Fake News Simulation

Econophysics

Gabriele Lubatti

Fisica dei Sistemi Complessi
Università degli Studi di Torino

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Abstract

The purpose of this work is to simulate how a fake news spread among individuals with an agent-based model. In the NetLogo simulation the population is made up of three kind of agents (breed) : experts, non-experts and conspiracists. If the news is covered by the media, is likelihood and is told in a dramatic storytelling way, then with higher probability the fake news will spread in the society. Each agent of the three previous category at the beginning of the simulation can be red or green (that is he believes/does not believe in the news). When the simulation is running agents interact between them and according to certain rules they will change or not their prior belief. Moreover, at a constant rate, a supporter of the news is introduced. This new kind of agent tries to convince all the other individual to believe in the news. At the end of the simulation we count how many red and green agents there are in order to understand if a fake news is become viral (that is a large percentage of the population is become red) or not.

Indice

1 Project description

The goal of the project is to simulate how a fake news spread among a sample of the population. Although the fake news phenomena is not recent (we can just think at Orson Welles case in the 1938), it assumed a huge importance and influence over the last years, in first place thanks to the use of the online social network [1].
I combine the features that play a fundamental role in the diffusion of a fake news into three factors. The first is the likelihood of the news. The second is the dramatic storytelling, that is the ability of using strong empathic methods in order to communicate a news. The third is the coverage of the fake news played by the media. The stronger these factor are and the easier the fake news will spread.
In the real world people with different cultural and social background interact. In my simulation I start from a sample of the population in which there are both experts and non-experts. By the word experts I mean all the individuals who have a high instruction level (for example all the people who get a degree in any subjects). So the expert is not necessary a specialist in the field of study linked with the fake news. The term non-experts stands for the individuals who have a low instruction level.
In the recent episodes of fake news it has been observed how a non-negligible fraction of people without specific skills and knowledge in a certain field has assumed a distrust behaviour towards the experts. We can just think at the high number of websites and social network groups focused on themes like flat earth and chemtrails [2]. In the following analysis I will call the individuals who behave in this way as conspiracists.
Emblematic is what happened at the Collegio Carlo Alberto, a research and teaching institution supported by "Compagnia di San Paolo", that, after hosting a seminar focused on the fake news, was accused to be at the service of freemasonry by a website run by supporters of the chemtrails [3].
A fake news is built because there is a group of people who have interest in spreading and supporting the news [4]. In my project this reinforce factor is done by the individuals who belong to the supporter group.
Individual's opinions are influenced by people with whom they interact during their daily-life. So in the simulation the interaction between agents is bounded in a circle of radius fixed.

2 How the simulation work

2.1 Set up

As said in the abstract, I realized the simulation in NetLogo. At the beginning of the simulation I fix the seed for the generation of the pseudo-random numbers, so it possible to reproduce the experiments.
In the model I start with a population of 100 agents who are split in two category according to cultural background (for example hold or not a degree). These categories are represented by two species: **nexperts** (that is the non-experts) and **experts**.
I add a third category characterized by the fact that members don't believe in the experts and they change opinions only by interacting with the non-experts. This species is called **conspiracy theorists**. All the conspiracists at the beginning always believe in the fake news.
I fix the number of experts and of non-experts by using the sliders **"people with degree"** e **"people without degree"** with which I can assign a number between zero and one hundred .The number of conspiracists is given by the difference between the whole population (100 agents) and the number of people who are experts or not-experts. Always by sliders it is possible to set the weights of the three boundary conditions and the value itself (interpreted as strength factor) of the boundary condition. The strength factors are number between zero and one. These values remain constant during the simulation.
The weights linked with the boundary conditions are used in order to compute the probability according to which individuals at the beginning of the simulation believe or not in the fake news. Each agent has a colour: green if he does not agree with the news, red otherwise. I assign the colour to the agents of the two category with a probability linked with the values of three factor that characterized the fake news. An expert will be red with less probability than a non-expert. For both species the number of red agent will increase as the strength factors of the boundary conditions growth.
Below there is the code used for the creation of the three categories of the population.
set boundcondition weigthlikelihood * likelihoodOfTheNews + weigthdramaticStorytelling * dramaticStorytelling + weigthmediaCoverage * mediaCoverage.
create-experts peoplewithdegree [ifelse random-float 1 < boundcondition / 2 [set color red set size 2 setxy random-xcor random-ycor set shape "person"] [set shape "person" set color green set size 2 setxy random-xcor random-ycor]]
create-nexperts peoplewithoutdegree [ifelse random-float 1 < boundcondition / 1 [set shape "person" set color red set size 2 setxy random-xcor random-ycor] [set shape "person" set color green set size 2 setxy random-xcor random-ycor]]
create-conspiracytheorists conspiracygroup [set color red set size 2 setxy random-xcor random-ycor set shape "person"]
These are the commands within the procedure **set-up**. Now I move to the procedure **go**.

2.2 Interaction

When I run the simulation I introduce in the population, at a constant rate, an individual of a new species called **supporters**. These agents are characterized by the fact that they always support and believe in the fake news during all the time of the simulation. So they are red.The related code is the following:
create-supporters 1 [set color red set size 2 setxy random-xcor random-ycor set shape "person"]
The first operation that is done inside the go-procedure is **change-colour** that works in the following ways.
An agent (agent 1) is selected randomly and another agent (agent 2) situated near the previous one is randomly chosen (in code: ***let myNeighbor one-of other turtles in-radius rad***).

- If agent 1 belongs to the **nexperts** species and if the two individuals have a different colours, then the selected agent (agent 1) assumes the colour of agent 2, regardless of the species of the two(***if myNeighbor != nobody and color != [color] of myNeighbor and breed = nexperts [set color [color] of myNeighbor]***).

- If agent 1 belongs to the **experts** species, then the model works as in the previous case with the difference that now the selected agent (agent 1) will change opinion only if agent 2 belongs to the **expert** category or is a **supporter**. In particular:
  - If agent 2 is a **supporter**, then agent 1 will change colour with a probability that increases with the value of the boundary conditions (***if [breed] of myNeighbor = supporters [if random-float 1 < boundcondition / 2 [set color [color] of myNeighbor]]***).
  - If agent 2 is an **expert** and agent 1 is red then agent 1 will always change colour(***if breed = [breed] of myNeighbor and color = red [set color [color] of myNeighbor]***).
  - If agent 2 is an **expert** and agent 1 is green then agent 1 wil change colour only with a probability that increases with the value of the boundary conditions and that it's higher than the one in the interaction supporter-expert(***[if breed = [breed] of myNeighbor and color = green [if random-float 1 < boundcondition [set color [color] of myNeighbor]]***).
- If he belongs to the **conspiracy theorists** then he will assume the colour of agent 2 only if agent 2 is a **supporter** or a **non-expert** (***if myNeighbor != nobody and color != [color] of myNeighbor and breed = conspiracytheorists [if [breed] of myNeighbor != experts [set color [color] of myNeighbor]]***).

I define the interaction in this way on the basis of the following motivation:
An expert in a certain field or more generally an individual with an high level of instruction usually is not influenced by a non-expert but only by colleagues

or people with similar cultural background. On the contrary non-experts tend to take into account the opinion of both experts and individuals who belong to their same category.
On the other hand the conspiracist, since he does not well understand the full problem and he lacks the knowledge in a specific field, he is unwilling to listen to the experts and he has a distrust behaviour towards them. Finally the supporters are the ones who always support the news and therefore never change opinion.
After the agents interact between them, the simulation executes the command **change direction** (the direction associated to the agents changes randomly) and **move** (the agents move randomly in their direction).
The full sequences of instructions in the procedure **go** is repeated for 500 iteration (ticks). In the end I print the number of people who believe in the news,the number of non-believers and then the simulation stops.

3 Results

The purpose of this work is double. In the first analysis I want to study when a fake news become viral by changing from one simulation to another only the values of the boundary conditions, while the composition of the population remains fixed.
In the second analysis I apply the opposite method: I fix the values of the boundary conditions and I run simulations with different compositions of the population. All the results reported below are obtained by fixing as pseudo random number the value 1233.

3.1 First Analysis

I fix the population in the following way: 35% are experts, 55% are non-experts and the remain 10% are conspiracists. I choose these percentages because this is similar to the average composition of an industrialized country.
I assign a value between zero and one as a weight for each of the three boundary conditions: 0.4 for the weight of the likelihood and 0.3 for both weights of dramatic storytelling and media coverage (I will use the same weigths for the second analysis).
Then I set the three boundary conditions with a number between zero and one (as a strength factor). The higher the number and the stronger is the boundary condition.
In the first analysis the composition of the population and the weight of the three boundary conditions are fixed. What changes from one simulation to another is the strength factor.
In the first simulation I simulate a weak fake news with these boundary conditions: 0.1 for the likelihood factor,0.1 for the dramatic storytelling factor and 0.1 for the media coverage factor.
Below I report the picture of the population at the beginning and at the end of the simulation. Green means an individual who does not believe in the fake news, while red stands for a person who believes in the news.

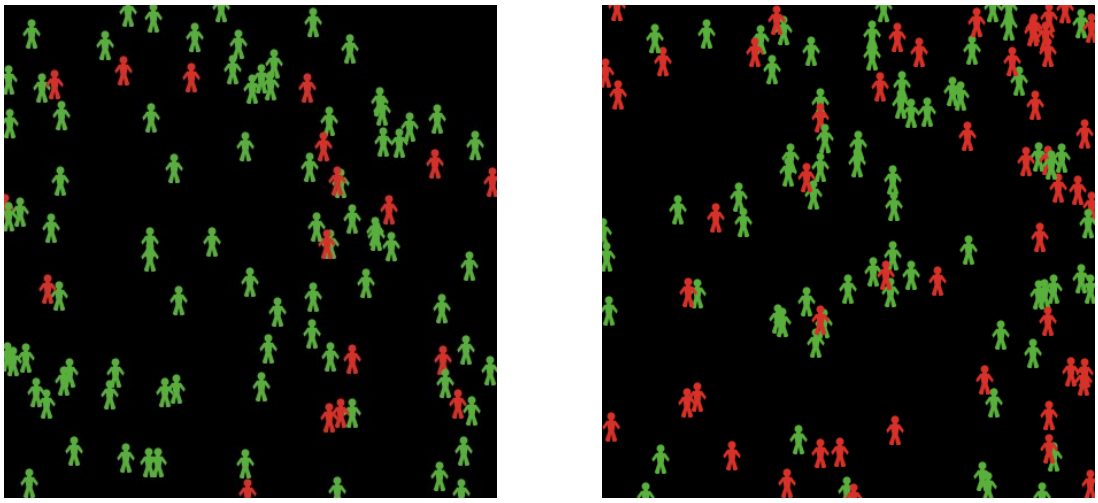

Figura 1: **Population at the beginning (left image) and at the end of the simulation(right image)**

The following graph represents the belief of the whole population.

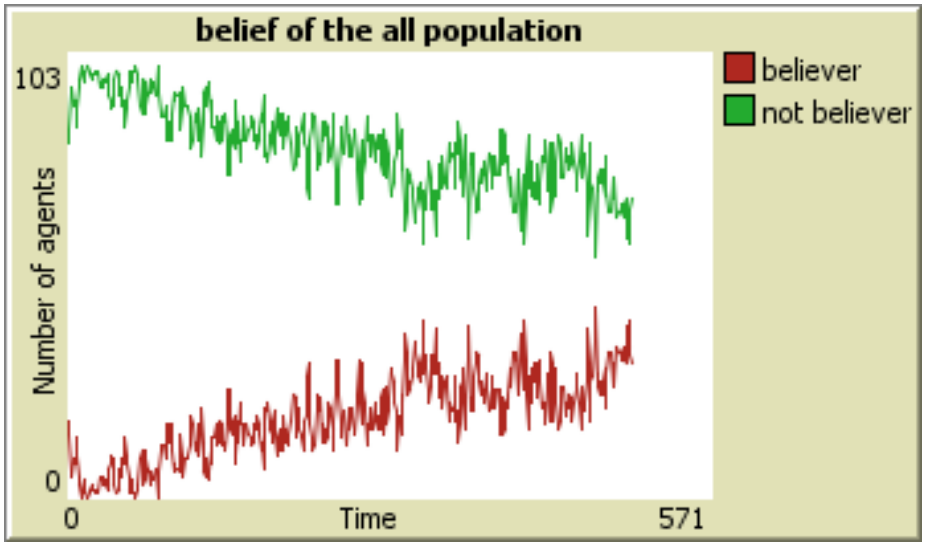

Figura 2: **change of belief of all categories of the population during the simulation.**

As we expect, since the strength factors are low, the fake news does not become viral at the end of the simulation because the number of people who do not believe (69%) is bigger than the ones who believe (31%).
In the previous percentages I consider only the experts, non-experts and conspiracy group. I exclude the supporters since they are an external force that tries to modify individual's opinion. In addition this category does not change belief during the simulation. In all the percentages that will appear in this first

and second analysis I will always exclude the supporters.
In the second simulation I study the effect of a fake news with stronger boundary conditions than the previous one: 0.5 for the likelihood factor,0.5 for the dramatic storytelling factor and 0.5 for the media coverage factor.
Below we report the picture of the population at the beginning and at the end of the simulation. Green means an individual who does not believe in the fake news, while red stands for a person who believes in the news.

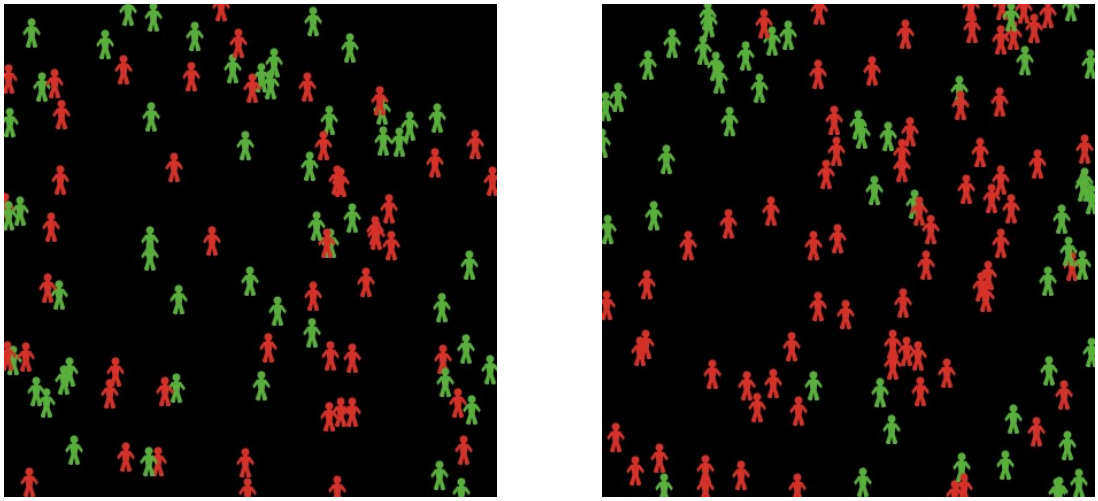

Figura 3: **Population at the beginning (left image) and at the end of the simulation(right image)**

The following graph represents the belief of the whole population.

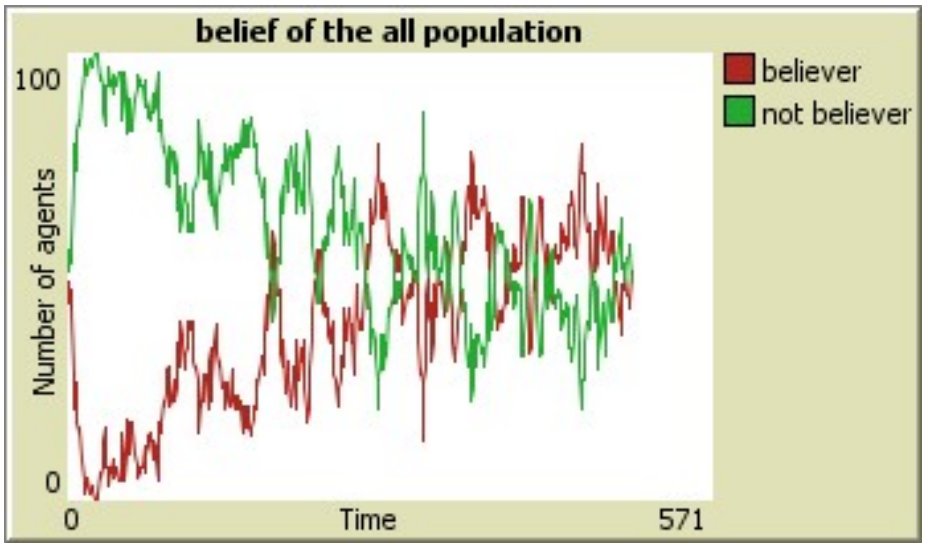

Figura 4: **change of belief of all categories of the population during the simulation.**

In this second situation the fake news does not spread across all the population, however a larger amount of people than the previous analysis agree with the news (about half of the population). At the end of the simulation the percentages are the following: 49% do not believe while the 51% believe.
In the third simulation I analyse a strong fake news with an high score in each of the boundary conditions: 0.9 for the likelihood factor,0.9 for the dramatic storytelling factor and 0.9 for the media coverage factor.
Below we report the picture of the population at the beginning and at the end of the simulation. Green means an individual who does not believe in the fake news, while red stands for a person who believes in the news.

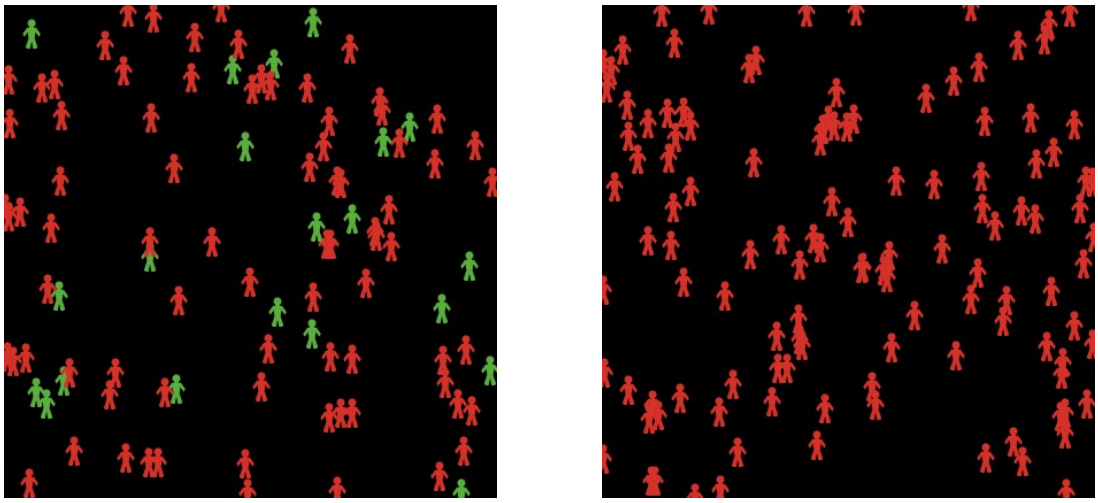

Figura 5: **Population at the beginning (left image) and at the end of the simulation(right image)**

The following graph represents the belief of the whole population.

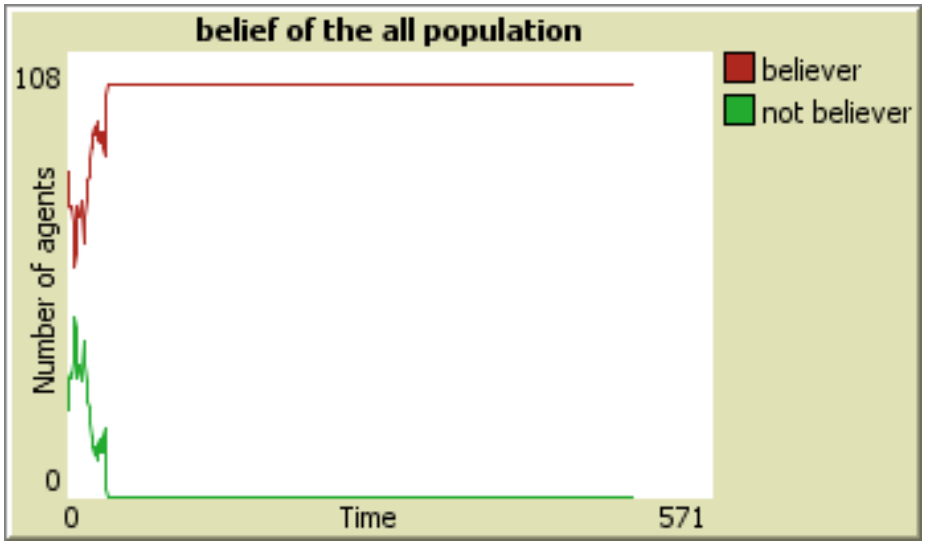

Figura 6: **change of belief of all categories of the population during the simulation.**

In this third situation we see that the fake news spread across all the population and become viral. At the end of the simulation all the individuals (experts, non-experts, conspiracy) believe in the news.

3.2 Second Analysis

In the second analysis I fix the strength factor of the boundary conditions in the following ways: 0.5 for the likelihood factor,0.5 for the dramatic storytelling factor and 0.5 for the media coverage factor. I choose these values (about half of the maximum score) since I want to simulate a typical common case of fake news.
In the first simulation I choose a population in which all the individual are experts.
Below I report the picture of the population at the beginning and at the end of the simulation. Green means an individual who does not believe in the fake news, while red stands for a person who believes in the news.

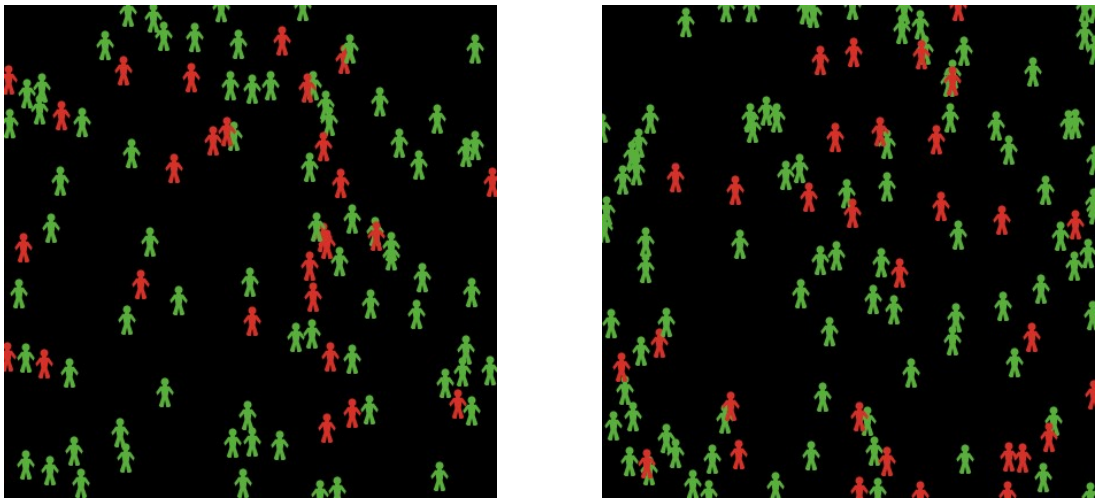

Figura 7: **Population at the beginning (left image) and at the end of the simulation(right image)**

The following graph represents the belief of the whole population.

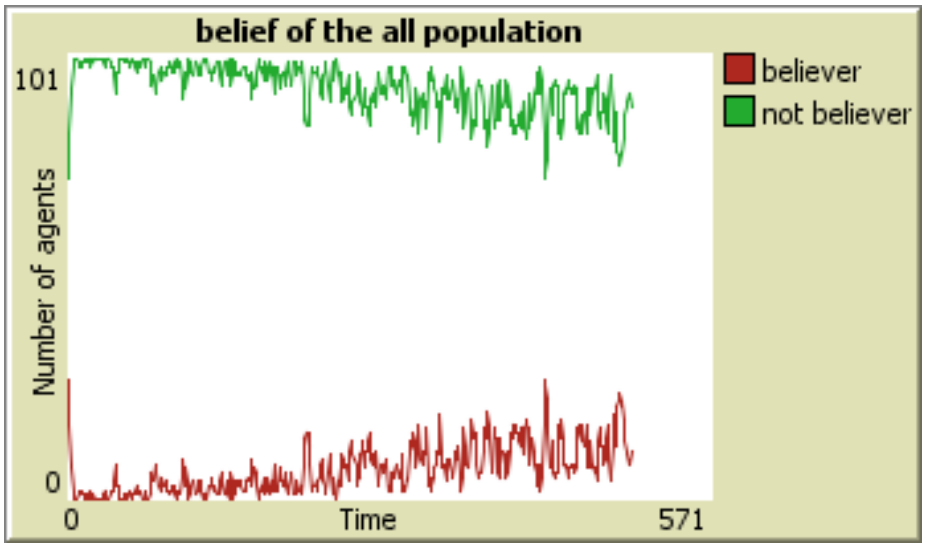

Figura 8: **change of belief of all categories of the population during the simulation.**

In this first case, since all the individuals belong to the expert category, we have that at the end of the simulation the 89% do not believe while only the 11% believe.
In the second case I set a population where all the population is made up of non-experts.
Below I report the picture of the population at the beginning and at the end of the simulation. Green means an individual who does not believe in the fake news, while red stands for a person who believes in the news.

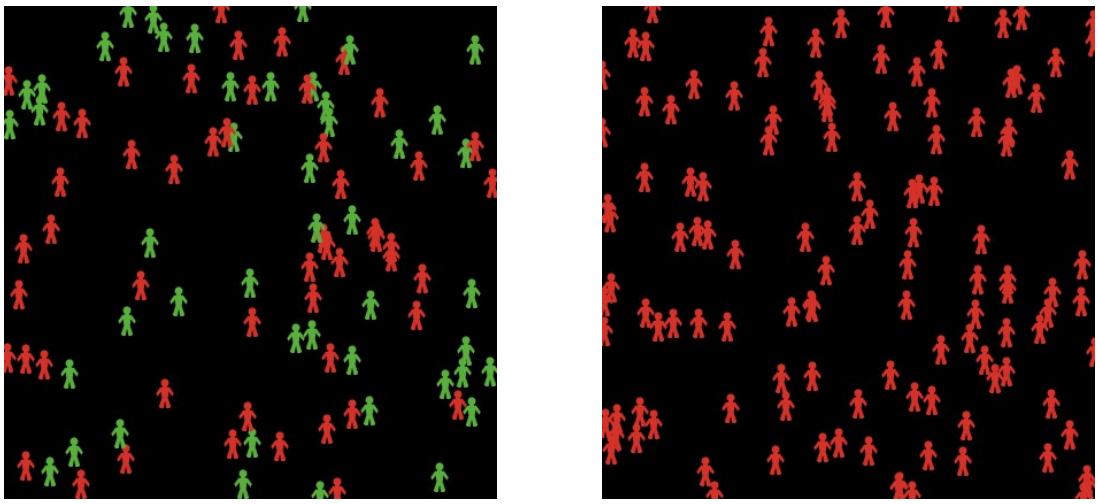

Figura 9: **Population at the beginning (left image) and at the end of the simulation(right image)**

The following graph represents the belief of the whole population.

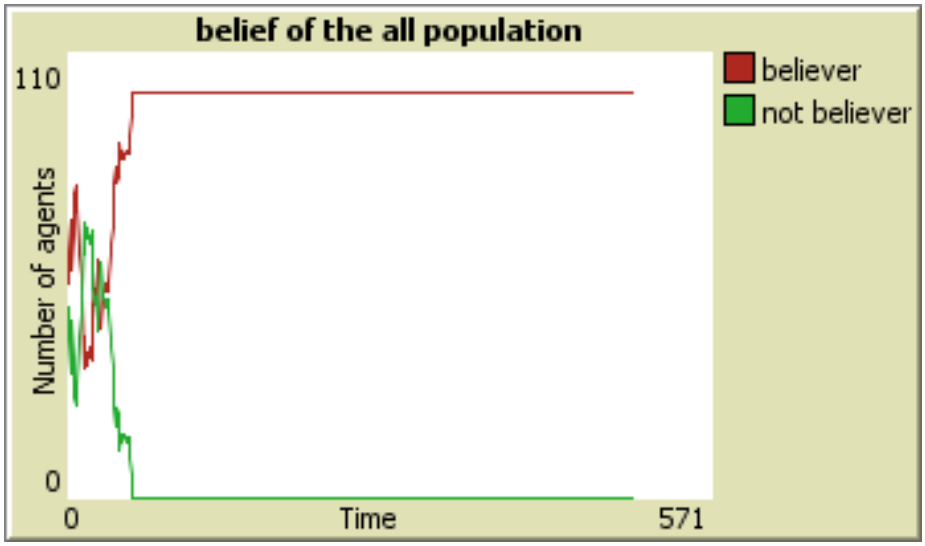

Figura 10: **change of belief of all categories of the population during the simulation.**

In this second case we have that at the end of the simulation the fake news become viral. So in a world where there aren't expert a fake news will easily spread across the population.
In the third simulation I set the following percentages: half of the population are experts and half are non-experts. In this case there aren't conspiracists.
Below I report the picture of the population at the beginning and at the end of the simulation. Green means an individual who does not believe in the fake news, while red stands for a person who believes in the news.

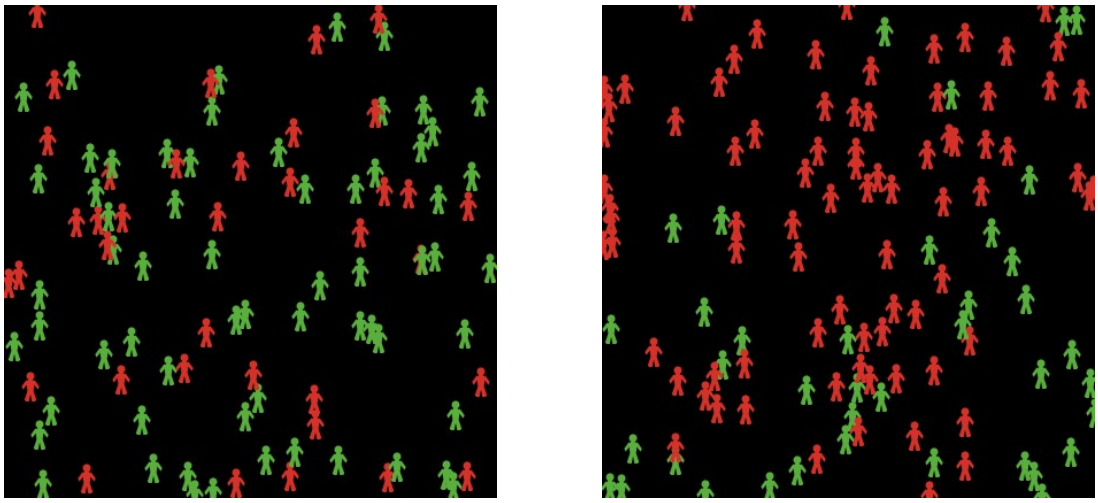

Figura 11: **Population at the beginning (left image) and at the end of the simulation(right image)**

The folowing graph represents the belief of the whole population.

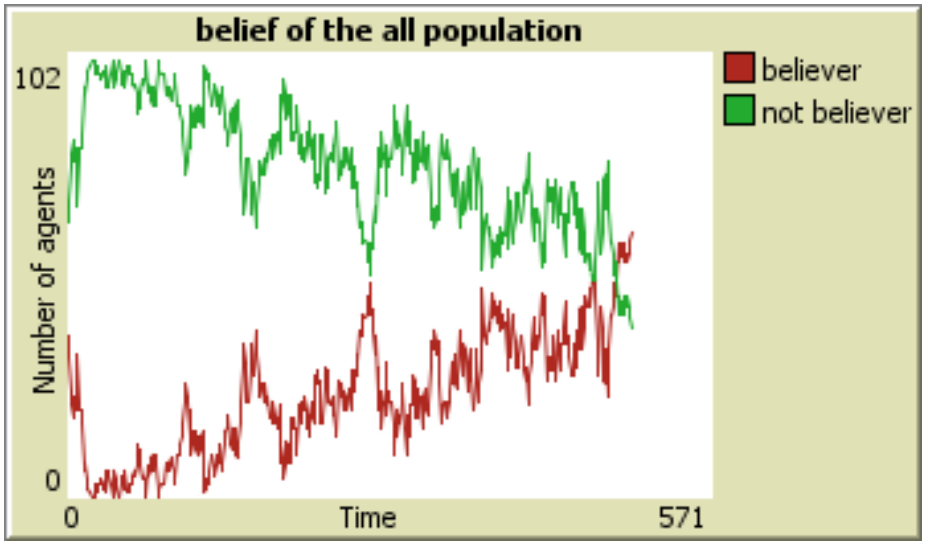

Figura 12: **change of belief of all categories of the population during the simulation.**

At the end of the simulation we obtain the following percentages: 39% of not-believers and 61% of believers. So in this contest the fake news is not able to become viral. In the fourth simulation I assign this composition: half of the population are experts and half are conspiracists. In this situation there aren't non-experts.

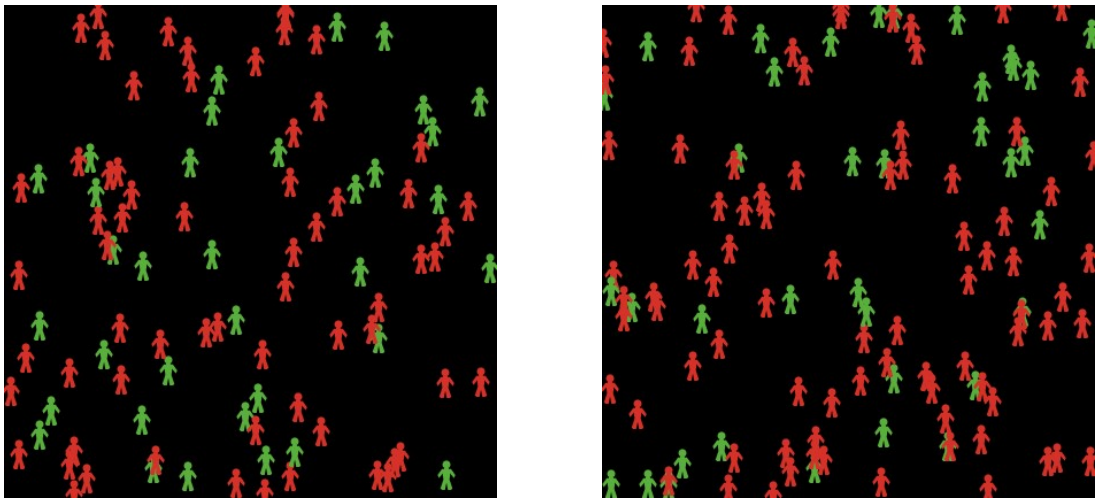

Figura 13: **Population at the beginning (left image) and at the end of the simulation(right image)**

. The following graph represents the belief of the whole population.

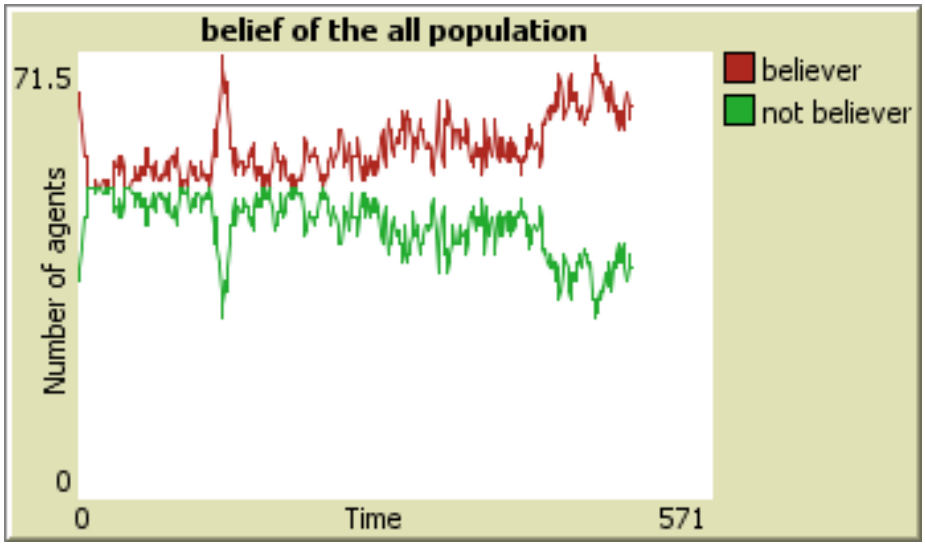

Figura 14: **change of belief of all categories of the population during the simulation.**

The results of the simulation is that the majority of the population believes in the news (63%). So the fake news will spread across the population a little bit easier if instead of non-experts we have conspiracists.
In the last simulation we determine a population in which there are both experts, non-experts and conspiracists with the same percentage (33,3%).
Below I report the picture of the population at the beginning and at the end of the simulation. Green means an individual who does not believe in the fake

news, while red stands for a person who believes in the news.

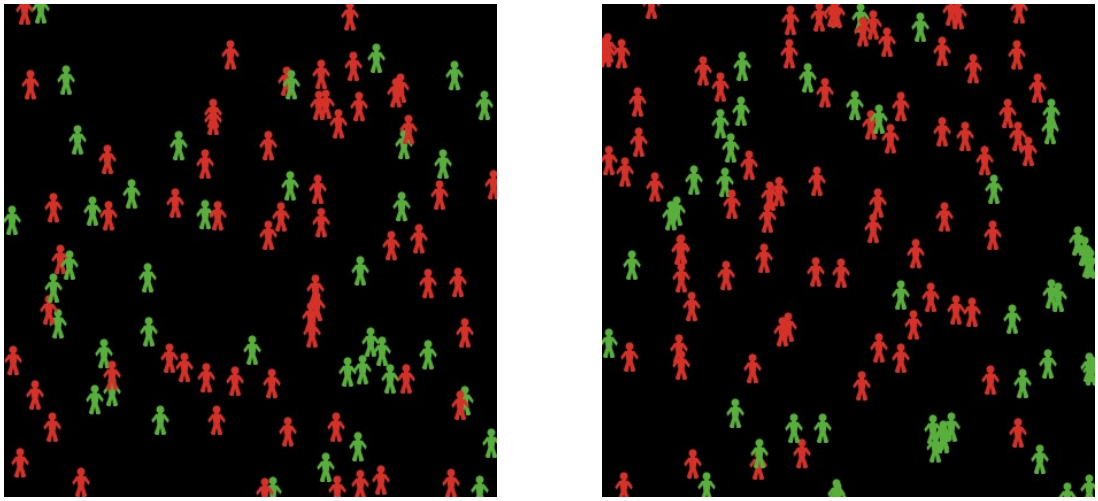

Figura 15: **Population at the beginning (left image) and at the end of the simulation(right image)**

The following graph represents the belief of the whole population.

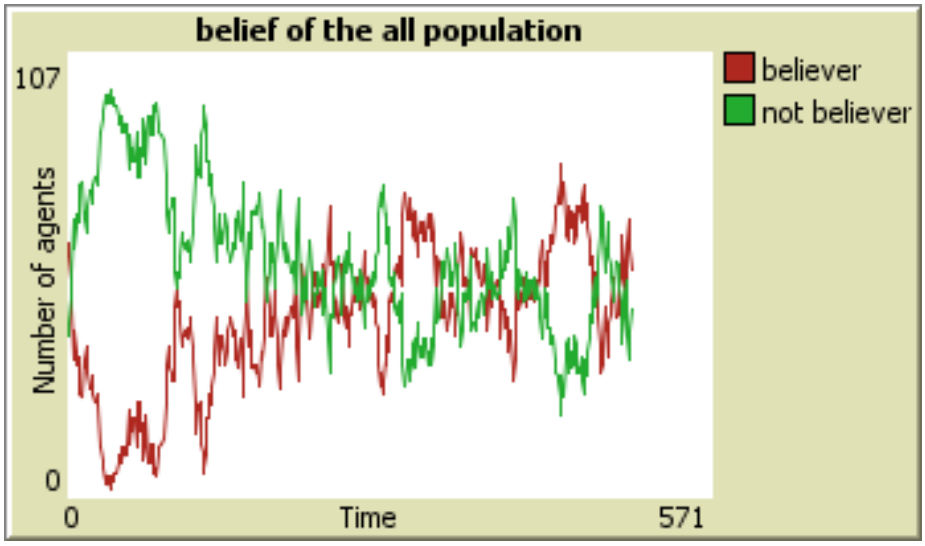

Figura 16: **change of belief of all categories of the population during the simulation.**

The result is the following: a little bit more than half of the population believes in the news (55%) and a little bit less than half of the population does not believe (45%). So if at least one third of the individuals is an expert, then

a typical fake news will not become viral.

4 Conclusions

The purpose was to analize in which situations a fake news became viral by using an agent-based simulation. We saw that both the features of the news and the composition of the population play a crucial role in the final results.
We investigated that if we started from a population in wich there were some experts and the values we assigned to the boundary conditions were very low (i.e close to 0), then at the end of the simulation the news did not become viral (the majority of agents was not red).
On the other hand if we started from the same population as before but we assigned high values to the boundary condtitions, then at the end the news spread among the individuals.
Another way of studying the phenomena was to fix the value of the three conditions and change the composition of the population. In this situation if we started from a population in which the are a lot of experts a normal fake news (0.5 for each of three conditions) did not become viral.
On the contrary if we started from an high percentage of non-experts or conspiracists, then a news with the same features as the previous one spread easily among the agents.
A possible continuation and improvement of this work will be the introdcution of new types of agents in the initial setting. In this ways not only the cultural background(expert/non-expert) would be taking into account, but also for example religiosity of individuals and being a left or rigth-wing parties supporter.

Riferimenti bibliografici

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