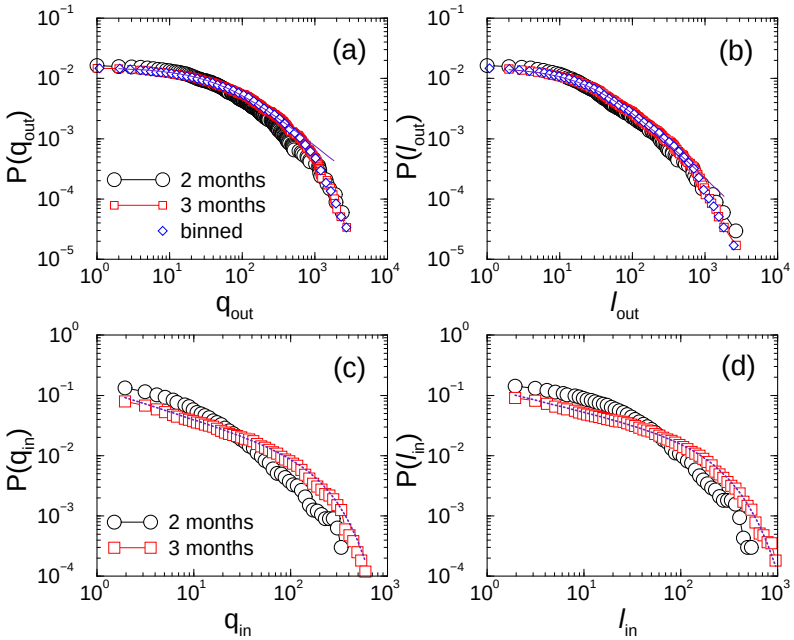


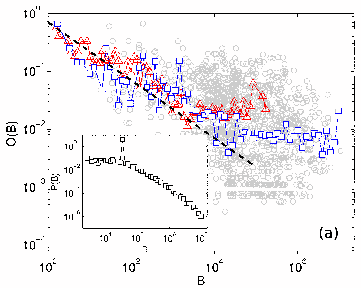
Critical fluctuations in the cluster size at a_c: Susceptibility to cutting links of a given arousal!

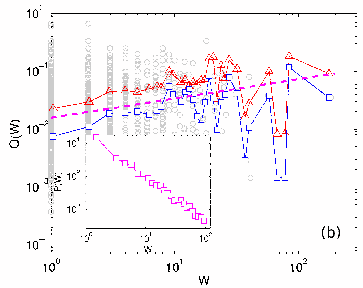
[Gligorijević, Skowron, Tadić: Physica A, vol.392,pp.538, 2012]

Topology of Social Dialogs in MySpace

Scale-free links organization; Disassortativity!; “weak tie” hypothesis holds, but exponents as in the “online games”!





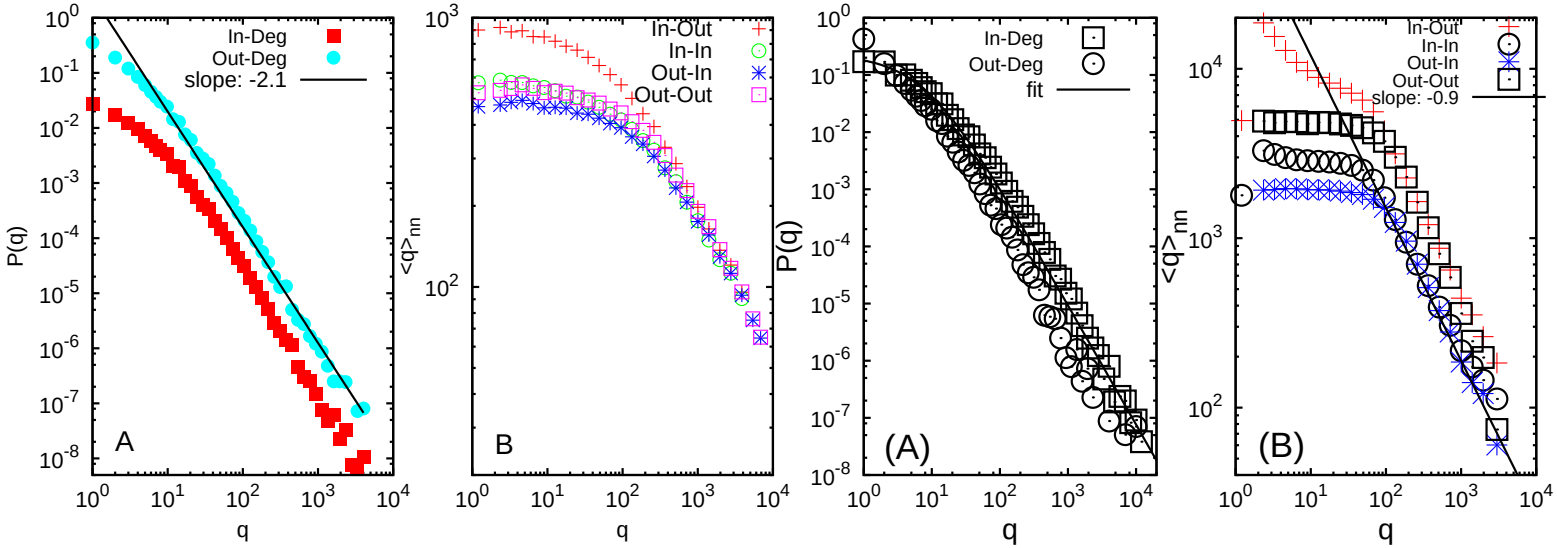


“Social” behaviors, but different from conventional (offline) social networks ;

[Šuvakov et al., J. Roy. Soc. Interface Vol.10, 20120819 (2013)]

Topology of Social Dialogs in Chat Channels

Online chats lead to hierarchically organized networks;
Scale-free in- out-degree; disassortative mixing patterns!



Networks from simulated message streams (ABM [ref]) give similar structure;

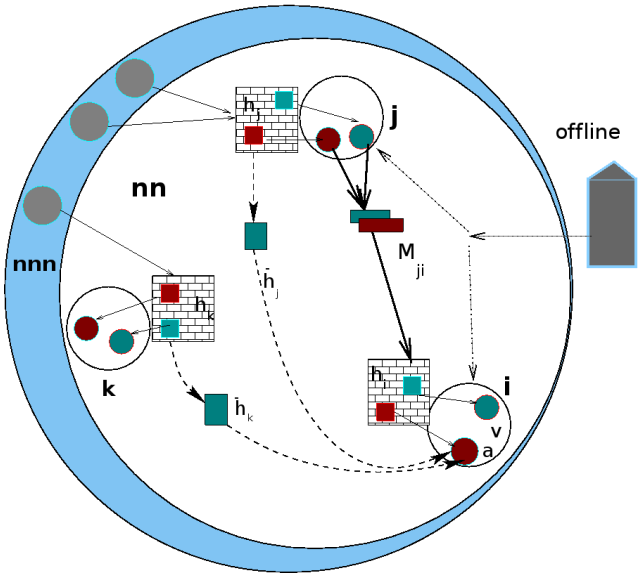
[Gligorijević, Šuvakov & Tadić: Building social networks in online chats with users, agents and Bots, Cambridge Scholar Pub. 2013]

Outline

Rules & Parameters of ABM in MySpace

To understand mechanisms of emotional bursts: Agent-based modeling [Ref] emo.agents $i = 1, 2, \cdots N = 33649$:

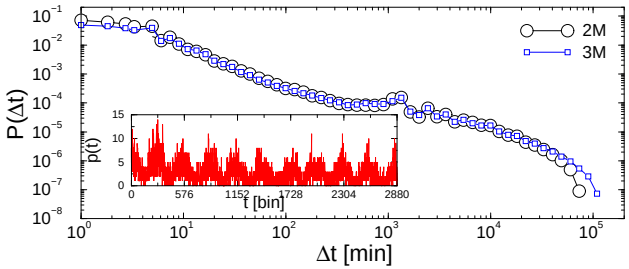
$$\{id, (a_i(t), v_i(t)), links \in OSN; circadian.cycles; action.delay\}$$



PARAMETERS:

p_0—input noise;

$\{p(t)\}$ – *driving*; ϵ-own/nn;



[BT, *Modeling Web users as agents with reason and sentiment*, in "Advances of Computational Modeling..." Novapublishing NY

Mathematical Structure of the Model

Arousal-Valence nonlinear maps [Refs!]:

$$a_i(t+1) = (1-\gamma_a)a_i(t) + \delta_{t_i,1}[\epsilon h_i^a(t) + (1-\epsilon)\bar{h}_i^a(t)] \times [1-a_i(t)]$$
$$v_i(t+1) = (1-\gamma_v)v_i(t) + \delta_{t_i,1}[h_i^v(t)] \times [c_1 + c_2(v_i(t) - v_i^3(t))][1-|v_i(t)|]$$

Influence fields:

$$h_i^z(t) = \frac{\sum_j \sum_{m\in M_{ji}} \theta(t,t_m) z_j(t_m) W_{ji} e^{-\gamma^h (t_{ji}^{lm} - t_m)}}{\sum_j \sum_{m\in M_{ji}} \theta(t,t_m) W_{ji} e^{-\gamma^h (t_{ji}^{lm} - t_m)}} e^{-\gamma^h (t - t_{ji}^{lm})}$$

Message stream: $h_{ji}^a(t) = \frac{\sum_{m\in M_{ji}} \theta(t,t_m) a_j(t_m) e^{-\gamma^h (t_{ji}^{lm} - t_m)}}{\sum_{m\in M_{ji}} \theta(t,t_m) e^{-\gamma^h (t_{ji}^{lm} - t_m)}} e^{-\gamma^h (t - t_{ji}^{lm})}$

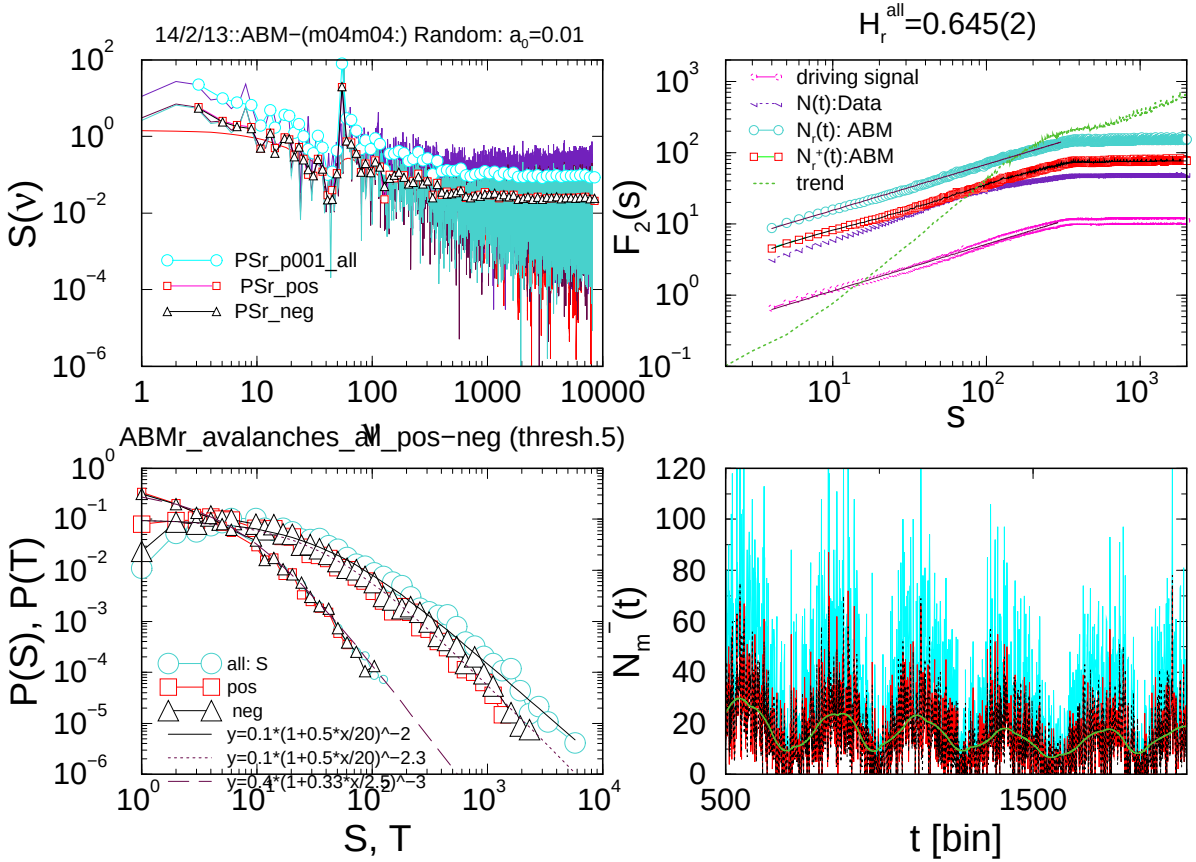
Driving: $p(t)$ new agents per time step, immediately active;
Active agent's environment on the network systematically observed;
and affected agents updated; high arousal triggers an action.

[Šuvakov et al., http://arxiv.org/abs/1205.6278]

Outline

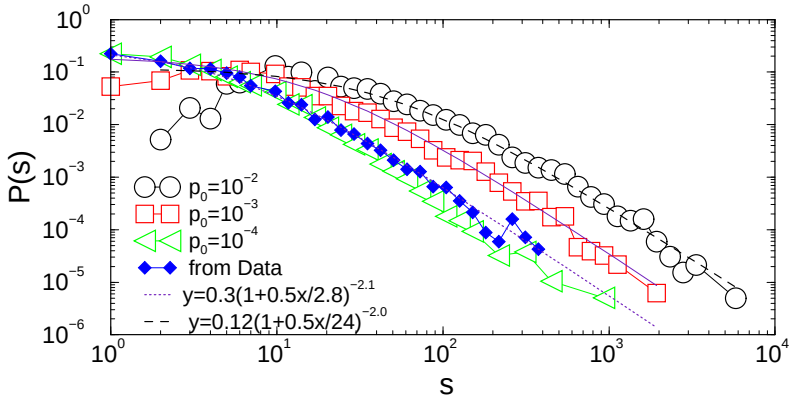
Self-Organized Dynamics of Emotional Dialogs

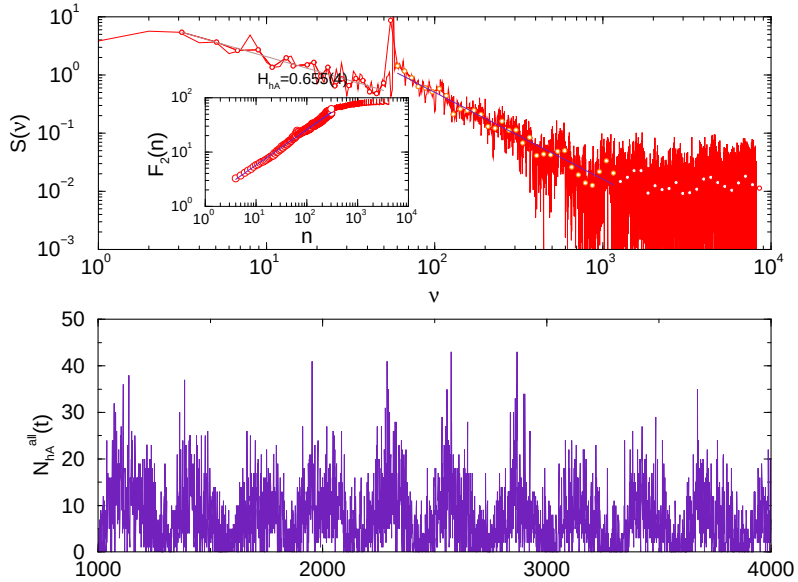
Compute: Fractal features of simulated time series and avalanches of emotional messages:



Varied input noise: p_0

Avalanches change:





Select High-Arousal messages: More correlations, but noise dependent!

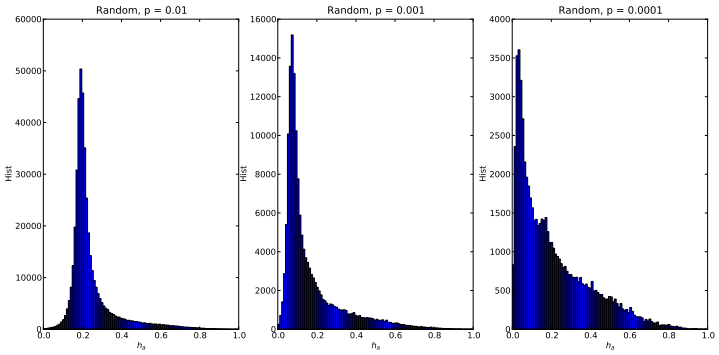
Question: Why this distribution? $P(s) = A\left(1 + \frac{1}{\alpha}\frac{s}{s_0}\right)^{-\alpha}$

Arousal Triggering Fields

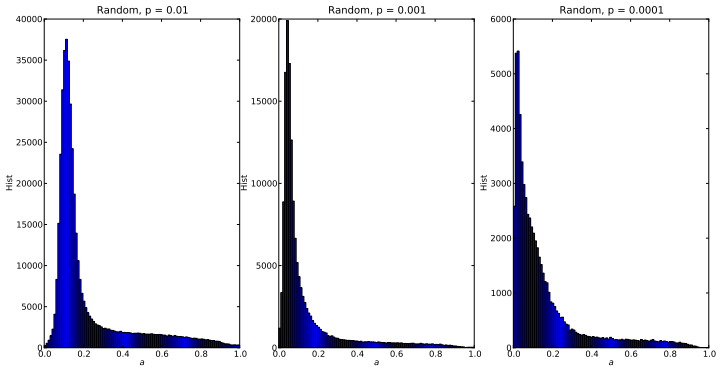
Theoretically, reasons can be found in the stochastic process:

- Coherent noise?/th. for noninteracting system [Sneppen]

In the simulations, we can look at values of triggering fields



a.trigg.fields



arousals

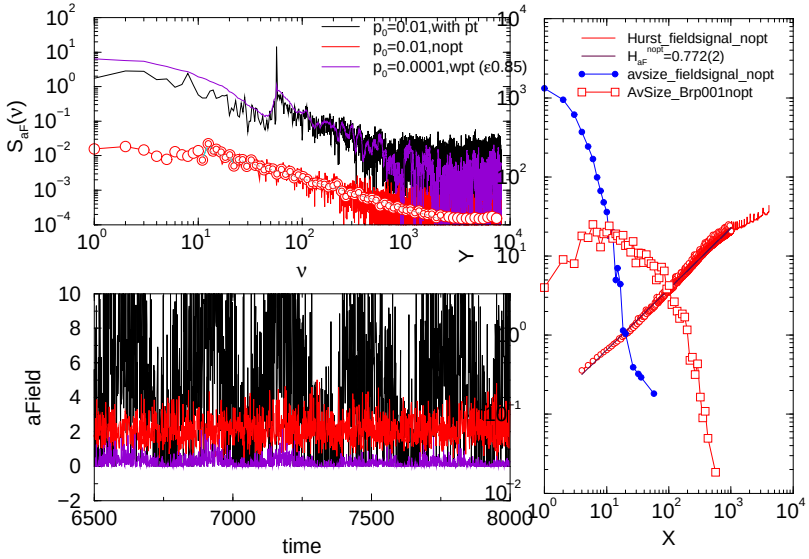
- Nonextensive dynamical systems with non-additive entropy

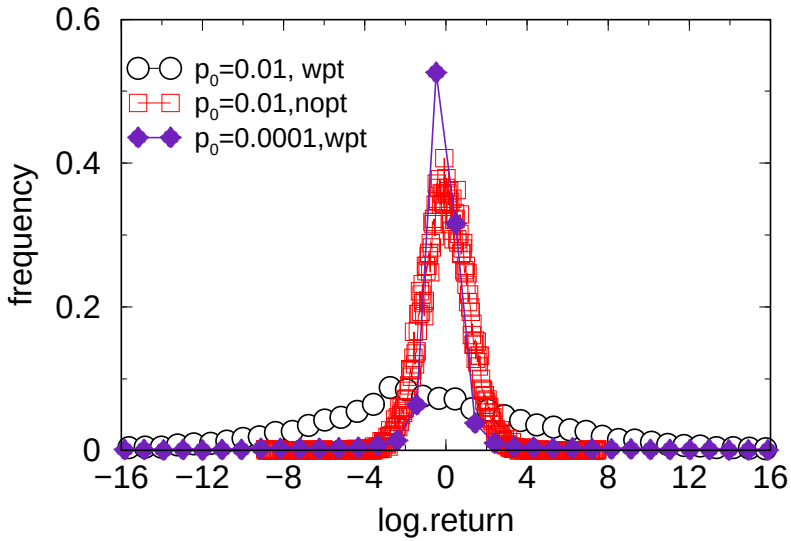
[Tsallis]? Reduced phase space; Correlated fluctuations, etc [Ref.]

[Hanel & Thurner: When do generalized entropies apply? How phase space volume determines entropy. EPL (2011)]

Fluctuations of Triggering Fields

Varying strength of input noise p_0 and/or removing $p(t)$: three cases

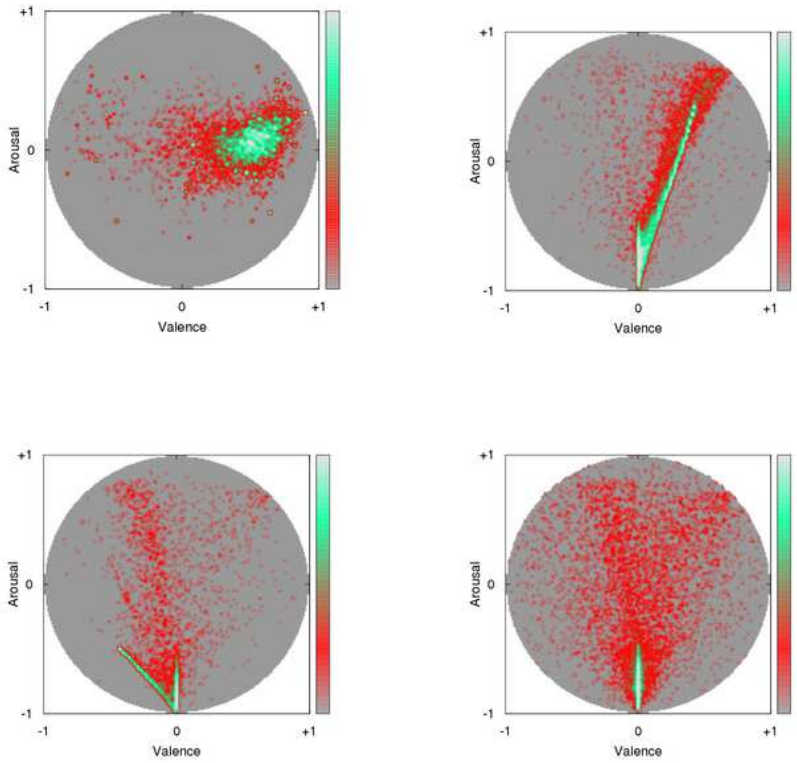




Triggering fields have persistent fluctuations (even without $p(t)$); Non-Gaussian distributions of **log.returns**, but noise dependent; Characteristics of nonextensive systems.

Trajectories in Phase Space

Filling the phase space of emotion variables by agent's trajectories simulated for different input emotion: Emotion dynamics:



nonextensive!

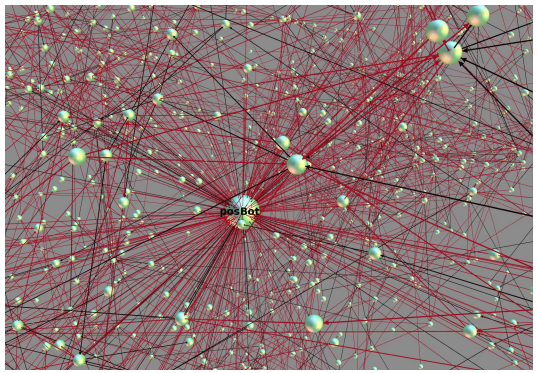
[Šuvakov et al., http://arxiv.org/abs/1205.6278]

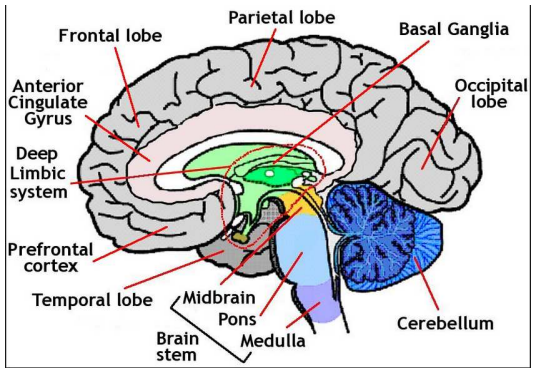
SUMMARY

- Online communications $\Leftrightarrow$ Online Social Networks
  - Topology classes; different from conventional social networks
- Contents & Emotions are relevant for networking
  - Emotion components (a, v) play a specific role;
- Agent-Based Modeling reveals the dynamics of emotions
  - Physics of collective emotional behaviors;

Robots can make use of it?

- Online world: paradise for robots (algorithms, Bots)
- “Emotional” Chat Bots can be designed
- Inverted mechanisms cognition→ emotion





[Tadić & Šuvakov: Can human-like Bots control collective mood? Agent-based simulations of online chats, cond.mat/1305.2741]

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THANK YOU