

Opinion Dynamics model

This is an example model used in Chapter opinion and politics of <https://intro2abm.com/>.

Each agent has an opinion and interact with other agents. Agents influence each other. Agents with different opinions adjust their opinions to come closer to each other in their opinions. However, this only works if agents tolerate each other's opinions in order to have a fruitful interaction. If agents do not tolerate each other's opinion agents may not influence each other or even repel and get more distant opinions.

In more formal notation,

- an agent i has an opinion x_i ,
- a threshold u_i which defines how big of a difference the agent still accept the opinion of the other agent j ,
- and a threshold t_i which defines how big of a difference in opinions between agents i and j need to be to not tolerate the opinion of the other agent.

Agents randomly are paired and interact. If agents accept the other opinion, they move towards each other. If the agents do not tolerate the opinion of the other agent, the opinions will become further apart.

The following rules are used for the adjustment of the opinion dimension x :

If $|x_i - x_j| < u_i$ change x_i into $x_i = x_i + \mu \cdot (x_j - x_i)$

If $|x_i - x_j| > t_i$ change x_i into $x_i = x_i + \mu \cdot (x_i - x_j)$

Where μ is the strength of the influence. The same rules apply for updating the opinion of individual j . The opinions are between $[0;1]$ and we use the same threshold values of all agents and both dimensions. Initially, agents are randomly assigned values of the opinions.

We use a μ equal to 0.1 of all 1000 agents and vary the threshold values between 0 and 1 with steps of 0.05. We measure the entropy of the distribution of opinions. We split of the space of opinions in $S = 100$ equal squares and calculate the relative frequency $F(o_s)$ of the agents with opinions within each square.

$$E = - \sum_{s=1}^S F(o_s) \ln F(o_s)$$

A higher entropy means that the opinions are less concentrated in one area. We see that for low values of acceptance opinions are spread widely, especially if combined with a high rejection threshold. If the acceptance threshold increases, agents start to aggregate in concentrated areas.

If $t_i = 1$ and $u_i = 1$ we see that all the opinions converge to 0.5 since all interactions lead to agents adjusting their opinions towards each other. However, if $t_i = 0.3$ and $u_i = 0.2$ the opinions start diverging into two groups ending up in a bimodal distribution of opinions being 0 or 1. The reason is that agents come closer if they are not more different than 0.2, while diverging if the difference is 0.3 or more. Using the entropy measure we can see in Figure

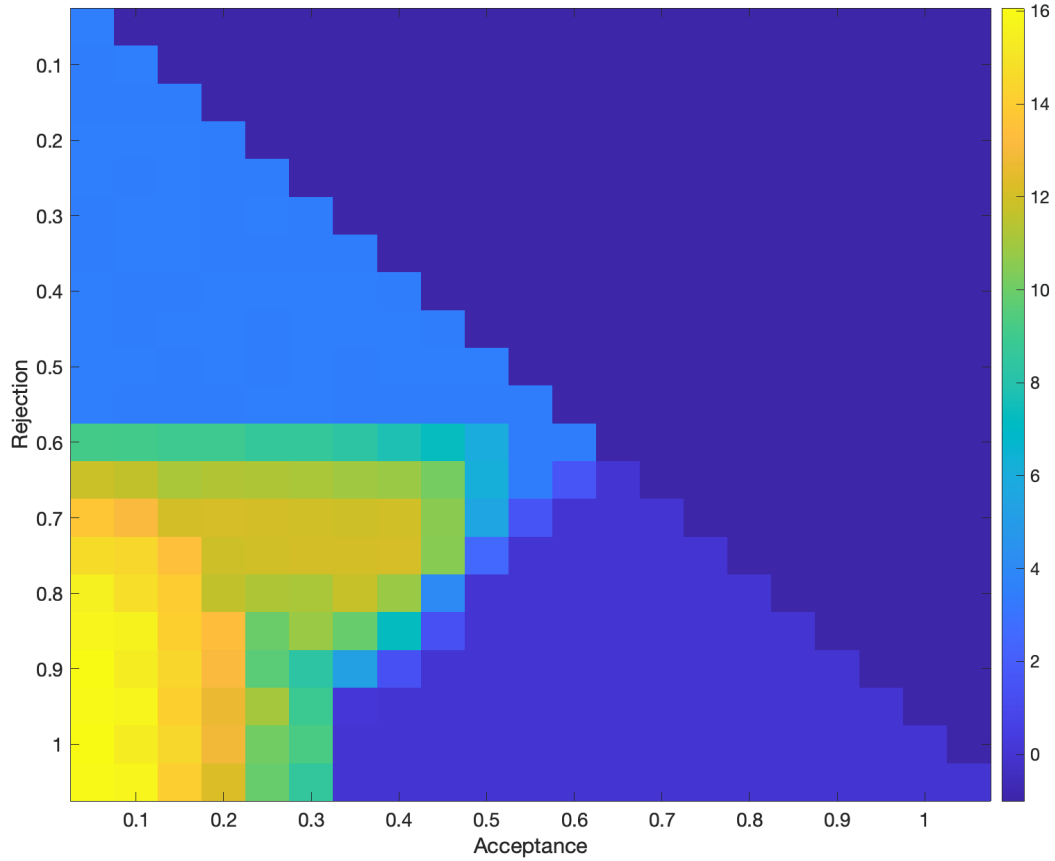


Figure 1: Overview of the entropy at the end of simulation experiments for u_i varying between 0.05 and 1.0 and t_i varying between 0.05 and 1.0 (with the constraint $t_i > u_i$) for 30 replications of each tested couple (u_i, t_i) .

The default model assumes the same probability of interacting with any two agents each time step. What would be the consequence if there is some social structure. For example, agents are located in a physical space and have more likelihood to interact with those who are physically close. Or agents are in a virtual space and are more likely to interact with those who have similar opinions.