Discrete chaos in everyday life

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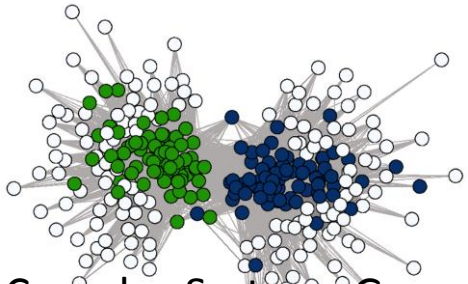


Complex Systems Group

AGH

essa The European Social Simulation Association

ESSA 2013: 9th Conference of the European Social Simulation Association
Warsaw School of Economics, Warsaw, Poland, September 16-20, 2013

Whenever you set out to do something, something else must be done first.

[Murphy law]

outline

1. Sociology of everyday life
2. Our aim
3. Discrete chaos in cellular automata
4. Data to collect
5. Cell states
6. The rules
7. Warnings
8. Inspirations

A *tentative* glance back: **sociology of everyday life: feeling of time**

positivism

macro-sociology

social structure determines human behaviour …

anti-positivism, interpretive sociology

social behaviorism: mind is created by interaction

symbolic interactionism; conversation analysis

… but not entirely !

social systems,

specific social systems…

time structure in specific social systems (e.g. teachers: kaleidoscope)

[P. A. Adler et al, Everyday life sociology, Ann. Rev. Sociol. 1987;
W. Bergmann, The problem of time in sociology, Time Society 1992;
P. Sztompka, The focus on everyday life: a new turn in sociology, Eur. Review 2008]

Our aim

- to reproduce the everyday experience

of overwhelming disorder and lack of control over timetable

by means of modeling

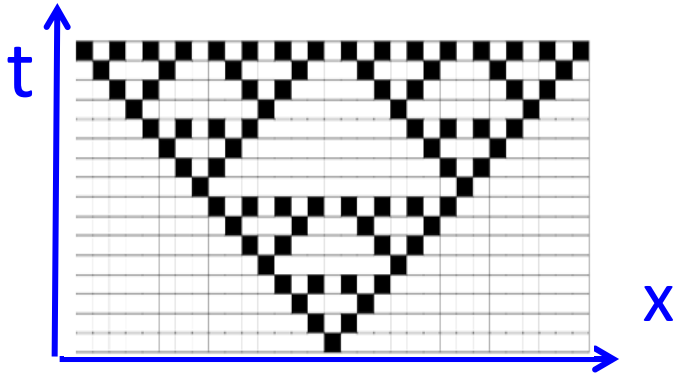
- to try to answer the questions: - is it inevitable?
  - how to control it ?
  - which parameters are crucial?

www.technobuffalo.com/2011/04/30/getting-a-grip-in-the-age-of-multitasking/

Df. A cellular automaton

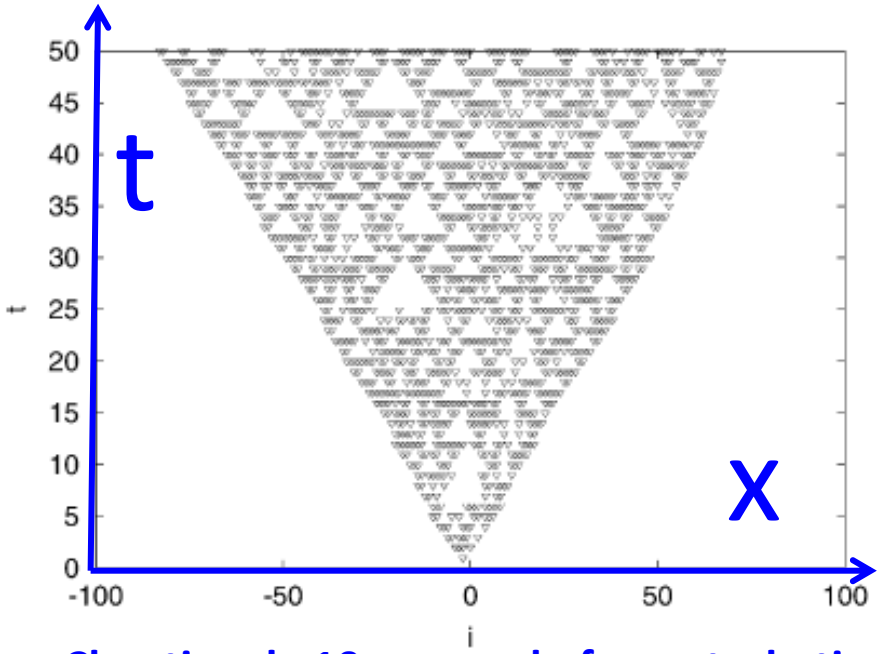
- lattice of cells
- set of states of a single cell
- a rule which determines the cell state at time *t+1*,
  given its state and states of neighboring cells at time *t*

Examples of elementary CA



XOR = rule 90. Single 1 at t=0

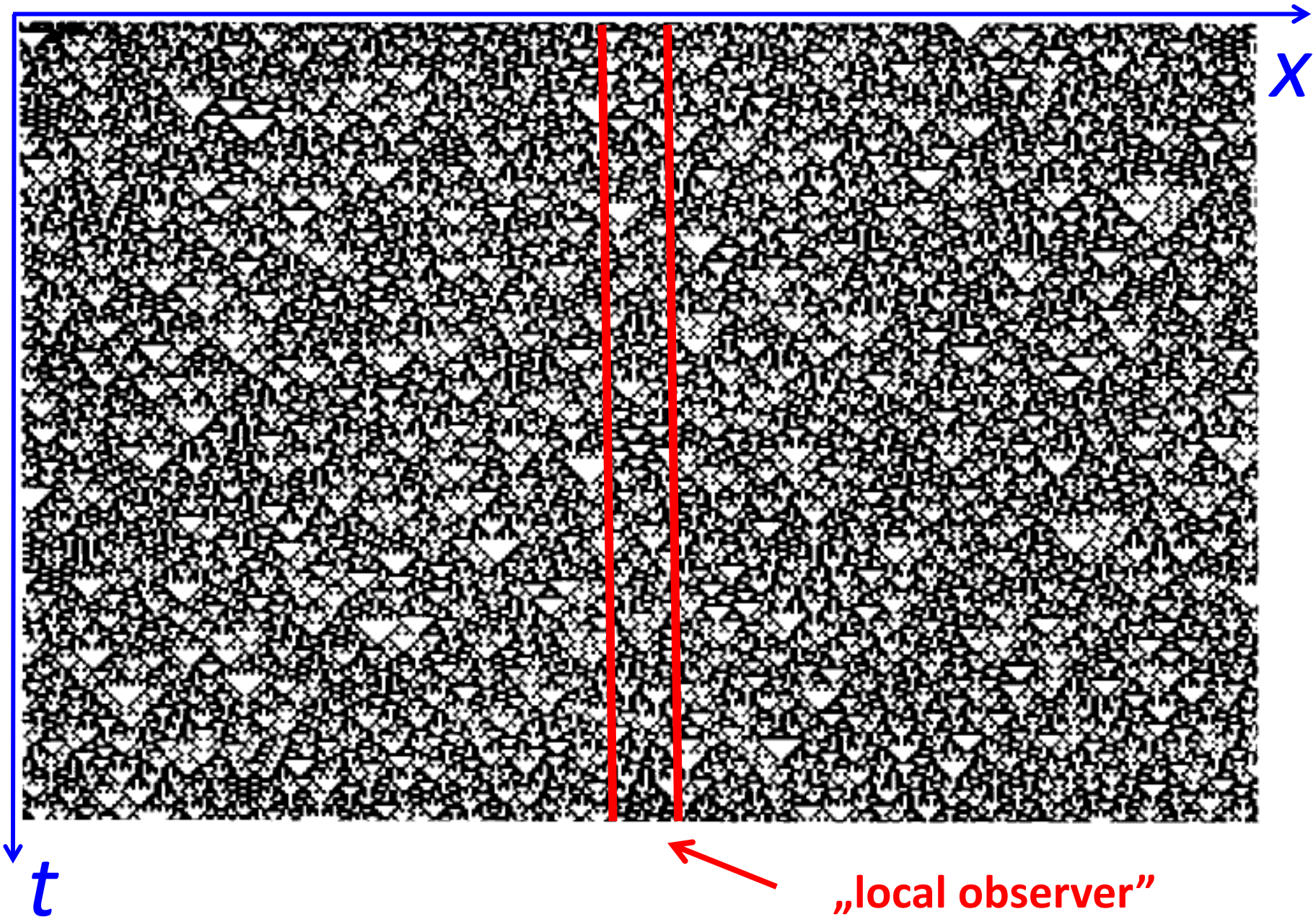
0 1 0 1 1 0 1 0



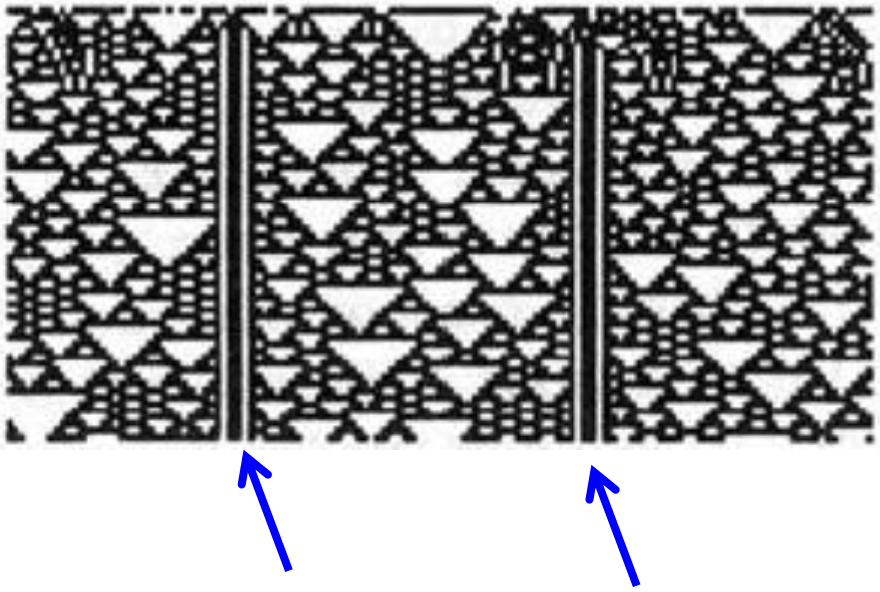
Chaotic rule 10 – spread of a perturbation (one cell changed in a random initial state)

[G. Bofetta et al., Predictability – a way to characterize complexity, Phys. Reports, 2002]

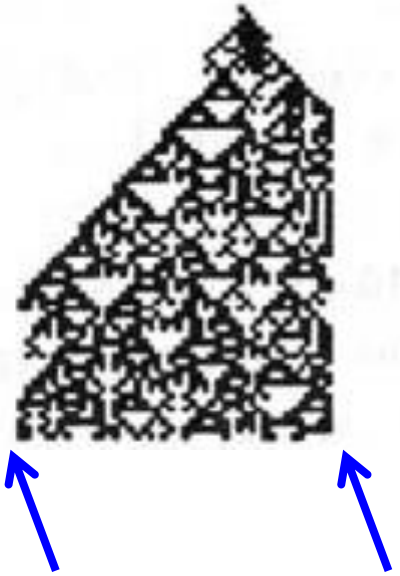
Rule XOR, random initial state



Are consequences of a local damage limited?



blocking configurations



limits of damages

[N.H. Packard, S. Wolfram, Two-dimensional cellular automata, J Stat Phys, 1985]

data to collect – an example

TIME SPAN	PLANNED	ACTUAL	WHY CHANGE	COMMENTS
9.00-12.00	reading	as planned	–	–
12.00-12.30	text corrections	poster preparation	deadline is over	for posters??
12.30-13.30	meet dean	as planned	–	–
13.30-14.00	take M home	meet dean	longer than expected	M got taxi
14.00-15.00	text corr.	meet poster coauthors	no idea what to do	–
15.00-15.20	text corr.	meet colleague	he wants consolation	–
15.20-15.35	lunch	proof of abstract	friend wants send now	–
15.35-15.50	lunch	as planned	–	–
15.50-16.30	reading	phones to Warsaw	copyright demands	webmaster CYA
16.30-16.45	reading	thought gathering	–	–
16.45-17.40	reading	as planned	–	–
17.40-18.50	reading	shopping, home	appeared urgent	–
18.50-19.30	diner, talking	as planned	–	–
19.30-21.00	some work?	internet surf	no idea	no surprise

coding of cells

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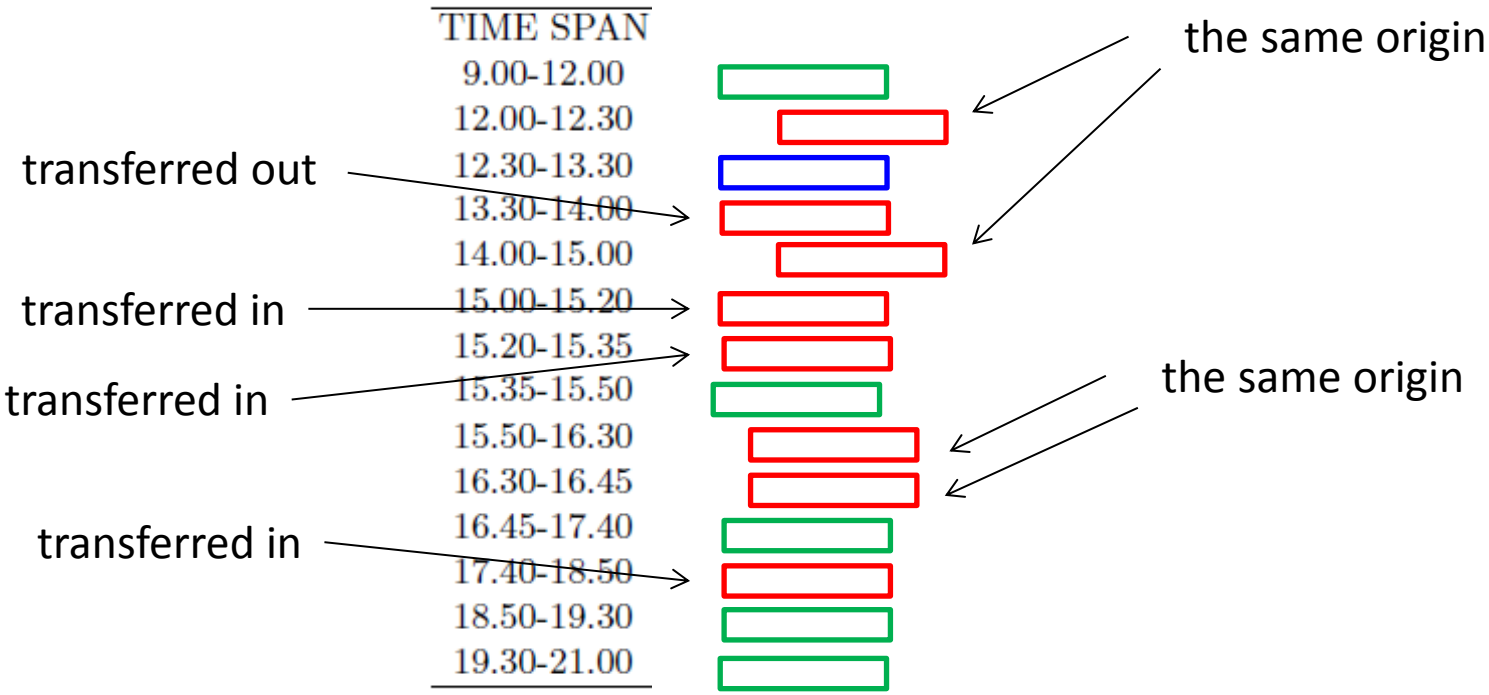
planned, movable

planned, fixed

unexpected

coding of time cells

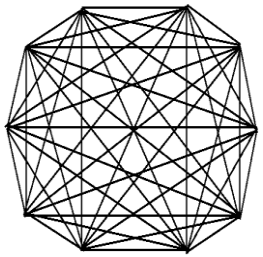


planned, movable

planned, fixed

unexpected

Simulation: handling of unexpected tasks

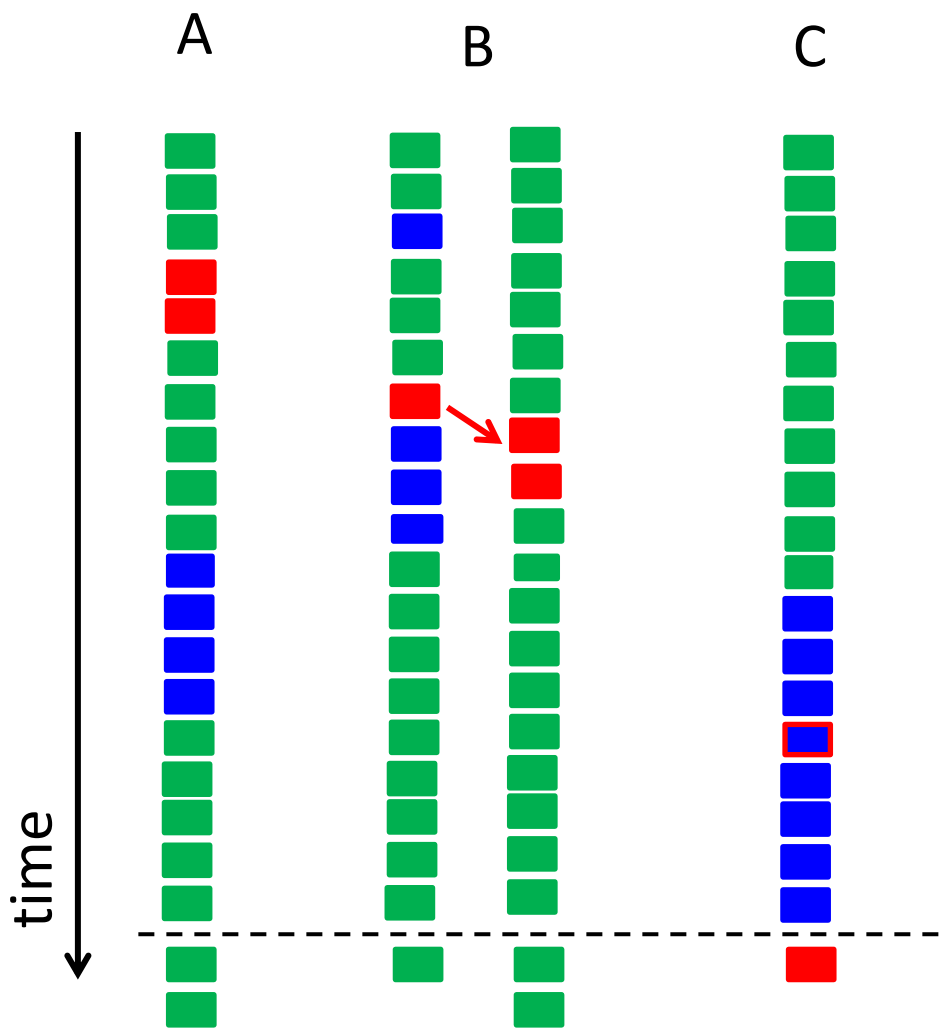


- network structure = a complete graph
- tasks characterized by length *L* and subject *X*
- tasks can be transferred. The transfer cost depends on the competence difference between the sender and the receiver.

task subject classification: **S** – scientific
I – computer
A – administrative
P – private (intransferable)

competence distribution:	**S**	**I**	**A**
	1	**1**	**1**
	2 2 2 2	**2 2 2 2**	**1 1 1 1**
3- highly competent	**1 1**	**3 3**	**1 1**
2 – medium	**1 1**	**2 2**	**1 1**
1 - uninterested	**3**	**1**	**1**

Examples



A: L=2, time shift, 2 undone

B: L=1, time shift+transfer,
transfer cost 2,
3 undone

C: L=1, ignored

Planned outcome

- percentage ρ of successful plans („I was doing what I planned”)

Warnings and complaints: classification* of assumptions

- integer time (E+C); tasks are distinguishable, yet length varies
- day as upper limit (K); unpredictable ≡ unpredictable today
- links of social networks, complete graph (C); boundaries?
- task handling depends on competence (E); what is competence?
- classification of competences into just 4 categories (E+C+K);
- competence is integer-valued (C+K); simplifies transfer cost
- administrative tasks delocalized (E+C); theoretically interesting
- undone = next-day-expected ? rigid? ignored? (K); to simplify

E – evidence, C – computational, K – ad-hoc

**[E. Norling et al., Informal approaches to developing simulation models, in Simulating Social Complexity. A Handbook, Eds. B. Edmonds and R. Mayer, Springer 2013]*

Expected limit cases

- density ***f*** of fixed cells so large that all unexpected tasks ignored

- no fixed cells, no transfers („do it yourself”)
  - low intensity ***w*** of unexpected tasks
    => linear decrease of $\rho(w)$ at given nodes
  - high intensity ***w*** => $\rho(w) \cong 0$

- no fixed cells, many transfers => homogeneous dynamics

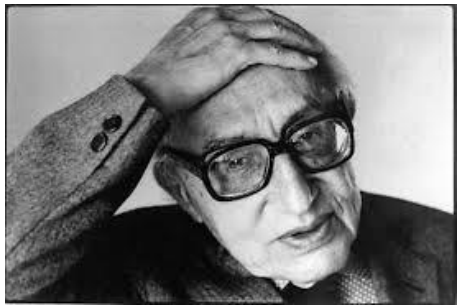
Nontrivial area

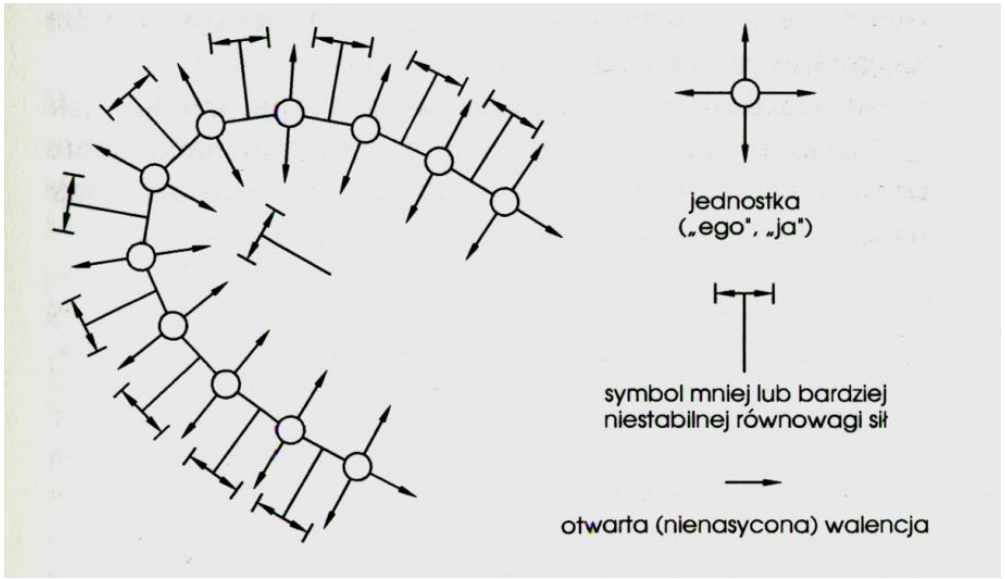
moderate density of fixed cells: long multiple transfers? **sharp $\rho(w,f)$?**

Parameters to be tuned - interpretation

- specialization – differences in competence => subnetworks
- additional time to transfer - transfer cost

Sociological inspirations: figurations

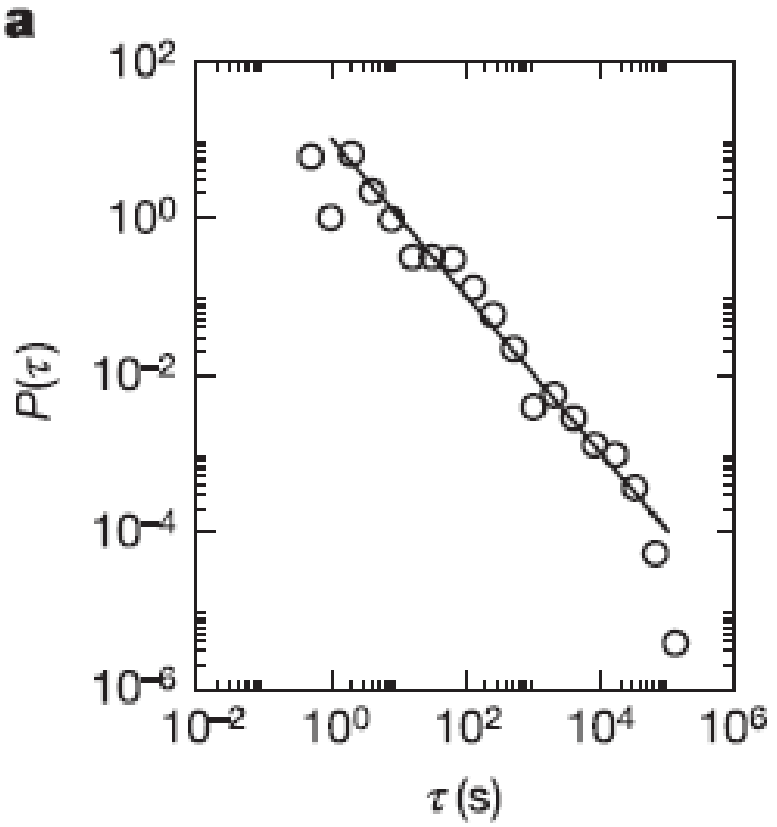




Concepts like ’family’ or ’school’ plainly refer to groupings of interdependent human beings, to specific figurations which people form with each other.

[N. Elias, Was ist Soziologie? 1970/1978/2010]

Inspirations: human dynamics

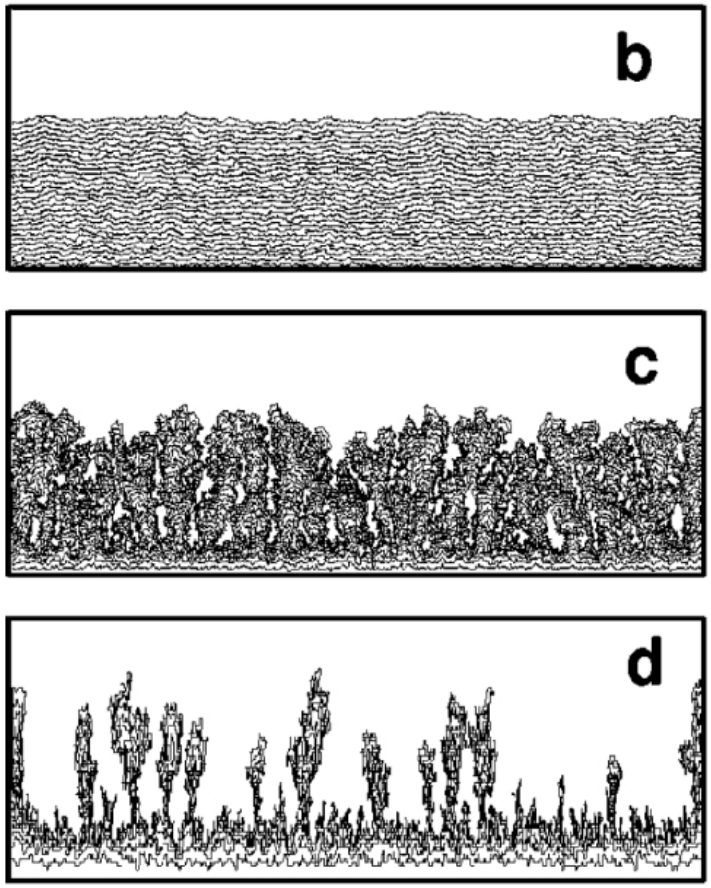


The distribution of time intervals between consecutive e-mails sent by a single user

[A. L. Barabasi, Nature 435 (2005)]

Physical inspirations: pattern formation

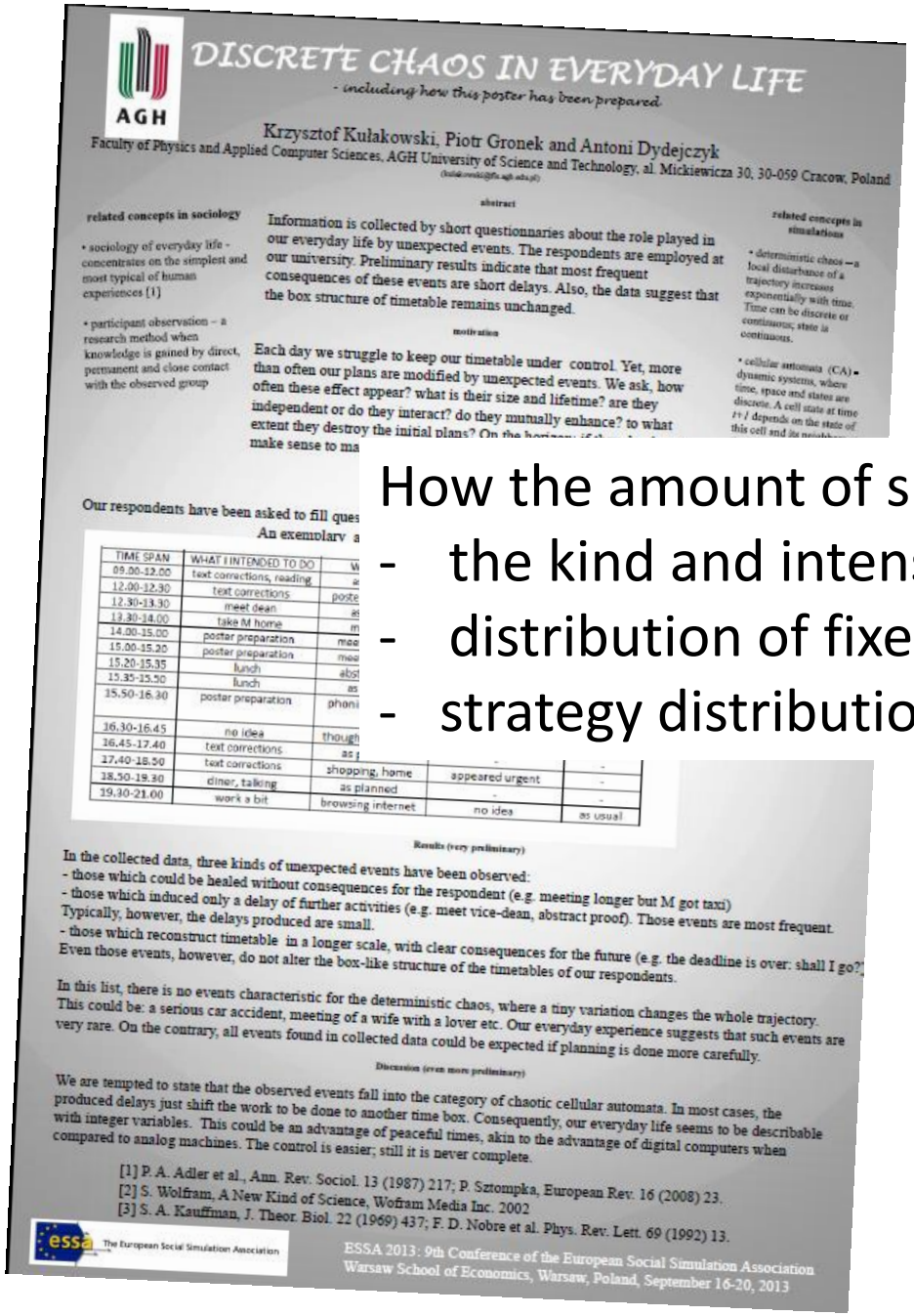
Repulsion (mutual excluding) between transfer chains =>
long transfers blocked at some value of intensity of unexpected tasks ?



Patterns in a model of fungal growth. Images from top to bottom correspond to decreasing food supply so that cells strive for dividing.

See also:
- viscous fingering,
- aggregation,
- electrochemical deposition.

[J. M. Lopez, H. J. Jensen, PRE 2002]



DISCRETE CHAOS IN EVERYDAY LIFE

- including how this poster has been prepared

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abstract

Information is collected by short questionnaries about the role played in our everyday life by unexpected events. The respondents are employed at our university. Preliminary results indicate that most frequent consequences of these events are short delays. Also, the data suggest that the box structure of timetable remains unchanged.

related concepts in sociology

• sociology of everyday life - concentrates on the simplest and most typical of human experiences [1]

• participant observation – a research method when knowledge is gained by direct, permanent and close contact with the observed group

related concepts in simulations

• deterministic chaos – a local disturbance of a trajectory increases exponentially with time. Time can be discrete or continuous; state is continuous.

• cellular automata (CA) - dynamic systems, where time, space and states are discrete. A cell state at time $t+1$ depends on the state of this cell and its neighbors

motivation

Each day we struggle to keep our timetable under control. Yet, more than often our plans are modified by unexpected events. We ask, how often these effect appear? what is their size and lifetime? are they independent or do they interact? do they mutually enhance? to what extent they destroy the initial plans? On the horizon of [illegible] make sense to ma

Our respondents have been asked to fill ques

An exemplary a

TIME SPAN	WHAT I INTENDED TO DO	W
09.00-12.00	text corrections, reading	a
12.00-12.30	text corrections	poste
12.30-13.30	meet dean	a
13.30-14.00	take M home	m
14.00-15.00	poster preparation	mee
15.00-15.20	poster preparation	mee
15.20-15.35	lunch	abs
15.35-15.50	lunch	as
15.50-16.30	postar preparation	phoni
16.30-16.45	no idea	though
16.45-17.40	text corrections	as
17.40-18.50	text corrections	shopping, home	appeared urgent	-
18.50-19.30	diner, talking	as planned	-	-
19.30-21.00	work a bit	browsing internet	no idea	as usual

Results (very preliminary)

In the collected data, three kinds of unexpected events have been observed:
- those which could be healed without consequences for the respondent (e.g. meeting longer but M got taxi)
- those which induced only a delay of further activities (e.g. meet vice-dean, abstract proof). Those events are most frequent. Typically, however, the delays produced are small.
- those which reconstruct timetable in a longer scale, with clear consequences for the future (e.g. the deadline is over: shall I go?) Even those events, however, do not alter the box-like structure of the timetables of our respondents.

In this list, there is no events characteristic for the deterministic chaos, where a tiny variation changes the whole trajectory. This could be: a serious car accident, meeting of a wife with a lover etc. Our everyday experience suggests that such events are very rare. On the contrary, all events found in collected data could be expected if planning is done more carefully.

Discussion (even more preliminary)

We are tempted to state that the observed events fall into the category of chaotic cellular automata. In most cases, the produced delays just shift the work to be done to another time box. Consequently, our everyday life seems to be describable with integer variables. This could be an advantage of peaceful times, akin to the advantage of digital computers when compared to analog machines. The control is easier; still it is never complete.

[1] P.A. Adler et al., Ann. Rev. Sociol. 13 (1987) 217; P. Sztompka, European Rev. 16 (2008) 23.
[2] S. Wolfram, A New Kind of Science, Wofram Media Inc. 2002
[3] S. A. Kauffman, J. Theor. Biol. 22 (1969) 437; F. D. Nobre et al. Phys. Rev. Lett. 69 (1992) 13.

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How the amount of success depends on:

- the kind and intensity of unexpected tasks?
- distribution of fixed tasks?
- strategy distribution: *'transfer it'* or *'do it yourself'* ?

THANK YOU