Discrete chaos in everyday life

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Abstract. We are interested in the role played in our everyday life by unexpected events. Information on daily timetable is to be collected by short structured questionnaries. Preliminary results collected from the university staff indicate that most frequent consequences of unexpected events are short delays. These data suggest also that the box structure of timetable remains unchanged. Consequently, the timetable structure can be described with integer variables, where the delays just shift tasks from one box to another. The model admits also to transfer a task to a neighbor in the agent's personal social network. Such a process can be modelled by a cellular automaton. Yet, the shift size and the overall distance travelled by a task is unlimited, what means that the automaton should belong to the chaotic class.

Keywords: time, everyday life, cellular automata

1 Introduction

Taking for granted that what is of interest for sociologists can be attractive also for the social simulation community, we note that the sociology of time is well established in social sciences [1, 2]. Our motivation here is the question to what extent we are able to control our daily timetable? To be more precise, what is the relation between what we plan in the morning and what we do during the day? The issue can be seen as a contribution to what is called everyday life sociology [3, 4]. To be more specific here, we limit our considerations to seemingly typical workdays of university staff, in our own social environment which we know best. The project is at the preliminary stage, hence our intention to present it as a poster.

In future research, we are going to distinguish four kinds of events: *(i)* those which could be healed without consequences for the respondent, *(ii)* those which induced only a delay of further activities, *(iii)* those of clear consequences for the future, *(iv)* those which alter the whole life trajectory. Yet, to make the classification operational, we are going to start from the difference between tasks which were anticipated and planned for a given day and tasks which enter unexpectedly and modify our daily timetable. This limits our scope to categories

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(i-iii). The type *(iv)* seems to need a separate research [5]. Further, tasks which are unexpected today, tomorrow will be treated as anticipated. This one-day framework is suggested by answers of pilot queries, gathered in our department. It appears that in most cases, we are faced with events of kind *(i-ii)*. On the other hand, once an event appears, it must be built into our timetable either as unexpected or as anticipated. As each event was unexpected at one time, we need to sharpen the criterion; the one-day timing is a convenient solution.

By the box structure of a timetable we mean that a given period (here a day) is divided into shorter periods (here a half of hour or so). We observe that this division remains fixed even in the presence of 'conventionally unexpected' events. More precisely, both our preliminary data and our daily experience indicate that the obligatory tasks with predetermined timing, as courses with students, are not influenced by unexpected events. This fact allows to represent the timetable of an agent by a one-dimensional chain of cells, each cell is equivalent to a given short time period. Three cell states are to be distinguished: cells occupied by performing anticipated but movable tasks (state 0), unexpected tasks (state 1), and anticipated tasks which cannot be shifted nor delayed (state 2). Further, the observed events do not modify the box structure of the timetable; it is only that tasks in cells 0 are shifted until later or to somebody else. With these simplifications, current modifications of the cells contents can be simulated by a kind of cellular automaton.

In two subsequent sections we sketch a project of the questionnaire which could be used to gather data and we propose the automaton rules which seem to us to be appropriate for the purposes mentioned above. Some caveats and warnings are given in the last section.

2 The questionnaire

The aim of our pilot questionnaire is to gather information about the number of unexpected events and their consequences, i.e. if they did modify the timetable of a respondent and what was the timeshift of tasks planned to do. We are also interested in gathering information of the resulting changes of the structure of the respondent's timetable. These issues have been addressed as queries in the Table 1.

If the exemplary data, presented in Table 1, happen to be supported by appropriate statistics, they could contribute to the following statements:
(a) most unexpected events lead to shifts of subsequent tasks, only some events are healed at cost of somebody else;
(b) the structure of daily timetable os not shifted by the unexpected events; no destruction of planned meetings;
(c) some time box remain unplanned; perhaps the last hours could be excluded

Table 1. The questionnaire - questions and exemplary answers

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

from the timetable,

Yet, we should add that the example presented in Table 1 is not quite typical: the respondent had no courses at that day, and much of his time was planned to be devoted to a structureless research. On the other hand, the data collected from other respondents, who had courses in their timetables, confirm the regularity (b).

3 The rules

Following our exemplary data as an illustration, we can imagine the following coding: one event in category *(i)* (the meeting longer than expected) which was healed at cost of somebody else, four unexpected events of category *(ii)* (the colleague in need, the abstract to read, the peculiar demands of a webmaster about a copyright, and the shopping) and one event of category *(iii)* (the unexpected deadline which modified plans in the scale of weeks). Two events (deadline and copyright) came from outside, whilst the other four were created in the direct environment.

Trying to keep the approach both descriptive and simple, we propose the model as follows. Links between agents form a network, and tasks can be transferred along the links. The agent state is 0, 1 or 2, as explained above. In an unperturbed state, the cells of all agents remain in states 0 or 2. Wherever an unexpected event is born, its treatment and perhaps its transfer to other agents depend on the event as related with competence, interest, status and responsability of agents involved. As a rule, an event appears at a node of an agent who is interested and/or responsable for the related task. The questionnaires reported by our respondents allow to construct their personal networks, both professional and private, but they also reveal the option to acquire an unexpected signal from outside.

Behavioral rules to be proposed should include an option to pass the task to a neighbor in the personal network. The direction of this transfer should be specific for the task as related to competences, interest, status and responsability of involved agents. It will never be possible to classify all tasks met in reality, but it is perhaps possible to include a meaningful part of them. A typical choice of an agent could be: either do it herself, or to pass it to a neighbor more competent, or to pass it to a neighbor (or neighbors) of lower status. The first option can be equivalent to ignoring the task, if more unexpected events appear in a short time.

As an outcome of the planned simulation we expect to get histograms of daily timeshifts, what is a measure of an overload of particular agents, as dependent of the performed strategy ("if possible, do it yourself" or "if possible, transfer the task to somebody else"). The real problem to be solved is the classification of unexpected events; for sure, this classification is specific for a given social environment.

4 Discussion

The chaotic character of the obtained/expected evolution follows from the fact that there is no spatial limit of wandering consequences of a given unexpected event. Basically, there is no temporal limits either; the one of 24 h is built into the model as a substitute of an *a priori* non-existent criterion to distinguish between expected and unexpected events. This deficiency of the approach could be removed at least partially if unexpected events with consequences longer than one day are classified as such also in the next day. However, as noted above, the criterion between expected and unexpected events is not sharp, and the solution accepted here makes the model much simpler.

In a common view, chaos is equivalent to an exponential time dependence of a small initial difference between neighboring trajectories [6]. Yet, in discrete world, an increase of this difference is limited from above by the spatial range of interaction per time step. Hence the term 'chaos' when related to cellular automata means that the number of agents influenced by a local event is not limited from above [7]. This is the famous chaotic class of cellular automata. In our case, the automaton is defined on a network, and the number of influenced nodes in subsequent time steps can indeed increase exponentially in time, as for example in the Bethe lattice - this dynamics depends on the network topology, what is not of primary interest here.

We are aware of multiple limitations of modeling in social sciences; for a recent handbook we refer to [8]. The condition of including the social environment is of primary importance, and it was repeated by social scientists under different labels, from figurations [9] and social embeddedness [10] to social context [11]. Our approach is intended to be valid only with an information on social context taken from questionnaries and encoded in the structure of a social network and in the specific rules of the task transfer. It is not expected to be valid as a general model without input data.

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