Systems Research and Behavioral Science
Syst. Res. (2010)
Published online in Wiley Online Library
(wileyonlinelibrary.com) **DOI**: 10.1002/sres.1071

■ *Research Paper*

Simulation of the Anomalous Social Behaviours with a Learning Model†

Mohamed Nemiche[1]* and Rafael Pla-Lopez[2]

[1]*Polydisciplinary Faculty of Ouarzazate, Department of Computer science, B. P. 638, OUARZAZATE 45000 Morocco*
[2]*Department of Applied Mathematics, University of Valencia, 46010 Valencia, Spain*

In this paper our objective is to understand the process of emergence in the study of social behaviours evolution with a learning model. When the system is too complex to study it is important to recreate an artificial universe in which experiments' simulation can help to understand the mechanisms of human social behaviours. In Previous work we determined the conditions that favour the perpetuity of the Capitalist Globalization, the possibility of its overcoming with a Free Scientific Society and the possibility of the Ecological Hecatomb. In this paper we have theoretically explained the emergence of the anomalous behaviours and developed statistical studies of the conditions that favour their apparitions and finally their geographical repartition. Copyright © 2010 John Wiley & Sons, Ltd.

Keywords simulation; anomalous social behaviours; globalization; dual social evolution; free scientific society

INTRODUCTION

To simulate the evolution of social behaviours, Pla-Lopez has built a Model of Social Evolution (Pla-Lopez, 1988, 1994, 1996, 1996b), from a General Theory of Learning (GTL) formulated in terms of the General Theory of Systems (GTS). In his model, Pla-Lopez simulated a temporal discrete social evolution of some populations composed of NP (NP > 1) social subsystems (societies/agents) distributed in a uniform manner on a circle (representation of the earth in one-dimension). Each social subsystem is defined by:

- A variable N indicating the position (and name) of the social subsystem in the circle.
- A weight, which specifies the relative importance of each social behaviour inside the social subsystem. This weight is expressed by a function of probability $P^t(U, N)$. Where U represents a social behaviour, N a social subsystem and t time. This probability can be modified by a process of learning through reinforcement.
- $m(N)$\in{1, 2, . . ., max} describes the dimension of the social subsystem N, which determines the scope of its possible behaviours.

* Correspondence to: M. Nemiche, Polydisciplinary Faculty of Ouarzazate, Department of Computer science, B. P. 638, OUARZAZATE 45000 Morocco
E-mail: nemiche@uv.es
†This paper has been realized under the program VOLUBIS Hubert Curien (Maroc) N° MA/08/201B Code Egide 17251VF.

Received 18 March 2010
Accepted 5 October 2010

The social behaviour U is described by means of a multidimensional variable with different components $U \equiv (U_0, U_1, \ldots, U_{\max-1})$. The technological development is simulated by means of an increase of the native dimension $m(N)$ of this variable-behaviour ($m(N)\backslash\text{in}\{1,2,\ldots,\max\}$) and, therefore, of the number of its available social behaviours. As the model works with binary components $U_i\backslash\text{in}\{0,1\}$ of the social behaviours, the increase of their native dimension is expressed by means of an increase of the used bits to describe them. In our implementation of the model the dimension is increased from an initial value 0 to a maximum value 4 ($\max = 4$).

Each social subsystem N can choose between different social behaviours U and evolves modifying the probabilities of these social behaviours $P^t(U, N)$, trying to maximize their satisfaction $P^t_{\mathrm{G}}(U, N)$ and interacting with each other through:

- The repressions of the social behaviours different from its own ($\sigma^t(U, N)$).
- The communication of the results of its own social behaviours to other subsystems, so that a subsystem not only learns from its self-experience, but also from the experience of other social subsystems ($P^t_{\mathrm{L}}(U, N)$).

The development of the model occurred to contemplate the adaptability of the repression $\mathrm{sts}^t(U, N)$, so that, even when each social behaviour had initially, in each subsystem, a certain repressive capacity $\kappa(U)$, this one could evolves tending to equal the suffered repression $\sigma^t(U, N)$. The delay in the adaptation of the repression $T^t_{\mathrm{a}}(N)$ is regulated by a parameter K_{a}, so that if K_{a} were of the order of the unit, this adaptation would be immediate. The bigger K_{a} values were, the slower adaptation will be. In the order to simulate the effect of the subjective factor, the satisfaction with a social behaviour in each subsystem tends to compare itself, through a process that we called 'resignation', with the average value of the satisfaction perceived in the subsystems with the set of the social behaviours. The delay in this 'resignation' $T_{\mathrm{r}}(N)$ is regulated by a parameter K_{r}, so that if K_{r} were of the order of the unit the 'resignation' would be immediate, and the bigger K_{r} values were, the slower 'resignation' will be.

With this model and under certain conditions, we have simulated:

- The perpetuity of the predominance of behaviour with total repressive capacity ($7 \equiv (1,1,1,0)$).
- The final predominance of a behaviour without repressive capacity but with total intrinsic capacity of satisfaction and communication ($15 = (1,1,1,1)$ in binary $= F$ in hexadecimal), that is why it was considered as a characteristic of a Free Scientific Society.

This description was not realistic in its application to the human history. This indeed, hasn't only gone through different phases, but rather it has followed different evolutionary lines in different areas of the world. Following Maurice Godelier's (Godelier, M 1964) description of social evolution, we could describe two evolutionary lines: the first, we could call 'occident', has passed by the following phases: Slavery, Feudalism and Capitalism with a significant role in all of them in different forms of the individual property. While in the second evolutionary line ('orient'), the 'collectivity sense' characterized all the phases starting from 'Asian or tributary production', then a differentiated type from Feudalism, and later the Real Socialism. Only by the end of the last century, the two different evolutionary lines converge to what it is known as Capitalist Globalization. In order to simulate this dual evolution, and with the contributions of M. Nemiche (Nemiche, M and Pla-Lopez, R 2000, 2002, 2003, 2005), besides to introduce a variation of the natural conditions ($\mathrm{natal}^t(N)$) in case of ecological degradation ($E^t/E^0 < 1$) from an initial value ($\mathrm{natal}^0(N)$) towards an ideal value (ntl^t) with a delay (T_{m}), we have introduced a fundamental distinction between 'individualistic' behaviours oriented to simulate the occidental evolution, and 'gregarious' behaviours, oriented to simulate the oriental evolution. This distinction only affect the first bit (U_0), so that $0 \equiv (0,0,0,0)$, $2 \equiv (0,1,0,0)$ and $6 \equiv (0,1,1,0)$ could be gregarious behaviours, whereas $1 \equiv (1,0,0,0)$, $3 \equiv (1,1,0,0)$ and $7 \equiv (1,1,1,0)$ could be individualistic behaviours.

DOI: 10.1002/sres

The impact of the ‘individualistic behaviours’ is characterized by the absence of the repression on their own subsystem, closest maximizes in the ‘neighbours’ subsystems and decreases with the distance. In contrast, the impact of the ‘gregarious behaviours’ is characterized by the maximum repression on the own subsystem.

SOCIAL BEHAVIORS AND INTERPRETATION (NEMICHE AND PLA-LOPEZ, 2003)

With our Model we have obtained an evolution with behaviours 1–3–7 (‘individualists’) in the ‘occidental’ area and 0–2–6 (‘gregarious’) in the ‘oriental’ area, which can be justified by superior initial value of natal (next to 37.5) in the ‘oriental’ are, and so the bigger ‘gregarious’ impact which is generated can compensate the bigger intrinsic satisfactoriness of the ‘individualistic’ behaviours. A possible interpretation of the dimensions and behaviours would be

- Dimension $m=0$: Primitive Society
- Dimension $m=1$: Agricultural Revolution $U=(0)\equiv 0$: Oriental Empire $U=(1)\equiv 1$: Occidental Slavery
- Dimension $m=2$: Technological Increase $U=(0,1)\equiv 2$: Oriental Feudalism $U=(1,1)\equiv$ 3: Occidental Feudalism
- Dimension $m=3$: Industrial Revolution $U=(0,1,1)\equiv 6$: Real Socialism $U=(1,1,1)\equiv 7$: Capitalism
- Dimension $m=4$: Technological Revolution $U=(0,1,1,1)\equiv \mathrm{E}$, $U=(1,1,1,1)\equiv F$: Free Scientific Society.

We have programmed our model in C language, and executed it on the Cray-Silicon Graphics Origin 2000 computer, with 64 processors (MIPS R1200 to 300 MHz), 16 Gbytes by memory central and 390 Gbytes in disk. The operating system is the IRIX 6.5.5, which is a variant of the Unix developed by Silicon Graphics (Servei Informàtic de la Universitat de València).

We call ‘simple dual evolution’ when the state $6\equiv(0,1,1,0)$ (Real Socialism) appear with strong predominance in the ‘oriental’ area and when the state $7\equiv(1,1,1,0)$ (Capitalism) appear with strong predominance in the ‘occidental’ area.

The classes of evolutions that we can find in this category are:

Phase I: when ‘simple dual evolutions’ show up.

Class I: when a Capitalist globalization ($U=(1,1,1,0)\equiv 7$) appears after a ‘simple dual evolution’.

Subclass I. a: When a Capitalist globalization ($U=(1,1,1,0)\equiv 7$) neither is overcome nor arrives to an Ecological Hecatomb. (Fukuyama, F 1995)

Subclass I. b: When a Capitalist Globalization is overcome by a Free Scientific Society ($U=(1, 1, 1, 1)\equiv \mathrm{F}$).

Subclass I. c: When an Ecological Hecatomb takes place during a Capitalist Globalization.

Class II: When an Ecological Hecatomb takes place during a ‘simple dual evolution’.

Class III: When a Free Scientific Society ($U=(1, 1, 1, 1)\equiv \mathrm{F}$) appears after a ‘simple dual evolution’ with the strong predominance of the state $6=(0,1,1,0)$ (Real Socialism) in more social subsystems.

REVOLT EFFECT

The executions of the program (show clearly that each one of the social subsystems starts from the initial social behaviour $0\equiv(0,0,0,0)$ and passes through the most probable states, Table 1 (high degree of satisfaction of the objective) with an increase of the native dimension (with $P(U,N)>0.5$)

Also intermediate states can appear in the subsystem with $P(U,N)<0.5$ U. But, in situations of crisis, previously improbable states with a low degree satisfaction of the objective, appear in ephemeral form, in some adecuate place and opportune moment. This process, to which we call ‘Revolt Effect’, normally in the following step

Table 1 The most probable states

Dimension	States more probable
$m=1$	$U=(0)$ $U=(1)$
$m=2$	$U=(0,1)$ $U=(1,1)$
$m=3$	$U=(0,1,1)$ $U=(1,1,1)$
$m=4$	$U=(0,1,1,1)$ $U=(1,1,1,1)$

DOI: 10.1002/sres

$\Delta t = 100$ leads to the destruction of the involved system.

In order to analyse how a revolt effect can stay for more or less long time, we adapted the model so that when such revolt effect appears we study the evolution in slow form, with transitions in shorter steps ($\Delta t = 5$). We found that in most of the cases the revolt effect continues disappearing in the following step, but in some cases can continue for two or more steps.

THEORETICAL FOUNDATIONS OF THE REVOLT EFFECT

To explain the appearance of a Revolt effect in a social subsystem N, we must start by the influence of a social behaviour U on the increase of its weight $P(U, N)$.

We remember that the nucleus of the learning is:

$$\Delta F^t(U,N) = \max\{2\Delta t\lambda^t(N)[P^t_{\mathrm{G}}(U,N) - P^t_{\mathrm{R}}(N)]P^t_{\mathrm{L}}(U,N), -F^t(U,N)\}$$

- If $\Delta F^t(U,N) = -F^t(U,N)$ then $F^{t+\Delta t}(U,N) = 0$, in which case the social behaviour U could not appear at time $t + \Delta t$ in subsystem N.
- In another case, if $\Delta F^t(U,N) = 2\Delta t\lambda^t(N)[P^t_{\mathrm{G}}(U,N) - P^t_{\mathrm{R}}(N)]P^t_{\mathrm{L}}(U,N)$ the influence of the behaviour U in the increase of $\Delta F^t(U,N)$ take place thus in

$$[P^t_{\mathrm{G}}(U,N) - P^t_{\mathrm{R}}(N)]P^t_{\mathrm{L}}(U,N)$$

By construction, $P^t_{\mathrm{L}}(U,N)$ is positive and increase in proportional form to $P^t(U,N)$ for all time (t)

$P^t_{\mathrm{R}}(N)$ is a value of reference, which is adapted with a delay determined by a K_{r} parameter to the average of satisfactions P_{G} provided by the different social behaviours

$$P^{t+\Delta t}_{\mathrm{R}}(N) = P^t_{\mathrm{R}}(N) + \Delta t/T_{\mathrm{r}}(P^t_{\mathrm{GM}}(N) - P^t_{\mathrm{R}}(N))$$

$$P^t_{\mathrm{GM}}(N) = \frac{\sum_U P^t_{\mathrm{G}}(U,N)\,P^t_{\mathrm{L}}(U,N)}{\sum_U P^t_{\mathrm{L}}(U,N)}$$

When the satisfaction decreases rapidly for all the social behaviours and the reference $P^t_{\mathrm{R}}(N)$ adapted slowly to the average of the satisfactions (high values of K_{r}) dissatisfaction for all the available social behaviors take place (situation of crisis).

$$\Delta F^t(U,N) < 0\,\forall U$$

$$B^{t+\Delta t}(N) < B^t(N) \tag{1.1}$$

In this situation of crisis a social behaviour little probable U_{R} (with a small $P^t_{\mathrm{L}}(U_{\mathrm{R}}, N)$ can provide: $[P^t_{\mathrm{G}}(U_{\mathrm{R}},N) - P^t_{\mathrm{R}}(N)]P^t_{\mathrm{L}}(U_{\mathrm{R}},N)$ is less negative for all $U \neq U_{\mathrm{R}}$ is to say $0 > [P^t_{\mathrm{G}}(U_R,N) - P^t_{\mathrm{R}}(N)]P^t_{\mathrm{L}}(U_{\mathrm{R}},N) > [P^t_{\mathrm{G}}(U,N) - P^t_{\mathrm{R}}(N)]P^t_{\mathrm{L}}(U,N)$ and like $2\Delta t\ \lambda^t(\mathrm{N}) > 0$ then $0 > 2\Delta t\ \lambda^t(\mathrm{N})$. $[P^t_{\mathrm{G}}(U_{\mathrm{R}},N) - P^t_{\mathrm{R}}(N)]P^t_{\mathrm{L}}(U_{\mathrm{R}},N) > 2\Delta t\lambda^t(N)[P^t_{\mathrm{G}}(U,N) - -P^t_{\mathrm{R}}(N)]P^t_{\mathrm{L}}(U,N)$ is the same $0 > \Delta F^t(U_{\mathrm{R}}, N) > \Delta F^t(U,N)$ for all $U \neq U_{\mathrm{R}}$.

Thus, if this process take place for enough time, a moment $t + \eta\Delta t$ ($\eta > 0$) can occur in which

$$F^{t+\eta\Delta t}(U_{\mathrm{R}},N) > F^{t+\eta\Delta t}(U,N) \text{ for all } U \neq U_{\mathrm{R}} \tag{1.2}$$

and

$$0 < B^{t+\eta\Delta t}(N) > B^{t+\eta\Delta t}(N) \tag{1.3}$$

From the relations (1.2) and (1.3) we concluded that

$$P^{t+\eta\Delta t}(U_{\mathrm{R}},N) > P^{t+\eta\Delta t}(U,N) \text{ for all } U \neq U_{\mathrm{R}}$$

The relation (1.3) facilitates the predominance of social behaviour U_{R} at time $t + {}^{\eta}\Delta t$ or later if it follows the situation of crisis in subsystem N. We now explain the conditions that favour the diminution of the satisfaction for all the social behaviors.

THE CONDITIONS THAT FAVOR THE DIMINUTION OF $P_{\mathrm{G}}(U, N)$ FOR ALL U

We remember that

$$P^t_{\mathrm{G}}(U,N) = (E^t/E_0)(\pi(U) - \rho(U,N))(1\text{-}\sigma(U,N))$$

We observe that satisfaction $P^t_{\mathrm{G}}(U,N)$ decreases for all U when the ecology go down ($E^t/E^0 < 1$) or when $\sigma(U,N)$ is increased for all U.

In case of ecological degradation, satisfaction $P^t_{\mathrm{G}}(U,N)$ decrease for all U due to the diminution

DOI: 10.1002/sres

of the value of E/E_0 as well as to the increase of the value of $\sigma(U, N)$.

When the suffered repression $\sigma(U, N)$ is increased U, the diminution of the $P^t_G(U)\,U$ is caused, and if reference $P^t_R(N)$ is adapted slowly to the average of the satisfaction (high values of K_r), it can lead to a situation of crisis that favours the possibility of apparition with no need for a revolt effect of ecological degradation.

HOW MUCH CAN SURVIVE A REVOLT EFFECT?

The four following conditions favour additional form of the living time of a Revolt Effect U_R in a social subsystem N during several steps of time $\Delta t = 5$

- When $F(U, N) = 0$ for all $U \neq U_R$.
- When the neighbour's social subsystems of N are predominated by some less repressive social behaviour, they have been destroyed or they are in intermediate state.
- In absence of ecological degradation or process of recovery of the same one.
- Intermediate values of the resignation.

Let us observe that the first condition favours the duration of U_R by absence of behaviors different from U_R, the second condition is that $\sigma(U_R, N)$ does not increase in a fast form and therefore it makes difficult the fast decrease of $P_G(U, N)$, the third condition avoids the possibility of the decrease of $P_G(U, N)$ by ecological reasons. Finally, higher values of resignation allow the appearance of revolt effect and low values favour their duration. Thus, the ideal values that favour the duration of the Revolt Effect are the intermediate values of K_r.

REVOLT EFFECT AND ECOLOGY

We study the occurrence of the revolt effect based on the ecology in the Phase I (origin of all simple dual evolutions).

The results of Table 2 were expected, since ecologic degradation favours situations of crisis.

Table 2 Number of revolt effect with and without ecological degradation

Revolt effect	$E^t/E^0 < 1$	$E^t/E^0 = 1$
$U = 4$	130	369
$U = 5$	809	33
$U = 8$	98	22
$U = 9$	101	33
$U = A$	11	0
$U = B$	219	7
$U = C$	193	12
$U = D$	16	0
Number of revolt effect in the phase 1	1577	456

Thus, we have found great number of revolt effect when $E^t/E^0 < 1$ in comparison with ideal ecological conditions $E^t/E^0 = 1$ for all the anomalous behaviors superior or equal to 5.

We can explain the apparition of the social behaviour $U = 4$ with more occurrence in ideal ecological conditions by its early apparition with low technological development.

GEOGRAPHIC DISTRIBUTION (ORIENTAL/OCCIDENTAL) OF THE REVOLT EFFECT

We have executed our model 1350 times with

$$(K_a, K_r, K_e) \in \{15, 20, \ldots, 80\}^2 \times \{3, 4, \ldots, 8\}$$

We observed that 83 revolts effect in the occidental area are detected from 676 processes (evolutions) with an average duration equal to 4.255. Most of the revolts (nearly 60%) take place with $U = 5$ and many (almost 24%) take place with $U = B$ (super-repressive society). Whereas in the oriental area 234 revolt effect are detected from 676 processes with an average duration equal to 12.95.

Also we observed that the social behaviors $U = 5$ and $U = B$ are those that produce more revolt effects in their dimensions. It is interesting, in the Table 3, the great difference in the number of occurrences of the revolt effects and its total average duration between the oriental and occidental areas.

Syst. Res. (2010)
DOI: 10.1002/sres

Table 3 Geographic distribution of the revolt effect and its average duration

Revolt effect	Occidental Area		Oriental Area	
	Number of occurrence of revolt effect	Average duration	Number of occurrence of revolt effect	Average duration
$U=4$	3	5	56	15.17
$U=5$	49	5.71	84	7.79
$U=8$	3	5	20	8.75
$U=9$	4	5	20	8.75
$U=A$	3	8.33	4	6.42
$U=B$	21	5	25	46.2
$U=C$	0	0	20	5.52
$U=D$	0	0	5	5
Total	83	4.255	234	12.95

INFLUENCE OF SOME PARAMETERS IN THE APPEARANCE OF THE REVOLT EFFECT

Using REGINT (Caselles, A 1998) software we have approximated the distributions probability p_1, p_2 and p_3 of the influence of K_a, K_r and K_e, respectively, in the appearance of the revolt effect. In Phase I the evaluation of p_1 give

$$p_1 = 0.346286-(0.199156/K_a) - 0.160534\exp(-0.1K_a)$$

with the coefficient of correlation $R_1 = 0.947225$.

High values of K_a (slow adaptation to the repression) favour again the appearance of revolt effects with a maximum probability near to 0.35. The evaluation of p_2 gives

$$p_2 = 0.334891-\left(\frac{0.282806}{K_r}\right)$$

with the coefficient of correlation $R_2 = 0.819891$.

Higher values of K_r (slow adaptation to the resignation) allow the appearance of revolt effects with a maximum probability near to 0.35. The evaluation of p_3 gives

$$P_3 = 0.234682-0.053817\log(K_e)$$

with the coefficient of correlation $R_3 = 0.978275$.

Higher values of K_e (slow ecological adaptation) permit the appearance of revolt effects.

CONCLUSIONS AND POSSIBLE INTERPRETATIONS

The revolt effect could provide satisfactory explanations for regimes of short duration like Nazism in Germany (approximately 11 years), the fascism in Italy, perhaps the regimen of the general Franco in Spain.

- A great number of revolts effects are detected when $E^t/E^0 < 1$ in comparison with ideal ecological conditions $E^t/E_0 = 1$ for all the anomalous behaviors superior or equal to 5. This result was expected, since the ecological degradation favoured the situations of crisis. Whereas we have explained the appearance of the social behaviour $U=4$ with the more occurrence in ideal ecological conditions by its early appearance with low technological development. As in the case of movements which are based in religious traditions.
- High values of K_e (slow ecological adaptation) favour the appearance of revolt effects. Expected because of the ecological degradation. As in the case if global warming could not be stopped.
- High values of K_a (slow adaptation to the repression) favour the appearance of revolt effects with a maximum probability near to 0.35. Expected for a greater repression. As in the case of totalitarian systems.

DOI: 10.1002/sres

- High values of K_r (slow adaptation to the resignation) favour the appearance of revolt effects with a maximum probability near to 0.35. It is coherent with what we have showed in theoretical explanation. As in the case if control of mass media prevent the emergence of viable alternatives.
- Less revolt effects are detected in the occidental area and with less average duration in comparison with the oriental area. This result is still to be explained and historically contrasted.

REFERENCES

Caselles A. 1998. REGINT: A tool for discovery by complex function fitting. In *Cybernetics and Systems'98*, Austrian Society for Cybernetic Studies: Vienna; 787–792.

Fukuyama F. 1995. The end of history, five years later. *History and Theory* **34**(2): 27–43.

Godelier M. 1964. La notion de ''mode de production asiatique'' et les schémas marxistes d'évolution des sociétés. *Centre d'études et de recherches marxistes*.

Nemiche M, Pla-Lopez R. 2000. A Model of Dual Evolution of the Humanity. In *2nd International Conference on Sociocybernetics*, Panticosa, 25–30.

Nemiche M, Pla-Lopez R. 2003. A learning model for the dual evolution of human social behaviors. *Kybernetes*, **32**(5/6): 679–691.

Nemiche M, Pla-Lopez R. 2005. Simulación del consumo en satisfacción y represión de algunos comportamientos sociales mediante un Modelo, *Sistémico Inguruak Revista vasca de sociología y ciencia política*, ISSN 0214-7912, 42: 147–156.

Pla-Lopez R. 1988. Introduction to a learning general theory. *Cybernetics and Systems: An International Journal*, **19**: 411–429. Robert Trappl ISSN: 0196-9722 EISSN: 1087-6553.

Pla-Lopez R, Nemiche M., 2002. Consecuencias del ataque a las Torres Gemelas para la evolucion de la humanidad. II Reunion Española de Ciencia de Sistemas (RECS-II), Valencia, 12–14 Junio 2002.