Why are the borders of Palestine/Israel and Wallonia/Flanders so different?: Entropic Analysis of a Schelling model with hierarchically structured initial conditions.

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“if an agent is surrounded by more individuals belonging to the opposite social group, he will move to an empty place in which he becomes surrounded by comparatively more individuals of his own social group”

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\[ \tau = \frac{2}{\pi} \tan^{-1} \frac{T}{T_0} \]

\( \tau \to 1 \) means \( T \to \infty \)
Minority fractal dimension
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\[ S(d) = \log \Omega(d) \]

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\( D_2 < D < D_1 \) the most uncontrollable regime
1.51 \leq D < D_1 = 1.77

The most segregationist regime


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where \( \Omega(d) \) is the total number of possible patterns having fractal dimension \( d \) in a \( \lambda \times \lambda \) array of pixels (see [reference]).

\[ D=1.14, r=0.05 \]

low entropy variations

less temporal evolution.

"status quo tends to prevail"
low entropy variations = less temporal evolution.

"status quo tends to prevail"


\[ S(d) = \log \Omega(d) \] where \( \Omega(d) \) is the total number of possible patterns having fractal dimension \( d \) in a \( \lambda \times \lambda \) array of pixels (see D=1.89, r=0.30)
$D_2 < D < D_1$

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$$S(d) = \log \Omega(d)$$

where $\Omega(d)$ is the total number of possible patterns having fractal dimension $d$ in a $\lambda \times \lambda$ array of pixels (see

$D=1.59$, $r=0.20$
Minority fractal dimension is basically time-invariant

“System’s dynamics basically occurs at the borders”
“An agent belongs to the border of his social group when he is next to another individual belonging to the opposite social group”

Minority border dimension

(Borders have a basically volatile nature)

$\frac{t=0}{t=\infty}$

$D_2 < D < D_1$

The most uncontrollable regime

$D_\theta \lesssim D_1$

“An agent belongs to the border of his social group when he is next to another individual belonging to the opposite social group.”
"An agent belongs to the border of his social group when he is next to another individual belonging to the opposite social group"
“An agent belongs to the \textit{border} of his social group when he is next to another individual belonging to the opposite social group.”

$D_2 < D < D_1$

The \textit{border} substantially changes its shape: There occurs an entropic regime change.

$D=1.59, r=0.20$
“An agent is unsatisfied when he is surrounded by more individuals belonging to the opposite social group”

The set of unsatisfied agents (usually indetectable) is even more volatile than the borders.

\[
S(d) = \log \Omega(d)
\]

where \( \Omega(d) \) is the total number of possible patterns having fractal dimension \( d \) in a \( \times \times \) array of pixels.

\[
D_2 < D < D_1
\]

The most uncontrollable regime

\[
D_3 < D_N < D_2
\]

The most uncontrollable regime of a space of dimensionality \( D_1 \)

\[
D_N \lesssim D_2.
\]
“An agent is unsatisfied when he is surrounded by more individuals belonging to the opposite social group”

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\[ D_2 < D < D_1 \]

The most uncontrollable regime

\[ S(d) = \log \Omega(d) \]

where \( \Omega(d) \) is the total number of possible patterns having fractal dimension \( d \) in a \( N \times N \) array of pixels (see M.E. Gaudiano (2015). An Entropical Characterization for Complex Systems Becoming out of Control. Physica A 440, 185.)

fractal dimension of the unsatisfied agents

\[ D_2 < D < D_1 \]
CONCLUSIONS:

1- Basic Schelling model + structured initial conditions = quite different temporal evolution in comparison with random initial conditions (widely found in the Literature). Many social aspects are naturally reproduced without introducing artificial parameters into the model.
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2- D is time-invariant (dynamics occurs at the borders of the minority-majority patterns): system’s macrostructure basically does not change with time, which corresponds with the idea of “idiosyncrasy”.

“On the role of structured initial conditions in the Schelling model”.
M. Gaudiano, J. Revelli. Physica A, october 2021,
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4- $D_2 < D < D_1$: Segregation easily blows up. Existence of recurrent segregation processes [include into the model a kind of regeneration mechanism (like e.g percolation)]. It corresponds to the out-of-control regime predicted in the general complex system formalism of [Gaudiano, 2015, Physica A 440, 185].

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THANKS FOR YOUR ATTENTION!!!