ID2209 – Distributed Artificial Intelligence and Intelligent Agents

Final Assignment – Behaviour of Different Agents

Group 20

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1. Introduction

In this assignment, we were tasked with creating a simulation that shows different behaviour and interactions between different types of agents. In this simulation we have chosen to solve the base assignment along with the challenge 1 that involves using the BDI implementation. The code was written in GAMA 1.8 and is presented along with this report.

To execute the code, run GAMA and import the file “Final_Assignment.gaml” in a new project. Press “gui_experiment” to run the simulation of each file. There are global parameters that can be modified during the simulation run without needing to modify the code.

2. Approach

Our approach consists on dividing people in different categories, but instead of creating 5 different static categories we decided to use a combination of three factors: Age, Gender and Profession. Age is of two possible categories, either young or old. Gender is also considered as binary, either female or male. For profession we chose 3 categories: Dancer, Signer and Fan. The combination of these qualities will give us 12 different types of people that will determine the way they behave (3x2x2).

On the other hand, the personal traits of each individual, regardless of the type of person they are, are given by the “Big 5 Personality Traits”: Openness, Conscientiousness, Extraversion, Agreeableness and Neuroticism. These five factors are sometimes referenced using the acronyms "OCEAN" or "CANOE". These personality traits are used to measure the affinity between people and for simplicity are considered boolean values.

The details of the main species we defined on this project are the following:

2.1 Stage

Stage is a species of agent that is represented in the simulation through yellow triangles and they are the places at which people can socialise. In this approach, the stages are a place where a good or service is given to the people nearby while they socialise with other people. These can be either music, drinks, food or a combination of these three. These values are initialised at random when the simulation starts.

2.2. Person

These agents are the main actors in this simulation. They represent a very diverse spectrum of people, given not only by their category (young/female/singer, old/male/dancer, young/male/fan, etc), but also by their personality (OCEAN). For simplicity, the personality traits are considered as boolean, so a person is either agreeable or it is not.

2.2.1 Activities and BDI

Apart from the intrinsic characteristics that define a particular person, they have the variables need_drink, need_food and need_music, in descending priority respectively, that describe what their current status is. The actual intention that the person will have at a moment will be the values that have the highest priority that are true at the moment.

When a person is in need of a drink and they do not have any beliefs about drink places, it will wander until it finds a stage that has drinks. When that happens, the person will add it to their list of beliefs with a predicate that identifies it as a place that has drinks. Whenever thirsty again, it will go to the place that has drinks in their beliefs. Same is applied to all places that offer food and music. For this purpose, each person has three beliefs, consisting of a list of places for either drinks, food or music.

When a person is in need of a drink and they do have a place that has drinks stored in their beliefs, then they will have a desire to satisfy this need. The desire with the highest strength will be set as the agent's current intention, and the agent will go towards the closest stage that has in its beliefs that can satisfy this desire.

When a person arrives at a stage where they can satisfy their desires, they will remain within this place for a set amount of time. This value can be modified by the user during the simulation as a global parameter. During this time, different people that are in the same location can socialise.

2.2.2 Socialising

Whenever different people meet at specific stages, they have the opportunity to socialise. The socialisation between people comes in two forms: based on profession and based on dates, and they will occur if they like each other. The liking between two people is a value that is 1 if they have the same personality traits and 0 if they have the opposite for every trait. By this definition, both will initially have the same likeness value for each other, although this value can change over time depending on their interactions.

When two people of the same profession who like each other meet, they will interact with each other either by dancing (if they are both dancers), singing (if they are both singers) or by chatting (if they are both fans).

Only extroverted people will initiate a request for either dates or profession-related activities. When an extrovert bumps into another person at a stage, if they like them and they share the same profession, they will request a profession-related activity. If the target is either extroverted, open or agreeable, they will accept the request and go on to do the activity at the stage.

Regardless of their profession, if one of them is extroverted and they have different genders (sadly, this simulation only considers heterosexual dates), the extroverted person will ask the other one out on a date. Similarly, if the other person is either extroverted, open or agreeable, they will accept the request and go on a date together.

Dates can be done in two ways: by splitting the bill or by one person paying for the whole bill. When two people who are either both young or both old, they will split the bill equally and will be considered as a regular date. If both parties have an age difference, the older person will pay the bill. These dates are considered sugar dates (from the terms "sugar daddy" and "sugar mommy", depending on the gender of the older person).

After each successful date or profession-based interaction, the liking of both people with respect to each other will increase by 10%. On the other hand, if a date or or profession-based interaction request is rejected, the liking of both people will decrease by 10%.

The criteria to consider that two people like each other is if the likeness value is above the parameter liking_share_threshold, which is between 0 and 1 and can be modified by the user as the simulation runs. If two people bump into each other at a stage for the first time, they will calculate their initial liking by calculating the differences between their personality traits. If the two people have all opposite traits, their liking will be 0 and, if they have the same traits, their liking will be 1. This is only calculated the first time they meet, but as they interact with each other either through dates or activities, their liking will change over time. If their liking is above the threshold, they will add each other to their "friend list".

2.2.3 Phone Calls

Whenever a person goes to a location to satisfy their desires, having the intention to do so, they will contact every person they have on the "friends list" (list of people they like) and recommend them to go to this specific location. This remote way of communication is done through the FIPA protocol.

When this happens, the receiver of the call will register this location in their beliefs as a location that has drinks, food or music, depending on the desire that was met by the caller. If they already have that location stored in their beliefs, the message will be disregarded. On the other hand if the receiver does not have the location stored, it will save it as a belief and a message indicating this will be written in the console.

Storing the location in its beliefs does not imply that the receiver will go to this place, but it will be a possible place to go in the future, if they have the intention of satisfying the particular need and they are near the location.

3. Experiments and Results

From the described approach we have considered the total liking of each individual person as a key metric to analyse the simulation run. This value is calculated for each person at every time step by adding all the liking values other people have of the particular person. This value represents how liked is an individual overall. By calculating this value for every individual we can later plot the change in this value over time for specific individuals, for example, by adding all of the total liking values for all extroverts.

On the other hand, we chose to keep track of relevant events, specifically, the number of successful dates, the number of profession-based activities and the number of rejections that all people have experienced in the simulation.On the following figure we can see how a typical simulation run has progressed through time:

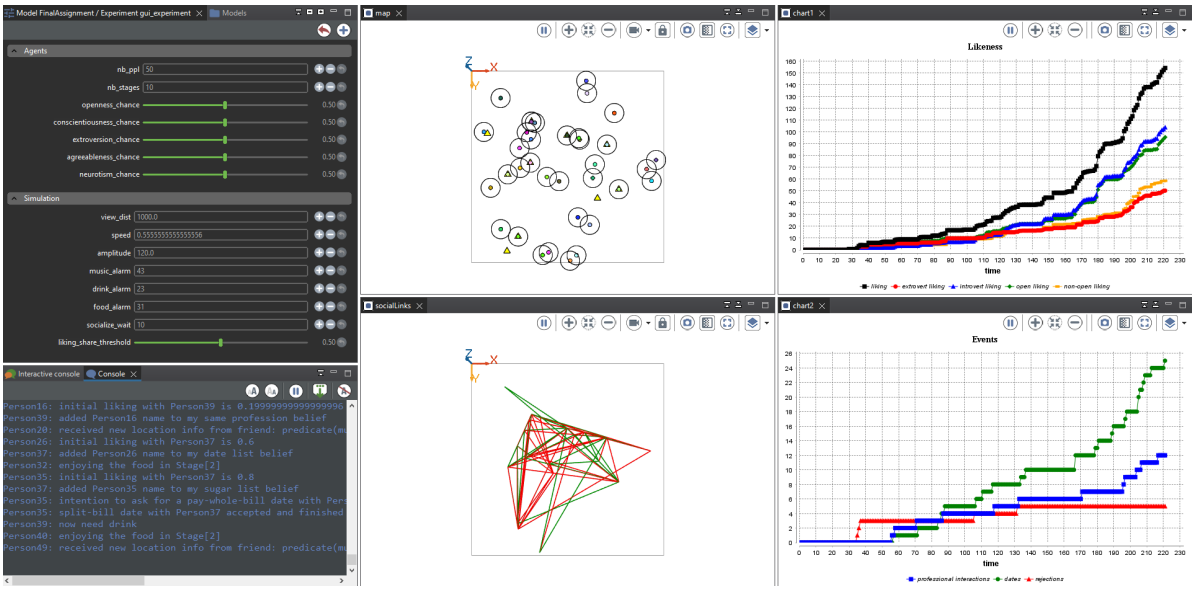

Figure 1: *Standard Simulation Run*

On the top left we can see the modifiable parameters that the user can change at the beginning of the run in the “Agents” tab and the ones that can be modified during the run in the “Simulation” tab.

At the bottom left we can see the console that logs every important event that occurs during the simulation. Here we can see when people’s needs are met, when new needs occur, when finding stages, when initial liking of new people is calculated, phone calls are done and locations are added by the receiver, when people are requesting a date or a profession-based activity and when either request is rejected or accepted.

In the top middle we can see a real time rendering of the people, depicted as circles with randomised colours, that can move about the simulation area and go to specific stages, which are depicted as yellow triangles. The circles around the people show their observing distance.

In the bottom middle, we can see a social link graph that shows how the relations between people are. When two individuals bump into each other and their liking is calculated, if it's above the liking threshold, their relationship will be shown as a green line that connects the position between these two individuals as they move, if they don't, it will be a red line.

On the right side of the figure we can see how the key metrics discussed above change over time as the simulation runs. At the top are the liking values of individuals, in black is the total liking for all individuals, in blue is the liking of all extroverted people, in green for all open minded people, in orange is for closed minded people and in red is for introverted people. At the bottom we can see another chart that shows the amount of dates in green, profession-based activities in blue and rejections in red.

In the next figure we can observe how these metrics change over time as the simulation runs for a very long time with the default values for every modifiable parameter (note that the above figure only ran for around 200 cycles, while the one at the bottom ran for about 1300 cycles):

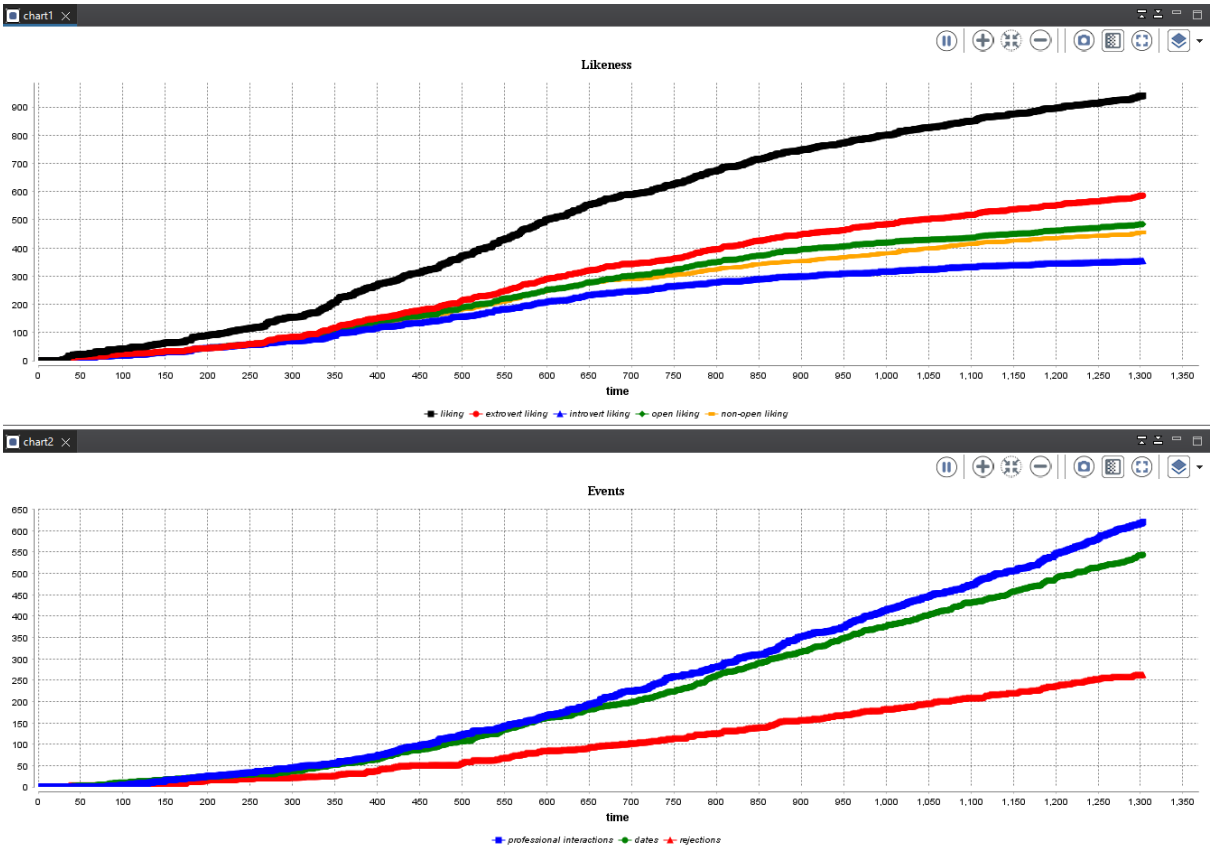

Figure 2: Default Simulation Metrics

On the following two images we can observe how the simulation results change as the liking threshold between individuals is changed, for runs that have elapsed around 400 simulation cycles. It is increased (harder for people to like each other) on the first image and decreased (easier for people to like each other) on the second image:

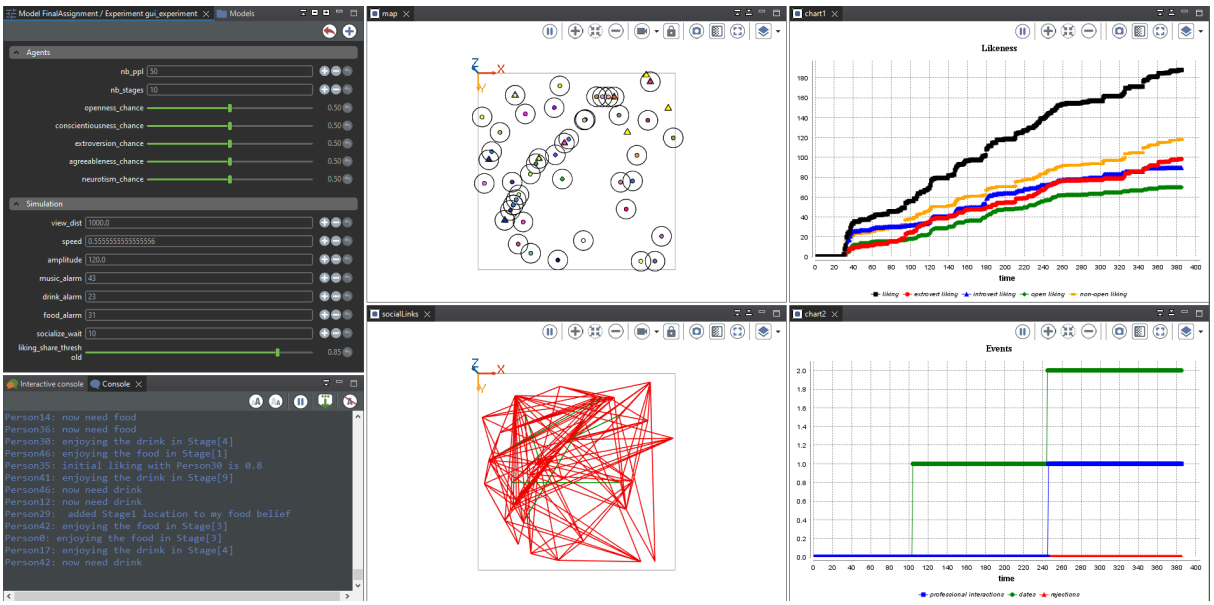

Figure 3: Increased Liking Threshold

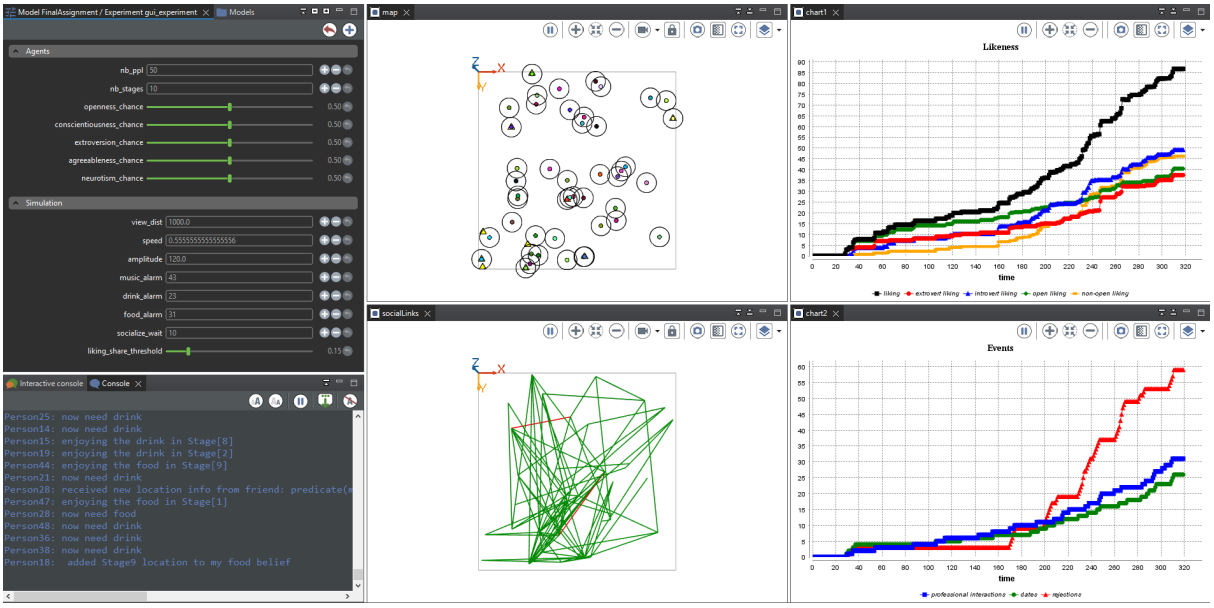

Figure 4: Decreased Liking Threshold

On the following two images we can observe how the simulation results change as the chance of individuals being extroverted and open changes, for runs that elapsed around 300 simulation cycles. The chance of individuals to be extroverted and open is increased on the first image and decreased on the second image:

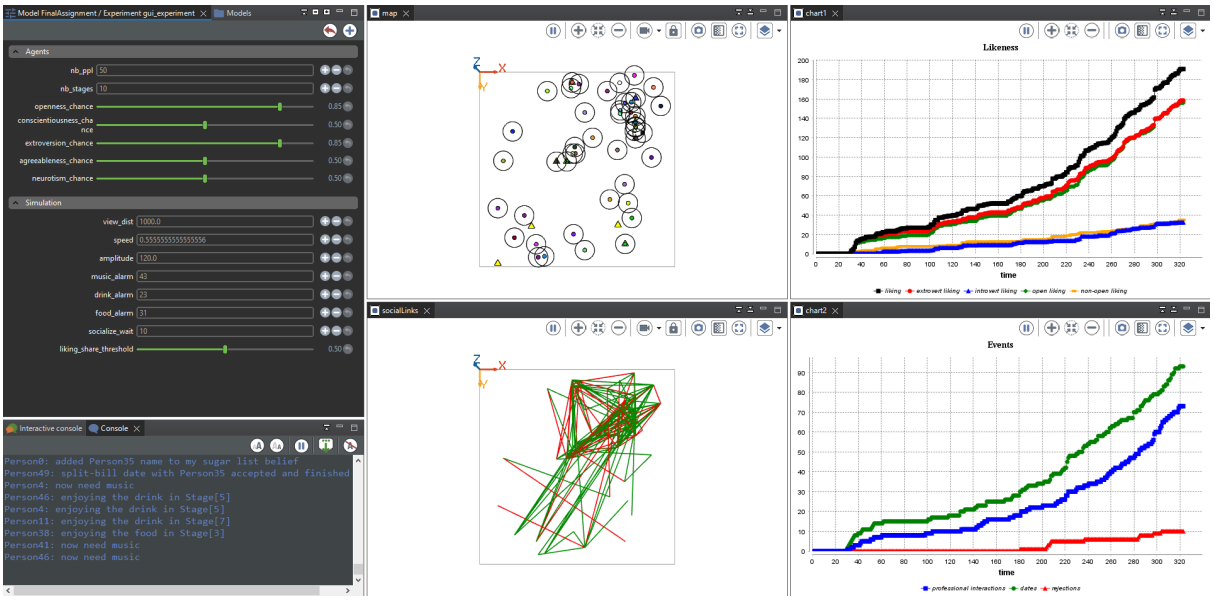

Figure 5: Higher Chance of Extraversion and Openness

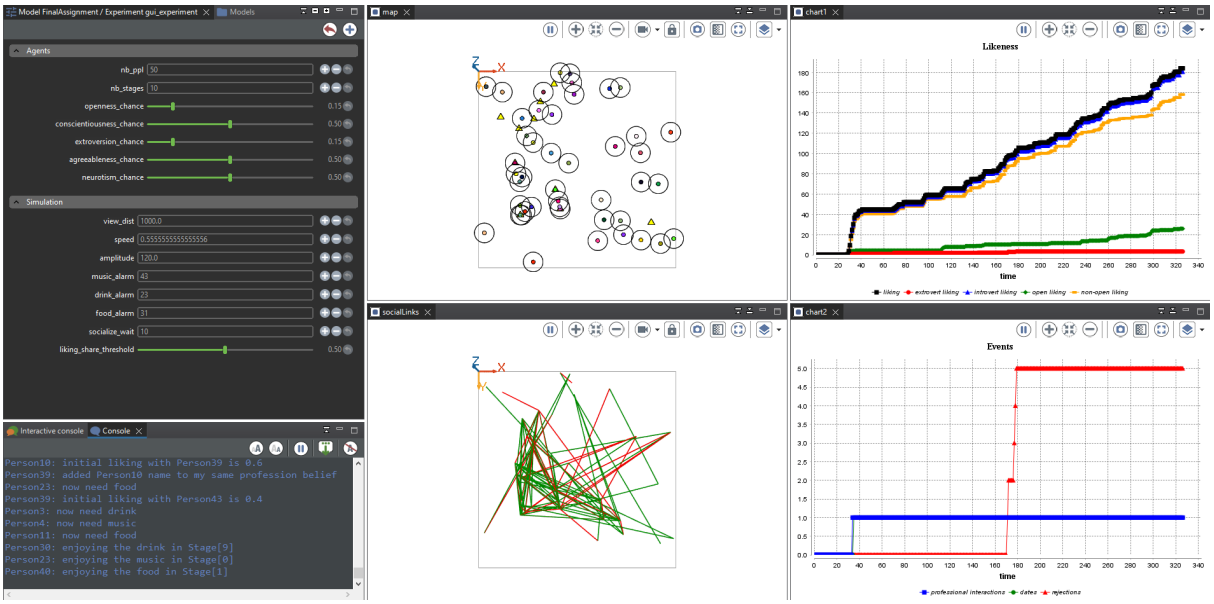

Figure 6: Lower Chance of Extraversion and Openness

4. Discussion and Conclusion

From this project we can observe a lot of interesting things. Firstly, with the help of GAMA and the simulation environment, we can create complex models to observe how individual agents can interact with each other in specific ways. By using the BDI model, we can simulate not only behaviours but also internal states through specific beliefs, desires and intentions, similar to how humans perceive themselves as they interact with their environment.

Through the development of this model we came to understand the complexity that comes with using explicit beliefs for every action that an agent can have. And, although it is a great modelling tool, using it for every aspect of the model for agents, it can make code longer and harder to read. In the future, a better approach would be to use the BDI infrastructure only when it would be particularly useful, and use simpler structures for the more superficial models.

What can be seen from the default simulation runs presented in figures 1 and 2, is that we can observe how there are two mechanics that govern how different personality traits end up being more liked or disliked. In the beginning, the individuals do not know each other, so as they begin to socialise and calculate their respective liking, the total value always goes up. This is because liking is a value between 0 and 1, so as they meet more people, even if they don't particularly like each other, their liking will go up. But, as time passes and they no longer meet new people, only previously met individuals, this value tends to stay constant.

The second mechanic comes from the interactions individuals who like each other will engage in. In this case extroverts are particularly important because they are the ones who initiate the requests, and only those who are either extroverts, open or agreeable will accept. As time goes on, the liking between different personality traits begins to separate as only some personality traits accept and increase their liking and others reject and decrease their liking. This will continue to play out until these extroverted individuals no longer like them and will not engage by inviting them to dates or profession-based activities. This behaviour can be seen clearly in figure 2.

By running several simulations for many cycles for different parameter configurations, we can see how these attributes change the way the relations between individuals develop, as can be seen in the figures presented in the results section.

By looking at figures 3 and 4 we can clearly see that the change in the liking threshold makes more people like each other in figure 3, which can be seen clearly in the bottom middle graph by the abundance of green lines. SImilarly, in figure 4, the abundance of red lines shows how most people don't consider they like each other.

If it is rare for people to like each other, the extroverts will rarely ask others out on dates or on other activities, which means these events, along with rejections, will be fairly low. This implies that the actual change in liking over time will be determined mostly by chance, depending on how the population was initialised.

On the other hand, if the liking threshold is low, the extroverts will ask others out more often, which increases the amount of activities, dates and rejections. This in turn will polarise the individuals into liking each other more with the ones that these events are successful and like each other less if they are rejected. This can be seen in the lower right graph in 4 by the surge of rejections that occur.

By looking at the figures 5 and 6, we can see how the amount of extroverts and open minded people change the simulation results quite drastically. First, by changing the chances of being a specific personality trait in any way, we are increasing the initial total liking that will be achieved, since it is calculated by the difference in the individuals' personality traits. By default every chance is 50%, so any change will make the population more homogeneous, and thus initial liking results will be higher.

On figure 5, the chance of being extroverted or open is increased, which gives a great advantage for extroverts. Not only do they find more people similar to them and thus attempt to ask for an event more often, but they will also get rejected a lot less. On the other hand, introverts, closed minded and non-agreeable people will get more requests than usual and, since they will always reject them, their liking will go down. These results can be seen in figure 5 by the high amount of extrovert and open liking compared to very low introvert and closed minded liking.

On figure 6 the opposite is true, so extroverts and open minded people are rare. In this scenario, extroverts will almost always be rejected by others, so their liking will constantly remain low. Open minded people do not initiate the requests, but will get asked very rarely, so their liking will not go up very quickly. Because of this, eventually extroverts will dislike most people and will mostly stop requesting events from others. This implies that most of the liking will be derived from the initial mechanic of meeting new people and comparing their traits. Since most people are initialised as introverts and closed-minded people, their liking will be much higher to the other counterparts, which is exactly what can be seen in figure 6.

Of course these are only some of the possible parameter changes that can be done in this simulation and, since there are so many parameters to modify, we have focused on the most relevant ones considering the importance of extroverts and liking. For further insight we invite the reader to try out the simulation with different parameter changes.

From this project we can conclude that asymmetrical social interactions with many actors can be very complex and can have counterintuitive results when viewed superficially, but that by analysing the mechanics by which they occur, they can be understood and can give relevant insight.

Because of this, the creation of models like this one to simulate complex systems is very delicate work and extensive testing is required to achieve proper results, along with the ability to compare the model with the real system that researchers intend to analyse, as to not overlook details that can make the system operate in a different manner.