Michela Apruzzese
Silvia Cicoira
Federica De Prospo

CLUBS AND SOCIAL INTERACTIONS

I. The theory of Club Goods

The theory of Club Goods was firstly developed by James M. Buchanan in the Sixties: he took under consideration the provision of this particular type of good, which has the nature of being non rival (or partially rival) but excludable.
Being non rival implies that, once the good is provided, its use from one consumer does not affect the quantity available for other consumers; being excludable implies that the benefits of such a good can be obtained only by becoming part of the Club. The payment of a membership fee is thus necessary in order to enjoy the benefits of the Club Good.
The notion of Club Good is close to the notion of Local Public Good, which has the same peculiarities of Public Good, except the excludability for those agents outside a certain geographical area. If we think about a local public good for which exclusion does not apply, then we will have free movements between localities and citizens preferences will be revealed on the basis of the place they choose to live (Tiebout Hypothesis).
Club Goods may suffer from congestion: it means that once the number of agents in a given club becomes higher that the optimal one, a rivalry problem may arise.
As with Pure Public Goods, the goal is to decide if the good has to be provided and in which quantity. Moreover also the size of the Club has to be found: adding a member reduces the costs but diminishes the benefits of the Club Good.
Going further, it is clear that not only the membership size is connected with congestion, but also the use of the Club Good by its members matters. Hence from a “Fixed Utilization” scheme, we need to move to a “Variable Utilization” scheme where we consider how frequently the facilities of the Club are used. In the first case efficiency is reached through the payment of a membership fee, while in the second case efficiency is reached through a “two-part tariff” (membership fee plus a charge for each visit).
The theory tells us that there is an important distinction between efficient Club membership small relative to the population and efficient Club membership large relative to the population. This is due to the difference between private optimal size for the club and social optimal size. If Club size is small the efficient outcome is an infinite population which can be divided into an infinite number of

small Clubs. In the second case the economy can support a limited number of large Clubs and the total population may be an integer multiple of optimal club size. The different outcomes may then be:

- a single Club with some population excluded
- a single Club with the entire population
- two equally sized Clubs
- two unequal Clubs

and the result depends on: costs of exclusion, congestion costs and benefits of optimality.
The goal of the Club Good Theory is to verify which is the equilibrium outcome in the sense of the optimal size of a club.
In particular it takes into consideration a Variable Utilization case: by assuming that all the Club members are homogeneous, the total use of a Club is the product of the total number of members times the visits they do. Therefore in a constrained utility maximization view, it is possible to find not only the optimal amount of Club Good (G*) and of club members (n*), but also the optimal amount of visits (price per visit*). With a membership price and no extra charge per visit, each member will choose the amount of its visits according to his own benefit, without considering the congestion cost on other members.

We will verify the effects of another tariff scheme, allowing for a two-part tariff composed of the membership fee plus an extra price for each visit. The theory is focusing on the optimal pricing scheme. We want to focus on the interaction of agents given a tariff scheme.

II. The simulation model

Introduction to the Simulation Model

The classical analysis of consumption describes individuals' optimal decision, given the behavior of other individuals when dealing with private goods. When dealing with public goods, it describes market failures and the optimal decision making process at the social level.

Instead, in our simulation model we aim to describe the movements of agents by taking as given the optimal amount of Club Good. In particular we want to verify the behavior of agents when they decide to join a Club and see how their interactions generate different outcomes when the different variables are changed.

The user of the program is able to set:

- the size of the population and the initial Club size;
- the fee to be payed by members and the periodicity of the payments;
- the agents probabilities to entry and exit;
- the initial costs and benefits.

Hence the program will define how those factors influence the movements of agents inside the Club and outside the Club.

The most important feature of our program is the introduction of a “social effect” which allows us to see how agents influence each other.

In our simulation we will take into account time, since it is very interesting to observe the dynamics of the simulation as time passes in order to see what Club members decide to do after one cycle (and why) and how non members decisions change as well. Also the space in which agents move is very important.

The rules of the game

We have decided that at every cycle the members have to pay a price per visit to use the Club facilities and a fixed fee with a certain periodicity; the latter has to be paid independently from the fact that they use the Club or not. The non members have to pay a price per visit if they want to visit the Club: this price is higher than the one of the members.

Differently from the theory, in our model we have introduced the possibility that agents move on the basis of a probability to entry and a probability to exit the Club: these probabilities are different for members and non members. The decision to join or not the Club can be implemented by an economic comparison which enforces the results of these probabilities. We also allow for the possibility to modify members' status once their benefit diminishes as a consequence of too high/too low Club participation and to modify non-members' status whereas they are convinced to become Club members.

The NetLogo model

Thanks to our model we are able to verify the Club Theory through an artificial application.

```
globals [space]

breed [agents agent]
agents-own [benefit cost]
```

Firstly we declare the global variable (space) for which there is only one value and every agent can access it. These variables are declared at the beginning of the Code tab, outside from any procedure definitions.

Then we create the only breed of the model; the breed agents is divided in agents with color yellow, representing the members of the Club and agents with color red representing the outsiders/nonmembers. The first input into the brackets defines the name of the agent-set associated to the breed. The second input defines the name of a single member of the breed. We also have two variables belonging to it (benefit and cost) which are replicated for each agent and that only agents have.

To setup

To setup defines the procedure named "setup", called in the graphical interface trough the so called button. This procedure sets up the initial state of the world. It creates the variables, the initial space, the patches and the turtles (agents in our model) used in our simulation.

```
to setup

   clear-all
   setup-patches
   setup-agents
   reset-ticks

end
```

Clear-all resets the world to an initial, empty state. All the patches turn black and every agent created disappears.

Setup-patches and setup-agents are two procedures that define the initial condition of patches and agents of our model.

Reset-ticks: with this procedure we are using the tick counter. In NetLogo models time passes in discrete steps, called “ticks”. Through the tick counter we can keep track of how many ticks have passed. The *tick* command in the go procedure advances the tick counter by 1. The *clear-all* command in the setup procedure clears the tick counter and the *reset-ticks* command starts the tick counter. The *tick* command also allows to update the view that in Netlogo can be continuous or tick-based.

End ends the procedure setup.

To setup-patches

```
to setup-patches

   ask patches [
     if pxcor >= 0 and pycor <= 0 [set pcolor green]
     if pxcor <= 0 and pycor <= 0 [set pcolor green]
     ]

end
```

We have divided the world in 2 areas: the Club is represented in green while the area outside the Club is represented in black.

The command *ask* is used to say to each patch to run the commands in the brackets.

To setup-agents

```
to setup-agents

   create-agents number-agents
   ask agents [
     setxy (-16 + random 33) (1 + random 16)
     set shape "person"
     set color red
     set benefit nonmembers-benefit
     set cost nonmembers-price-per-visit
     ]

    ask n-of number-members agents [
     setxy random-xcor random-ycor
     set color yellow
     set cost members-price-per-visit
     set benefit (members-benefit + (Fee / periodicity-of-fee))
     ]

end
```

Our agents are both members (yellow agents) and non members (red agents) of the club.

Firstly we have created agents as a number defined by the slider named “number-agents”. The agents start standing at the origin, the center of the patch (0,0). The agents can move in the direction set by the command *setxy* and can also enter the Club from the back of world. Then we ask agents to take the shape of a person, to became red, to move to the black space upwards in the world of NetLogo and to have benefit and cost defined by the two sliders in the Interface tab “nonmembers-benefit” and “nonmembers-price-per-visit”.

The same is for members (yellow agents), with the difference that, through the command *setxy random-xcor random-ycor,* each agent runs firstly the reporter *random-xcor* which will report a random number from the allowable range of agent coordinates along the x axis. Then each agent runs the reporter *random-ycor* same for the y axis. Finally each agent runs the *setxy* command with these two numbers as inputs, so the agents move to the point with these coordinates (randomly in the space of the world).

The number of members is set on the basis of the “number-members” slider and their cost is defined by the slider “members-price-per-visit”. Their benefit is given by the sum of two elements : the value of the slider “members-benefit” and the ratio between the value of the slider “Fee” (paid by members independently from the fact that they use the club or not) and the “periodicity-of-fee”, determined by another slider, which refers to the period (computed in number of days) in which members have to pay their fee during the simulation. The Fee is not paid by red agents because of their status of nonmembers. We have assumed different costs to join or not the Club and different benefits for both members and nonmembers.

At time 0 in fact we see that the non members are outside and the members are spread in the world: some members are “active” (they pay the fee and use the services of the club) but some other members are “lazy” (they are paying the fee but are not using the services of the club).

The setup of the model is quite well representative of the real world: take as an example a gym where some people go often and other go only once.

To go

The *go* procedure, called by the relative button in the Interface tab, is used to start the simulation, to move agents and to change the state of patches. Usually it contains the instructions to run only once the simulation, but if we press on forever, this button repeats the actions until we don't press again the button “go”.

```
to go

   move-agents
   modify-status
   do-plots
   tick

end
```

In this case the go procedure contains three other procedures: move-agents, modify-status and do-plots.

We have set the procedures *move-agents* and *modify-status.*

We have set the entry/ exit probabilities of all agents.

Tick advances the tick counter by one tick.

To move-agents

When we start the model the agents start moving as indicated by he procedure move-agents.

The ratio behind their decision to go inside or outside the club is determined by:

- an economic comparison or
- a probability.

Let us go deeper.

When the economic comparison switcher is activated (so it is on) the agents move according to their cost-benefit analysis and according to their probabilities to enter and exit.

- The non-members' benefit is determined by the user through a slider. Its cost is set by the slider “nonmembers-price-per-visit”. This represents the price per visit a non member should pay every time he uses the service.
- For the members of the Club rules are slightly different. They pay a fee (e. g. 60 Euros every 30 days, both the Fee and the periodicity-of-fee are set by the user via the sliders in the interface) in order to be members of the Club and take advantage of some privileges. In our case the cost per visit a member must pay to use the services of the Club is determined by the slider “members-price-per-visit” (we have set it considering that non-members should pay more than members for a visit so that the members' incentive to pay the fee is effective). The benefit of a member of the Club is determined through a slider by the user; moreover also the Fee divided the number of days that are passed from the last payment of the fee is to be added to the benefits of a member.

If the total benefits of a visit of a non-member are greater than the cost for each visit, the non-members will move in the Club. Otherwise he will remain outside the Club.

If the total benefits plus the ratio (Fee / periodicity-of-fee) of a member are greater than the costs, members will go in the Club and the incentives we have designed are such that also the lazy members prefer to go in the Club.

We can notice that the simulation mixes the actions made by agents because when the switcher “economic-comparison” is activated the agents probabilities are enforced by the economic comparison criterion: the program considers both the economic comparison based on the cost-benefit analysis and the agents' probabilities to entry and to exit. This is done in order to have a larger range of cases to discuss and analyze, even though the use of economic-comparison switcher does not improve the probabilistic result with unexpected outcomes.

When the “economic comparison” switcher is dis-activated (it is off) the criteria of visiting the Club is just a probability: the user of the program has the possibility to set the probability through some sliders.

The rule is very simple: every agent move on the basis of where he is. If an agent is outside the Club and its probability to enter is high, then he will enter the Club. The opposite will occur if its probability to exit is high and he is inside the Club.

In sum:

- On one hand we ask members which are into the Club to exit from the Club (and to go in the black space outside the club) if they have an high probability to exit . In addition, if the switch labeled “economic-comparison?” is “on” (the comparison is true) this probability is enforced by the economic-evaluation.

- On the other hand members that are outside the Club (in the black space), the so-called “lazy-members” will have an incentive to move inside the Club if their probability to enter is high.

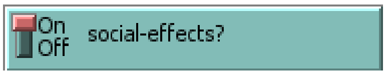
- The same line of reasoning is applied to red agents (nonmembers) that want to enter and exit the Club. The difference with respect to the previous cases is that in the economic evaluation, activated when the switch in on, nonmembers compare their cost (nonmembers-price-per-visit) only with their benefit (without considering the fee).

```
to move-agents

  ask agents with [color = yellow and pcolor = green] [
     if random-float 1 < members-prob-exit
     or (economic-comparison? and random 50 < members-price-per-visit
     and random 50 >= members-benefit + (Fee / periodicity-of-fee))[move-to patch (-16 + random 33)(1 + random 16)]
     ]

   ask agents with [color = yellow and pcolor = black] [
     if random-float 1 < members-prob-enter
     or (economic-comparison? and random 50 > members-price-per-visit
     and random 50 <= members-benefit + (Fee / periodicity-of-fee))[move-to patch (-16 + random 33)(-1 - random 16)]
     ]

   ask agents with [color = red and pcolor = green] [
     if random-float 1 < nonmembers-prob-exit
     or (economic-comparison? and random 50 < nonmembers-price-per-visit
     and random 50 >= nonmembers-benefit) [move-to patch (-16 + random 33)(1 + random 16)]
     ]

   ask agents with [color = red and pcolor = black] [
     if random-float 1 < nonmembers-prob-enter
     or (economic-comparison? and random 50 > nonmembers-price-per-visit
     and random 50 <= nonmembers-benefit) [move-to patch (-16 + random 33)(-1 - random 16)]
     ]

end
```

The probabilities to enter and to exit and the economic decisions are individual choices for all agents. If the probability to enter is greater or equal to a random float number between 0 and 1, then agents (both members and nonmembers) enter into the Club or they exit from the Club if the probability to exit of both type of agents is greater or equal to a random float between 0 and 1. In the case of the economic comparison, agents enter into the Club if the switcher “economic-comparison?” is activated and if the price-per-visit is lower or equal to a random number between 0 and 50 and the benefit is greater than the random float from 0 to 50. This is valid for members and nonmembers. The opposite occurs when benefit is lower than the random number between 0 and 50 and the price-per-visit is greater or equal to the same random number.

To modify-status

With this procedure we have introduced a useful criterion to join or not to join the Club. Sometimes there are social conditions that influence the decisions of agents about their belonging to the Club and in this case we want to analyze the effect of these conditions.



The switcher "social-effects?" represents the effects of social conditions. If it is activated two things may occur:

1. if there are a lot of yellow agents (members) near to red agents (nonmembers), outside the Club, nonmembers are influenced: they become members (changing their color from red to yellow) and they want to join the club on the basis of the members' preferences introduced by the move-agents procedure.

The command:

```
ask agents with [color = red and pcolor = black] [
  if social-effects? and any? agents with [color = yellow and pcolor = black] in-radius 2 [
    set color yellow
    ]
  ]
```

allows members (yellow agents) to convince non members (red agents) to become Club members if they are placed outside the Club (black patch) and if they surround the non members at a certain distance (in this case *in-radius 2*).

2. If in the Club there is a big number of agents (greater or equal to half of the total agents) or a small number of agents (lower or equal to one fifth of the total agents), some members become red (they turn nonmembers) and they move accordingly to they procedure defined in *move-agents*.

```
ask agents with [color = yellow and pcolor = green] [
  if social-effects? and count agents with [pcolor = green] >= (number-agents / 2) [
    set color red
    set nonmembers-benefit random 10
    set members-benefit random 10
    ]
  ]

 ask agents with [color = yellow and pcolor = green] [
  if social-effects? and count agents with [pcolor = green] <= (number-agents / 15) [
    set color red
    set nonmembers-benefit random 10
    set members-benefit random 10
    ]
  ]
```

When agents using the Club are a lot, this create a congestion phenomenon: a Club good cannot be used by every one because if the users are too many the benefit of agents staying into the Club reduces to a low random number between 0 and 10.

When agents are few, no one has an incentive to stay into the Club and so members want to exit on the basis of their preferences and also in this case the utility of agents reduces to a low random number between 0 and 10.

To do plots

It is the procedure that allows to create and to update a graph.

In our model we have two graphs: one showing the total number of members (into the Club and outside the Club) for each tick, and the second graph showing the total number of nonmembers (into the Club and outside the Club) for each tick.

```
to do-plots

   set-current-plot "total members"
   set-current-plot-pen "members in club"
   plot count agents with [color = yellow and pcolor = green]
   set-current-plot-pen "members outside club"
   plot count agents with [color = yellow and pcolor = black]

   set-current-plot "total nonmembers"
   set-current-plot-pen "nonmembers in club"
   plot count agents with [color = red and pcolor = green]
   set-current-plot-pen "nonmembers outside club"
   plot count agents with [color = red and pcolor = black]

end
```

We have first set the graph for members: after setting the plot we have defined the pen describing members inside the Club and the pen describing members outside the Club. We have done the same for the graph for non members.

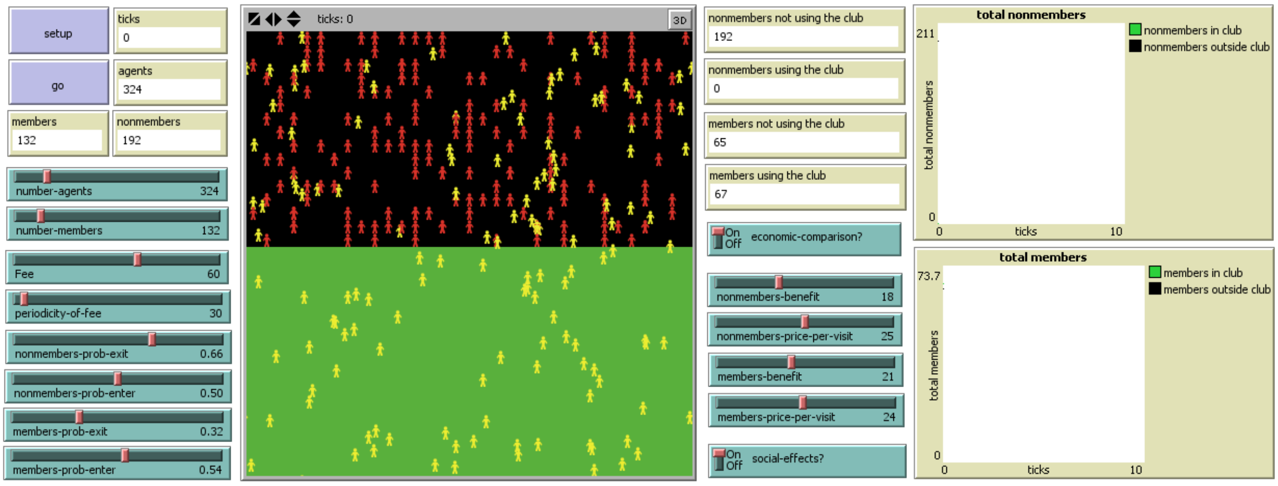
Thanks to these two graph we are able to verify the evolution of Club size as the time goes by. Therefore we are able to compare the behavior of the two types of agents in different situations.

Interface tab

In the interface we have:

- monitors which show the value of every variable and control the updates;
- the buttons “setup” and “go” to set the world and to run the simulation;
- sliders that represent a rapid way to change the values of the different variables without the need to set every time the procedure. By moving the slider, the user can see what happens into the model;
- switchers that allow us to view or not the action specified in the code;
- two plots: one showing the total number of members (into the Club and outside the Club represented by a black and a green line) for each tick. The second plot shows the total number of nonmembers (into the Club and outside the Club represented by a black and a green line) for each tick.

The view of the model is on the continuous mode.



setup
ticks
0
go
agents
324
members
132
nonmembers
192
number-agents 324
number-members 132
Fee 60
periodicity-of-fee 30
nonmembers-prob-exit 0.66
nonmembers-prob-enter 0.50
members-prob-exit 0.32
members-prob-enter 0.54
ticks: 0
3D
nonmembers not using the club
192
nonmembers using the club
0
members not using the club
65
members using the club
67
On Off economic-comparison?
nonmembers-benefit 18
nonmembers-price-per-visit 25
members-benefit 21
members-price-per-visit 24
On Off social-effects?
total nonmembers
nonmembers in club
nonmembers outside club
211
total nonmembers
0
0
ticks
10
total members
members in club
members outside club
73.7
total members
0
0
ticks
10

III. Experiments

a. Basic model

We can start to use the program through a basic model. We will set all variables as we expect them to be. In fact we expect members to have higher probability to entry that to exit the club and non members to have higher probability to exit than to entry. Following the same line of reasoning we expect members to have benefits higher than costs and viceversa non members to have lower benefits than costs. We'll set the initial number of members as half of the total population (e.g. 150 members over 300 agents) and a monthly fee of 50 euros.

1. **all switchers off**

   member-prob-entry > member-prob-exit

   non-member-prob-entry < non-member-prob-exit

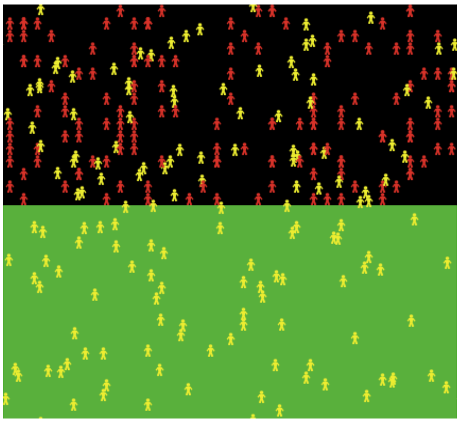
   number agents = 300

   number-member = 150

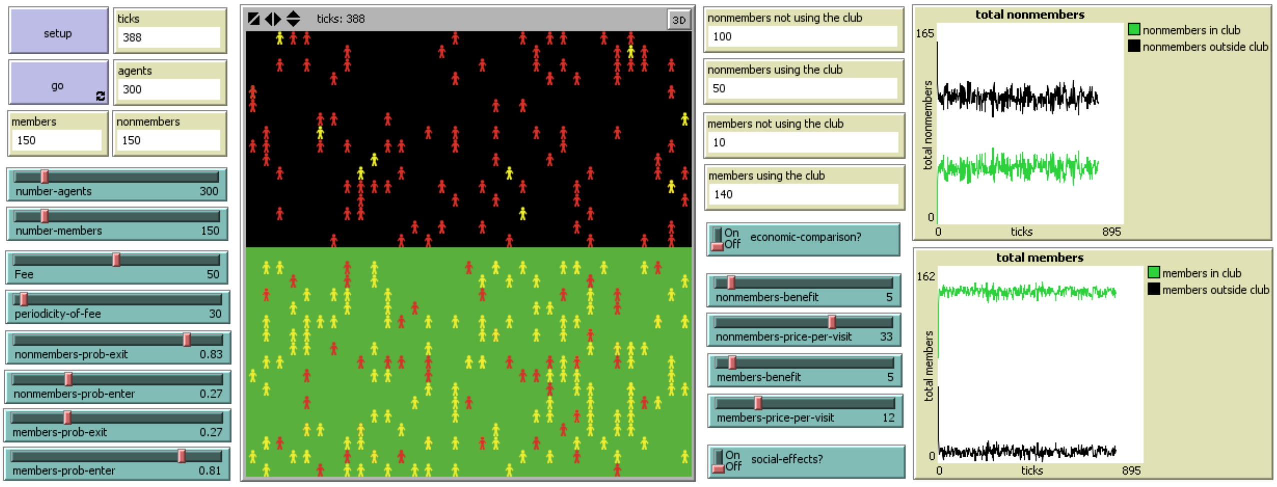
   fee = 50

   periodicity = 30 days

Let us see what happens to our model when we keep all switchers off and we consider only agents' probabilities.



setup



As we can see in the images, from the initial situation where we have the population randomly spread around the NetLogo space, with non members outside the club, we pass to a situation where non members enter the Club according to their probabilities and members stay mostly in the Club, except those "lazy" members that prefer to stay outside.

Let us see what happens when we turn the "economic comparison" switcher On, keeping the variables as before and adding a cost-benefit structure already defined before.

2. **economic-comparison = on**

   members-prob-entry > members-prob-exit

   nonmembers-prob-entry < nonmembers-prob-exit

   members-benefit > members-price-per-visit

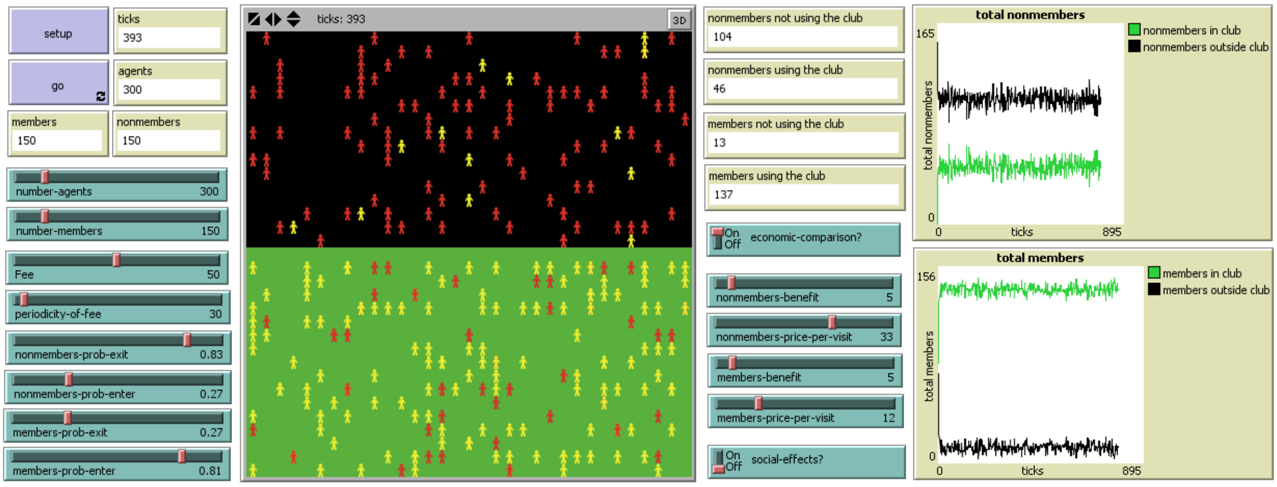
   nonmembers-benefit < nonmembers-price-per-visit

   number agents = 300

   number-members = 150

   fee = 50

   periodicity = 30 days



Not many differences occur with respect to the previous experiment: this is due to the fact that the cost-benefit analysis goes in the same direction as the probability system. If we design the probabilities and the costs-benefits differently, we would have another result. We will go through this case in the following experiments. Now we want to explain as the program works with the most simple assumptions.

Let us add the switcher "social-effects" and let us see how the social interaction modifies the simple model.

3. **economic-comparison = on**

   social-effects = on

   members-prob-entry > members-prob-exit

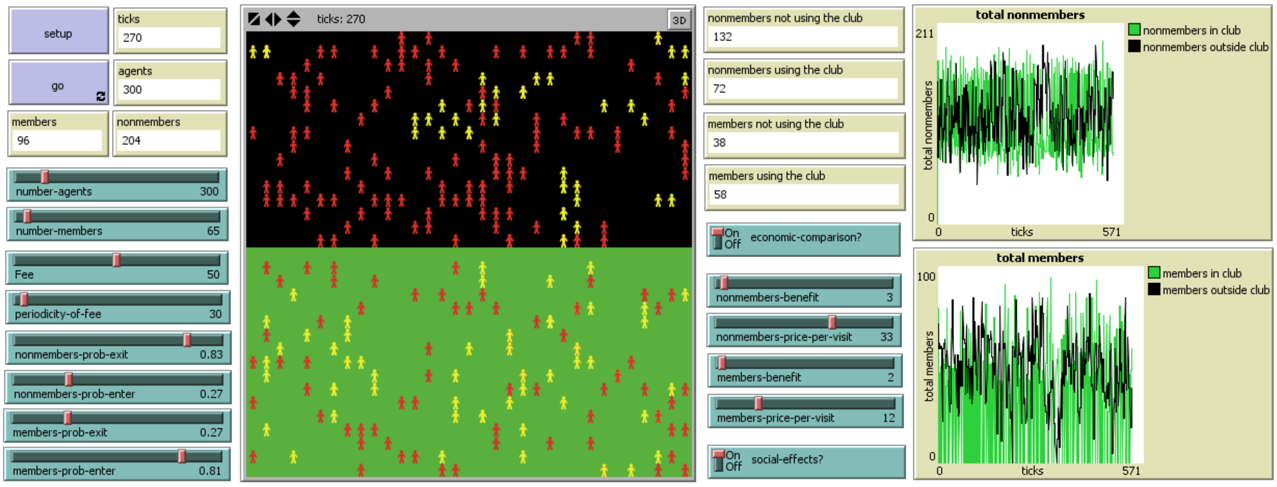
   nonmembers-prob-entry < nonmembers-prob-exit

   number agents = 300

   number-members = 150

   fee = 50

   periodicity = 30 days



Now things are very different: social interaction adds to the model something new.
The number of members changes as the non members change status when they are convinced to join the club. At the same time the number of the people that use the club remains below the amount that would cause congestion. The members change status when too many agents start using the club: they become non members and exit the club because their benefit reduces and become lower than the price-per-visit.
This mechanism allows for an efficient use of the club and everybody is happy with his situation.

b. Effect of the fee on member-benefit

We can start analyzing some more interesting cases. We will see how the benefit mechanism we have designed is useful to separate the members and the non members.
We can isolate the cost-benefit system by setting all probabilities equal to zero.

First, consider the case of members benefits greater than their cost and non members benefits lower than their costs.

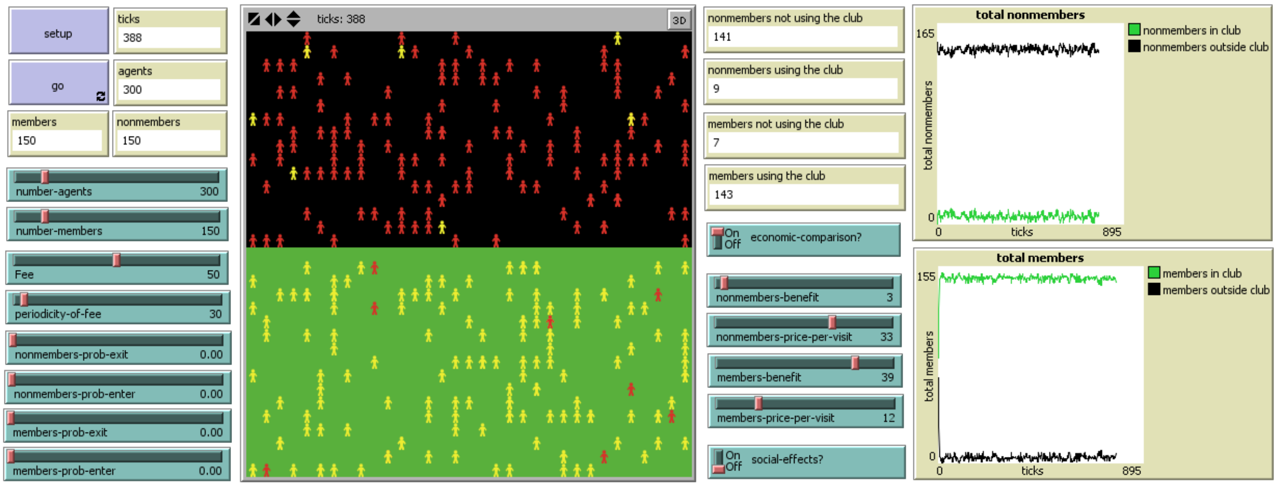
4. **economic-comparison = on**

   social-effects = off

   all probabilities = 0

   members-benefit > members-price-per-visit

   non-member-benefit < non-member-price-per-visit



When agents behave accordingly to their costs-benefits comparison the result that we have imagined is stronger than in situation number 2: almost all members are in the club and almost all non members are outside the club.

We can therefore see what happens if we set for each agents benefits equal to costs.

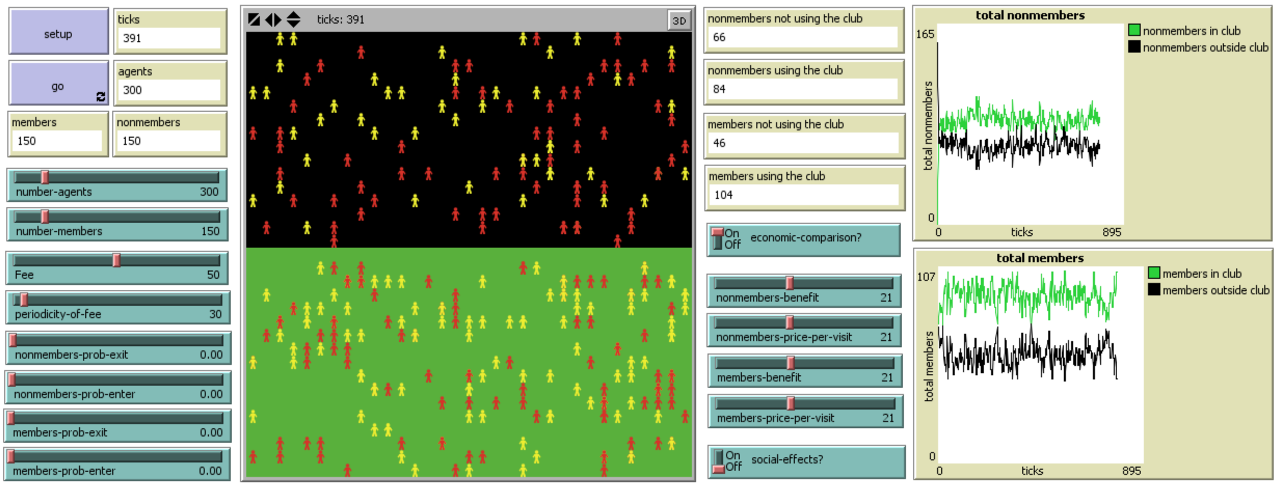
5. **economic-comparison = on**

   social-effects = off

   all probabilities = 0

   members-benefit = members-price-per-visit

   non-member-benefit = non-member-price-per-visit



While the proportion of non members using the club tends to be equal to the proportion of non members not using the club, we notice that the proportion of members using the club is greater than

the proportion of members not using the club. This is due to the fact that members have higher incentive to use the club because they have been paying the membership fee.
We have the counter-proof of this element if we increase the amount of money to be payed every month to use the club.

6. **economic-comparison = on**

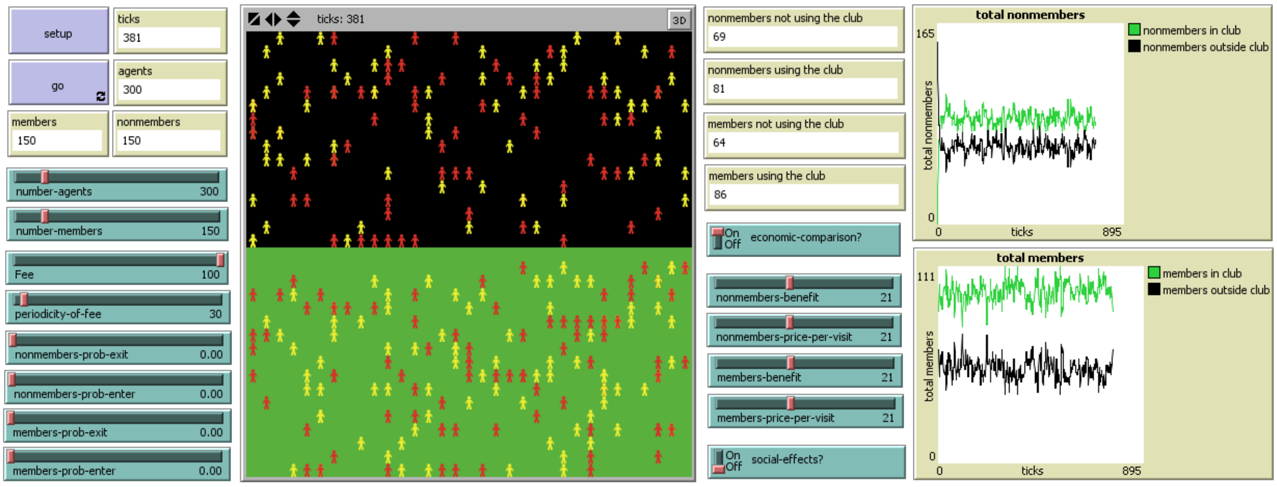
   social-effects = off

   all probabilities = 0

   members-benefit = members-price-per-visit

   non-member-benefit = non-member-price-per-visit

   Fee = 100



It is clear that the highest if the fee, the greatest is the incentive for members to visit the club.
We have the evidence of this if we think about a person who has payed the monthly fee to the gym: having payed, it is better to go often to the gym and make money "flourish" than loosing them by staying at home!

c. Social persuasion effect

7. **for all agents benefit = 0**

   all probabilities = 0

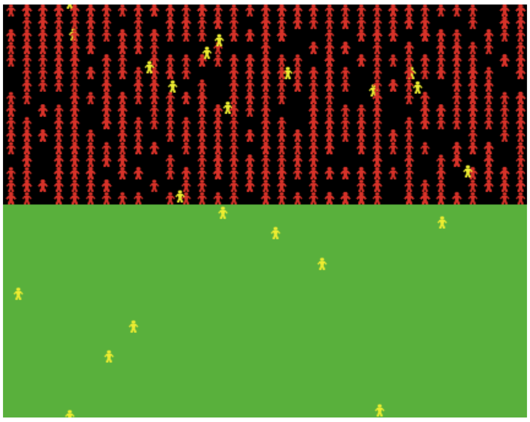
   economic-comparison = on

   social-effects = on

   Fee = 72 euros

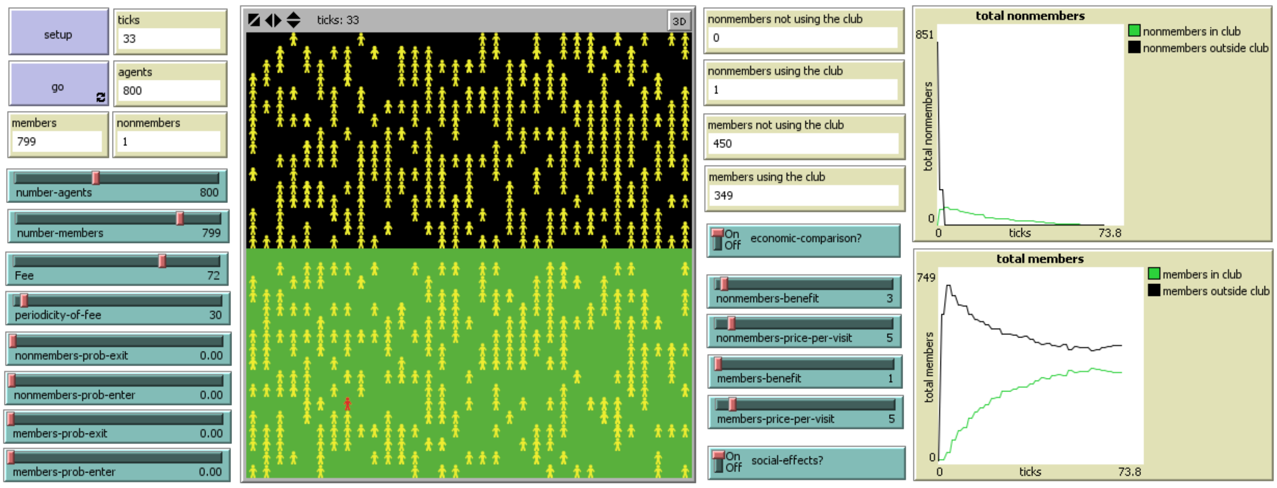
Imagine a club where the most you go, the less you obtain (for your wallet, or for your reputation, or for your health). Assume the choice is between smoking and not smoking (smoking can be assimilated to a "bad" club). Its consumption is not beneficial for anybody and costly for all in terms of health. Being a smoker of cigarettes implies a monthly cost of 72 Euros (the "fee"). Non members are the non smokers while members are the smokers. Assume that we are in a school of about 800 students and at the beginning of the year only very few students smoke (around 20). The green area is the place where these "bad" students usually hide themselves for smoking: they look very cool because they look older and when they go around the school for smoking(black area) other students may want to be like them (social effect). If they try a cigarette they become addicted very fast.

This is the initial situation:



The smokers do not hide them selves all together, sometimes they smoke in the public places of the school (e. g. in the toilets if it is raining).

Let us verify what will be the outcome after one year of school:



Given our assumption that bad habits are easy to get, we see that all students are now smokers. This

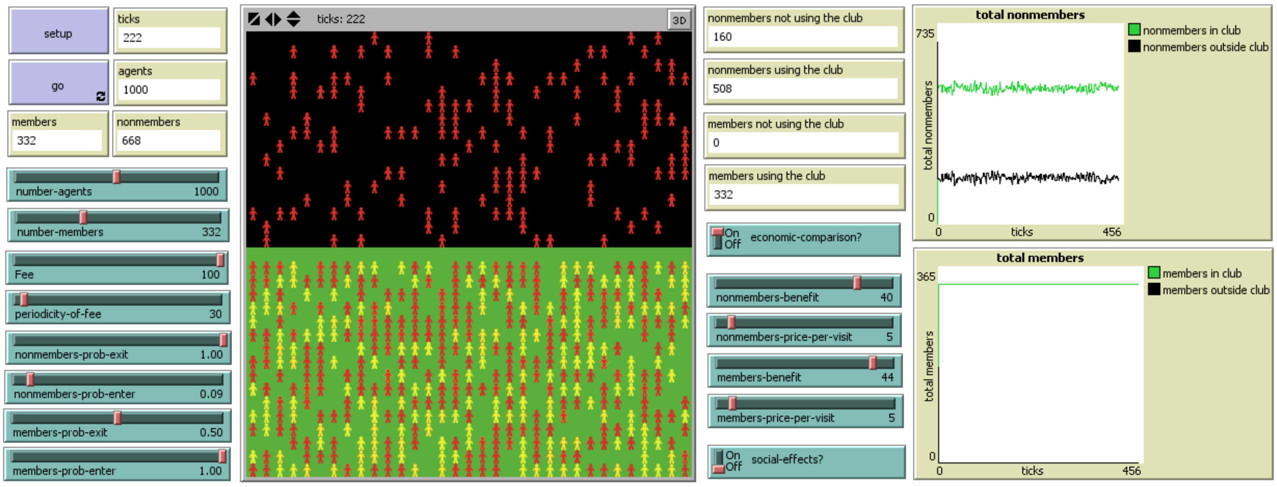
is due to the fact that is easy to be convinced. Notice that the secret place now is not secret anymore: instead the smoking area is full because it has become normal to use this place of the school. The number of non smokers gradually decrease, even though some smoker decide to try to quit smoking. Unfortunately they do not succeed. As a result: number of non smokers tends to one, number of smokers tends to be equal to the whole population and smokers in the smoking area tends to be equal to the number of smokers around the school. An interesting feature is that while members benefit has remained zero, the non-member benefit is increased. This may be due to many factors, such as the increased utility deriving from the fact the the only non smoker becomes the favorite pupil of the teachers.
Given this terrific situation, the school director should undertake some educational action such as: detecting from the principle the smokers, allowing the smokers since the beginning to smoke in a given area of the school, and strictly forbid to smoke outside that area. Moreover the school should educate all students to think with their own head and not changing behavior in order to be “cool”.

d. Super beneficial club

Imagine a State where taxation is convenient, weather is mite, prices are low and social welfare works. It looks like the perfect country to live: unfortunately, there are very strict rules about immigration. If an immigrate enters the country and police discovers him, he will be sent back the day after. The probability to enter the Country for a citizen is maximum: for sure he will be allowed to enter his home place. The probability to exit for a citizen is 50 per cent (they may wish to move abroad). The rules for non citizens are different: very low probability to enter (few possibilities to be accepted) and maximum probability to exit (it is illegal for immigrates to remain the country). The fee is to be meant as the local tax to be payed on a monthly basis (100 Euros). The number of citizens is about a third of the total population and they are allowed to travel.

.

8. **economic-comparison = on**
   non-members-prob-entry = 0
   non-members-prob-exit = 1
   members-prob-enter= 1
   member-prob-exit = 0.50
   benefit > price-per-visit for each agent
   social-effects = off



As time goes by we can see that even though the members probability to exit is maximum, they still prefer to go in the “dream” country. The benefit they wish to obtain is dominant in their choice. The citizens, then, prefer to remain in their country, since the benefit abroad is not as good as in their home place. We can interpret the non citizens remaining outside as being bind to their home country by some strict contract.

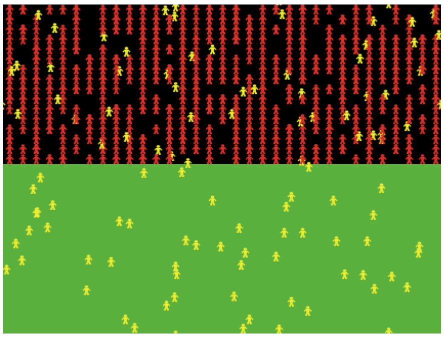
Given the strong affluence to the “Club-Country”, policymakers should think about some regulation in order to facilitate integration of immigrants since, even with their strict anti-immigration rules, they are not able to “eliminate” the problem.

e. Clubs and sustainable lifestyle

Let us assume that the club good is not exclude but rival : it means that the fee is zero. Rivalry occurs when there are too many agents in the Club, but also agents dislike the club whenever few people are in the Club.

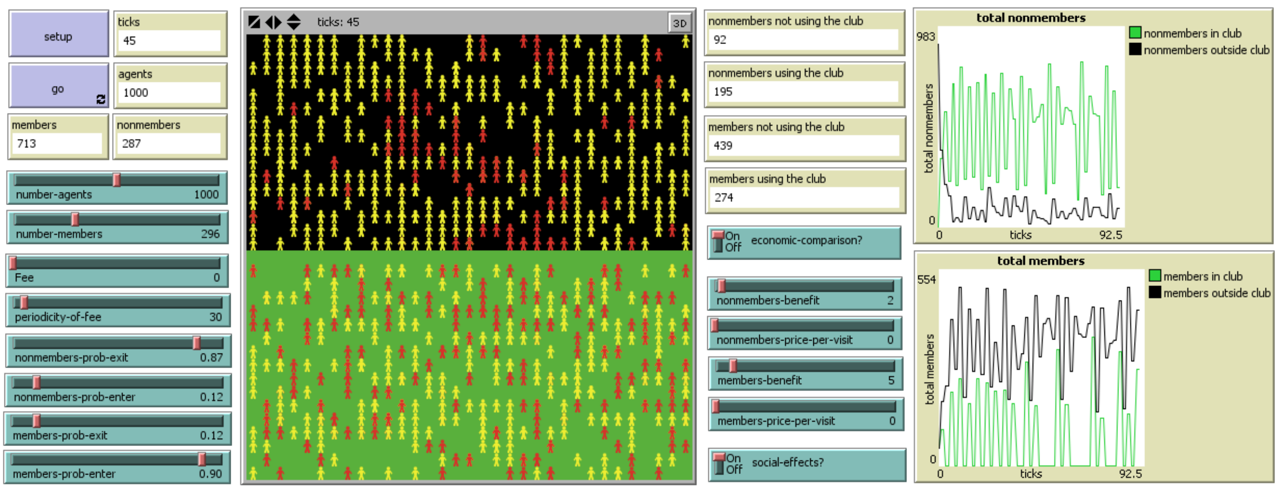
This is what happens in those communities where no taxes have to be payed and individual income is given by a share of the product of the land. If there are few people, the workforce is not enough and no production occur. Hence if there are too many people individual income decreases (the benefit of the lower personal effort is off-set by the reduction in income). Viceregal no production implies subsistence income and lower benefit. In the both cases the people of the village look for another place to leave. Assume the Club is the village, the red agents are the visitors and the yellow agents are the villagers. No taxes is equivalent to fee equal to zero and all agents cost-benefit analysis will be equivalent: we assume zero costs and positive benefits for everybody. Probabilities represent personal preferences: villagers are assumed to be born in the village (probability to entry is very high), and they exit with very low probability. Visitors enter the village with low probability (it is an unconventional experience), end exit with high probability (they are more likely to return to their normal life). Let us set a low number of initial villagers (but greater than 1/15 of the total population) and an high population size (around 1000) and let us assume that villagers outside convince other people to become a villager.

9. **Economic-comparison = On**
   social-effects = On
   Fee = 0
   price-per-visit = 0 for all agents
   members-benefit > nonmembers-benefit > 0
   members-prob-enter = very high
   members-prob-exit = low
   nonmembers-prob-entry = low
   nonmembers-prob-exit = high



setup

At time zero only villagers are in the village and some of them is outside, in order to find new people that want to join their cause.



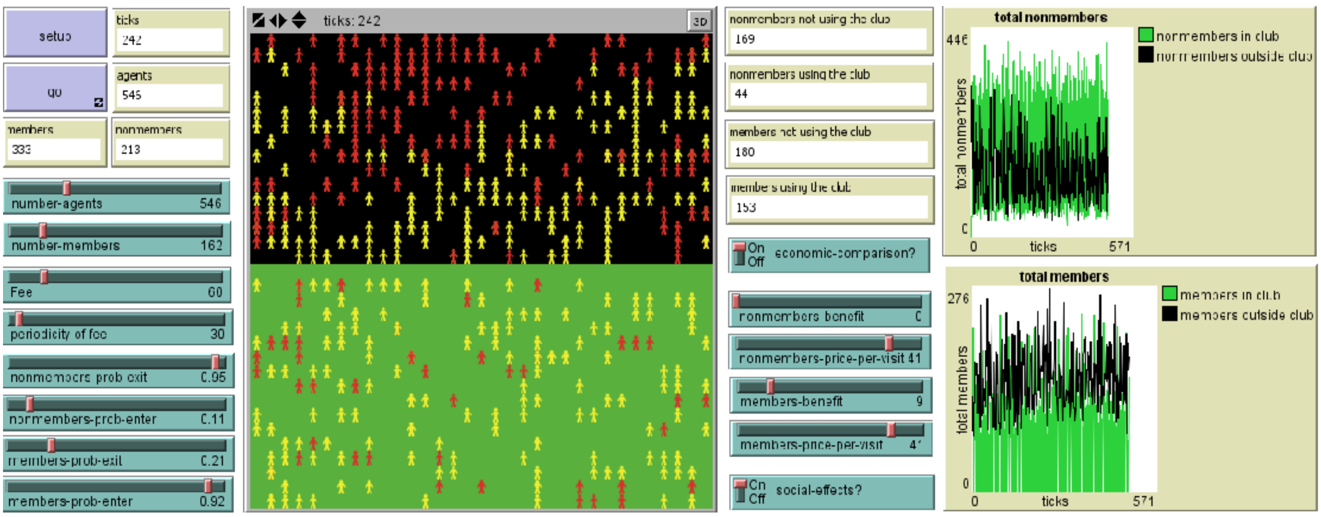
After some time we can see that there are continuous movements of members and non members in and out the village and they change status very often. This is due to the interactions that we have defined above. We can notice that the benefits change as a function of the number of agents that live in the village, but it remains always positive. From this example we can conclude that a positive externalize has been created: as people move in and out the village more awareness about a new, more sustainable lifestyle has been spreading between the population and more people start behaving more Eco-friendly.

f. Social influence of members on non members

We can imagine a situation where members of a club try to influence with their values and their ideology non members that are outside the club and are not very interested in attending the club and its believes . An example can be the case of individuals that want to improve environmental causes or policies against smoking and try to influence who is not interested in. The experiment shows that the influence on non member is higher where there is a major concentration of members.

10. number-agents = 500
number-members = 300
nonmembers-prob-exit = 0.95
nonmembers-prob-enter = 0.10
members-prob-exit = 0.20
members-prob-enter = 0.90
economic-comparison = on
nonmembers-benefit < nonmembers-price-per-visit
member-benefit > members-price-per-visit
social-effects = on
fee = 60
periodicity-of-fee = 30

In this experiment we can analyze the effect of the congestion when into the club there are too many agents but also a low number of agents. Initially, the members they tend to enter into the club. The nonmembers go outside the club for the effect of the probability to exit and because the nonmembers cost is higher than the nonmembers benefit, therefore they have a low incentive to stay into the club. Only few non members enter the club, but this creates a congestion problem because the number of agents into the club becomes too high, there are a lot of members in the club and also some nonmembers. As a consequence of the congestion, some yellow agents become red (they dissociate and from members they change their status into non members), so they move outside the club according to their probabilities and the economic comparison. The same occurs when into the club remains a low number of members. With the congestion we have a reduction of the benefit of both members and nonmembers, that move below the price per visit of both type of agents. Therefore according to economic comparison, after the congestion, both members and nonmembers want to move outside the club. Once outside the club, red agents are influenced by yellow agents: this is the social effect represented by the influence that members con have on nonmembers outside the club. Then when red agents, influenced by yellow agents, become yellow after changing their status, they move according to their probabilities and the economic comparison. We can notice that the social effect on red agents is higher where there is an high concentration of yellow agents around red agents outside the club. In the two graphs representing the total number of members and nonmembers into and outside the club (respectively green line and black line), we can see that initially we have two separated lines with the green line above the black one in the graph of total nonmembers, whereas we have the opposite in the graph of total members. Then the difference between the two lines reduces, the level of total nonmembers outside the club remains lower than the level of nonmembers into the club (the black line is below the green line but with large fluctuations), whereas the members outside and inside the club are almost one half. Going on with the simulation the two lines became two dense blocks.



g. Congestion with a low number of agents and weak social influence

We can assume a situation in which there are few members into the club and few agents. In this case there is a very low incentive to go and to attend the club for non members and also the benefit for members attending the club is lower because, for example, when there are few individuals attending a gym or a social club in which people go to share interests or to socialize or to share hobbies, with a low number of persons the function of the club is compromised and therefore individuals tend to leave the club or not to go into. In a situation like this, the social influence of members on nonmembers outside the club is weak, and at the end the reduction of the benefit due to the presence of a low number of agents into the club, creates for agents, an incentive to go outside the club.

11. **number-agents = 30**
    number-members = 10
    nonmembers-prob-exit = 0.90
    nonmembers-prob-enter = 0.05
    members-prob-exit = 0.60
    members-prob-enter = 0.70
    economic-comparison = off
    social-effects = on
    fee = 60
    periodicity-of-fee = 30

In this experiment we can notice that the red agents tend to move outside the club according to their probabilities to enter and to exit (in this case the economic comparison is irrelevant since the relative switch is not activated), whereas members move outside and inside the club according to the very low difference between their probabilities to enter and to exit into and from the club. Then when the number of agents into the club is low (is 1/15 of the total agents into the club), it occurs the congestion effect with a low number of agents using the club. So yellow agents become red agents (they dissociate from their status because the incentive to remain a member using the club is very low) and they move according to the probabilities of red agents. Once outside the club, red agents are influenced by yellow agents: this is the social effect represented by the influence that members con have on nonmembers outside the club. Then when red agents, influenced by yellow agents, became yellow after changing their status, they move according to the probabilities of members. In the two graphs, we have initially very strong fluctuations: in the graph of total nonmembers the black line, is firstly above the green line that is at a very low value, then the green line peaks up towards the black line, going above the latter (so the black line becomes lower than the green one), the opposite occurs in the other graph representing the total number of members. Then the two lines continue to fluctuate up and down in both graphs becoming more and more dense. Going on with the simulation, we can see that when all agents turn red because there remain only few members, after fluctuations, the black line in the graph of total members reaches the zero level along with the green line because there aren't any members left into and outside the club. While the black line into the total nonmembers graph increases reaching an high value and the green line reduces towards lower values. The slider representing the number of members reduces to zero whereas the slider of the number of agents increases.