

Religious Convictions Agent Based Model

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Abstract—In this contribution, an agent based model of how people’s religious convictions change while exposed to social unrest and religious-political controversial topics is presented. The agents (people) may be either non-believers or believers with a low, medium or high religious conviction; each of them having a level of rationality such that the more rational the less emotional. Social unrest (i.e. wars, poverty, epidemics) affects agent’s emotions, making non-believers become more committed, as well as believers become more committed, creating a polarization between non-believers and believers. High level of religious-political controversial topics in society (i.e. euthanasia, abortion, evolution, homosexuality) affects agent’s rationality, creating a polarization between the group of non-believers and low conviction believers and the group of medium and high conviction believers. The model may be calibrated to show how in a specific country religious conviction becomes polarized under social unrest and religious-political controversy.

Keywords—religion model, agent based modelling, phase transition

I. INTRODUCTION

Religion emerged in society since ancient times and have kept alive probably due to its capacity of: providing answers to people’s philosophical questions about the universe and the being, giving hope for the after-death, settling moral standards, and more. People become religious by emotional and rational reasons. Emotional reasons may include life changing psychological experiences or pressure from family members; rational reasons may include not finding in science an answer to the question “Why there is something rather than nothing?”, the thought that the complexity of the world is such that cannot be derived by chance, or the conclusion that the teachings of a religious book are true. However, due to the incredible discoveries of science that have challenged religious trustworthiness, the abuse of power by religious leaders, etc., during the last centuries there have been an increase in the percentage of non-believers in society.

During the last decades, religious-political controversial topics like euthanasia, abortion, evolution, homosexuality have increased. People with medium and high conviction about their religious beliefs have been forced to study more and think better about what they believe, causing much of them to become more committed to their beliefs and a few others to become less committed. On the other side, lots of people with low conviction about their religious beliefs have declined them. For example, a low committed religious homosexual person who is not willing to change its sexual

preferences may become even less committed to his faith or become a non-believer. Also, non-believers have increased their commitment after being forced to study for example why abortion and euthanasia are good under some cases, or why homosexuality is not to be considered bad.

Social unrest (i.e. wars, poverty, epidemics, ethnic abuse) have also caused people to change their levels of commitment in religious beliefs. For example, during a war that is killing thousands of civilians, non-believers may increase their commitment after thinking that a divine power could have stopped the tragedy from happening, but did not; however, believers may increase their commitment in the search for divine protection during the war.

When there is no religious-political controversial topics in the media or in the public domain and there is no social unrest, things begin to ease up. There is less discussion and friction among people with different points of view, and people is less forced to study in depth what they believe, causing the population to become less polarized and more homogeneous regarding religious beliefs.

In the following sections, an agent based model for the dynamics of a society affected by social unrest and religious controversy is presented.

II. ARTIFICIAL SOCIETY AND AGENTS

A toroidal grid of 60 x 30 patches (or squares) was built in Netlogo programming language to represent an artificial society. Each agent (or person) is a square that can interact with his closest four neighbors – up, down, right, left –, and has the following attributes:

-Religion: Non-believers are black, low conviction believers are yellow, medium conviction believers are orange and high conviction believers are red.

-Commitment to its religious view: goes from 0 (low) to 1 (high).

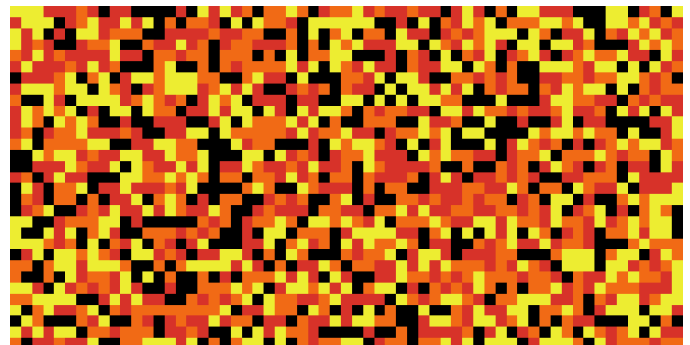


Figure 1: initialization of the artificial society.

-Rationality: goes from 0 to 1. The closer to 0 means the agent is less rational and more emotional; the closer to 1 means the agent is more rational and less emotional.

In the beginning of the simulation, religion and level of rationality are assigned randomly, while commitment is always set to 0.5. Figure 1 shows how the society looks before a simulation begins.

III. CONTROL PARAMETERS

The model has the following control parameters:

- Setup-random: initialize the society.
- Go-once: iterate dynamics just once.
- Go-forever: iterate dynamics indefinitely.
- Rational-controversy: sets level of religious-political controversy.
- Random-rational-controversy?: makes level of religious controversy be a random walk.
- Emotional-unrest: sets level of social unrest.
- Random-emotional-unrest?: makes level of social unrest be a random walk.

Figure 2 shows the user graphical interface of the controls.

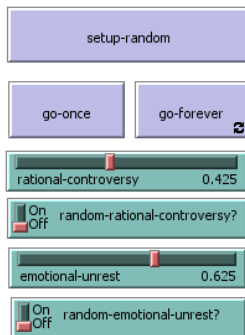


Figure 2: user graphical interface of the control parameters.

IV. AGENT'S INTERACTION RULES

There are rules created for three types of dynamics that may coexist in this model: peace, religious-political controversy, and social unrest.

i. Rules for peace

Even though there is no religious-political controversy and no social unrest, agents interact with their closest four neighbors in the following way (which is considered peaceful):

-Non-believer: if its rationality is below 0.9, commitment with this world view decreases under the presence of neighbor believers. If commitment reaches a value equal or below 0.26, he converts to a low conviction believer. If his rationality is equal or above 0.9, commitment stays the same; this is to reinforce the idea that very rational non-believers don't change under the presence of believers.

-Low conviction believer: lowers his commitment in the presence of neighbor non-believers, and if it reaches a value equal or less than 0.26 he converts to a non-believer. Under the presence of medium or high conviction believers his commitment increases, and if it reaches a value equal or greater than 0.74 he converts to a medium conviction believer.

-Medium conviction believer: increase his commitment in the presence of neighbor high conviction believers, and if it reaches a value equal or greater than 0.74 he converts to a high conviction believer. Under the presence of non-believers or low conviction believers his commitment lowers down, and if it reaches a value equal or less 0.26 he converts to a low conviction believer.

-High conviction believers: if his rationality is below 0.9, commitment decreases under the presence of neighbors with a different religious view. If commitment reaches a value equal or less than 0.26, he converts to a medium conviction believer. If his rationality is equal or above 0.9, commitment stays the same. This is to reinforce the idea that very rational high conviction believers don't not change under the presence of less religious people or non-believers.

The rules for peace were made and calibrated to fit common religious Latin-American countries, in which by tradition most people are low or medium conviction believers. However, parameters may be varied easily to match for example a more non-believer European country.

ii. Rules for religious-political controversy

The religious-political controversy affects especially the rational people, since other people who run more by emotions don't care too much about debating ideas. As religious-political controversy increases, the following dynamics apply more and more in the artificial society:

-Non-believer: increase commitment with controversy.

-Low conviction believer: decrease commitment with controversy if his rationality is above 0.5.

-Medium conviction believer: increase commitment with controversy if his rationality is above 0.5.

-High conviction believer: increase commitment with controversy.

iii. Rules for social unrest

In the model, social unrest affects especially the religious convictions of more emotional people. As social unrest increases, the following dynamics apply more in society:

-Non-believer: increase commitment with social unrest.

-Low conviction believer: increase commitment with social unrest if his rationality is below 0.5 (highly emotional).

-Medium conviction believer: increase commitment with social unrest if his rationality is below 0.5 (highly emotional).

-High conviction believer: increase commitment with social unrest.

V. DYNAMICS OF THE MODEL

The model has three possible dynamics: peace, religious-political controversy, and social unrest. The three of them will be explained using an example.

i. Peace dynamics

If there is no religious controversy or social unrest the only dynamics present in the model is the peace dynamics. Given the rules and the initial random configuration of Figure 1, peace dynamics converges towards a society mostly ruled by low and medium conviction believers. It is important to reiterate that the rules for peace were made and calibrated to fit common religious Latin-American countries, in which by tradition most people are low or medium conviction believers. However, parameters may be varied easily to match for example a more non-believer European country. The example society with only peace dynamics converges to the following:

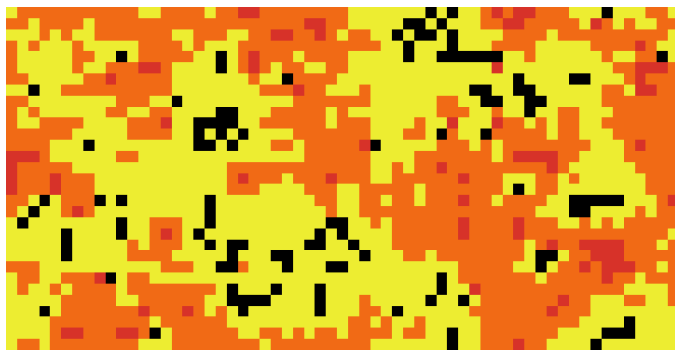


Figure 3: society with just peace dynamics.

The distribution of religious views for the first 184 iterations (weeks) is presented in the following plot:

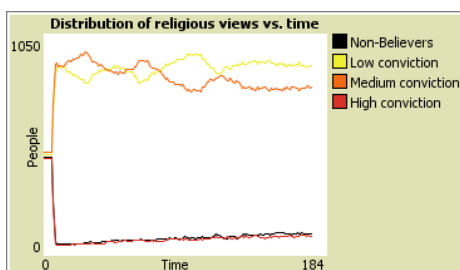


Figure 4: distribution of religious convictions for the first 184 weeks of the example society.

Since there are low quantities of people with extreme views (non-believers and high conviction believers), we say that the polarization is very low. Polarization is defined as:

$$P = \frac{\text{non-believers} + \text{low conviction}}{\text{people}}$$

The following graph shows the low polarization during the initial 184 week period:

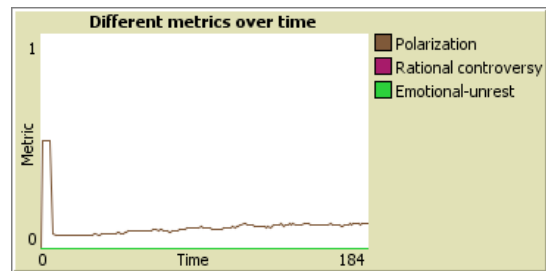


Figure 5: low polarization with just peace dynamics occurring during the first 184 weeks.

ii. Religious-political controversy dynamics

The society of Figure 3 may begin experiencing religious-political controversy when the government for example wants to decide policy over gay marriage and abortion. Given the rules for controversy, society will polarize in the following way.

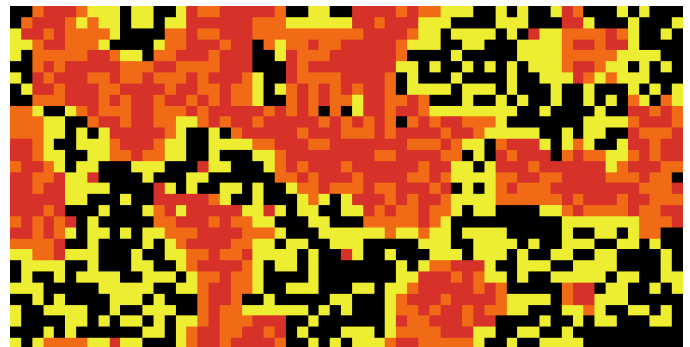


Figure 6: religious-political controversy appeared in the example society, creating a visible polarization.

Now the populations of each of the four religious views are more evenly distributed due to the polarization generated by the religious-political controversy.

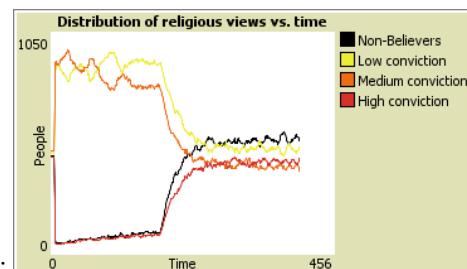


Figure 7: effect of the distribution of religious convictions after religious-political controversy appeared in the example society.

The following plot shows how polarization (brown) increased with controversy (purple) in an underdamped way. It is important to reiterate that controversy affected especially the very rational beings.

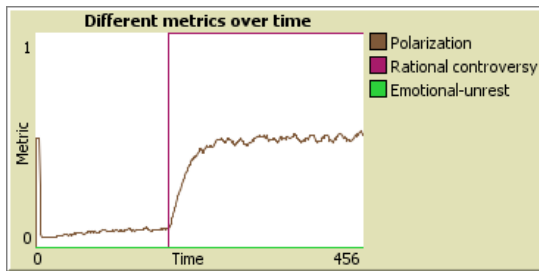


Figure 8: increase in polarization due to a sudden extreme increase in religious-political controversy that affects especially rational beings.

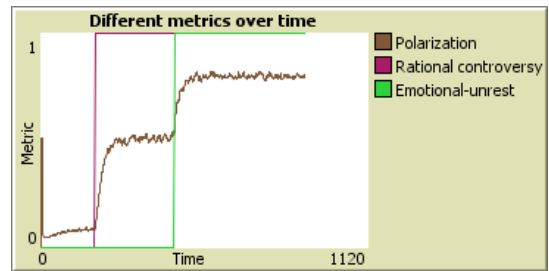


Figure 11: increase in polarization due to a sudden extreme increase in social unrest that affects especially emotional beings.

iii. Social unrest dynamics

The society of Figure 6 may now face a 7 year war that for many religious people looked like the end of the world. Then most low conviction believers began to commit more with their beliefs in search of divine protection, while other non-believers, after the pain at looking to so much destruction, reinforced their commitment as non-believers. The simulation yields to an even more polarized society:

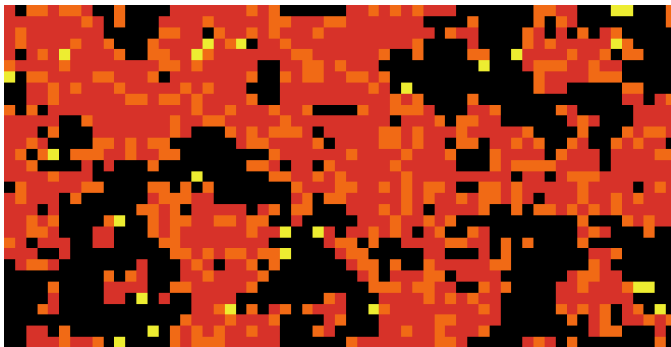


Figure 9: society becomes extremely polarized when having extreme social unrest and religious-political controversy.

The disappearance of the believer's class is notorious, while now people with extreme views are the most common in society:

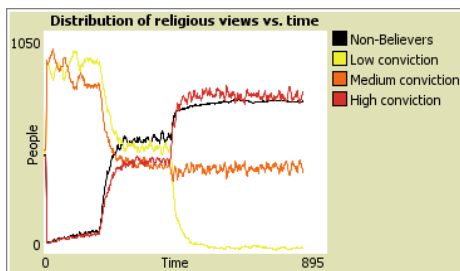


Figure 10: effect of the distribution of religious convictions during a 7-year war that generated social unrest in a society already having religious-political controversy.

Now peace in society comes after the storm, and society returns to total peace:

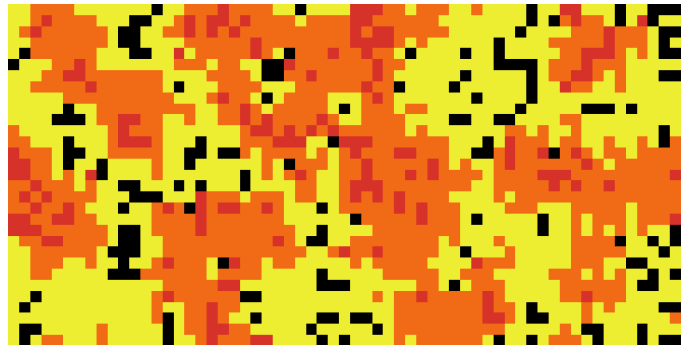


Figure 12: society comes back to total peace.

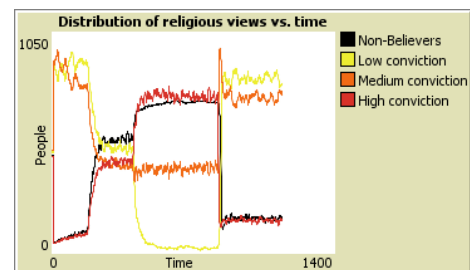


Figure 13: religious views (convictions) are again less extreme due to total peace in society.

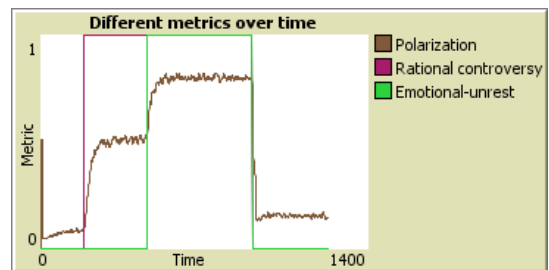


Figure 14: polarization is again low due to total peace in society.

Now polarization has increased even more since there is not just rational religious-political controversy but also high emotional social unrest. The following plot shows the effect how polarization increased over time.

VI. FURTHER DISCUSSION

The model presented was calibrated for Latin-American countries where religious belief is considerably high, like Mexico or Guatemala. This explains why under total peace dynamics the majority of agents are low and medium conviction believers.

The agents that generate the most interesting behavior are the low conviction religious ones. This is because when social unrest increases, the commitment of the more emotional (less rational) of these agents increase too; however, when religious-political controversy increases, the commitment of the more rational (less emotional) of these agent decrease. The result is that this group is essential in deciding how society will polarize.

The peace dynamics generates a self-organization phenomenon in the society. The agent's religious convictions are random in the beginning (Figure 1), and after 26 weeks the agents seem to self-organize in such a way that their neighbors tend to have equal or similar religious views (Figure 3).

The social unrest or controversy generate polarization in society. If both are present polarization may reach very high levels – 85% in our society model (Figure 11). Polarization is to be considered a phase transition in society. In a thermodynamical system, phase transitions occur when heat inputs or outputs of the system cause matter to change phase (i.e. from liquid to gas). In this society the social unrest and controversy injects 'energy' into the society, creating the polarization effect considered to be a phase transition.

VII. CONCLUSIONS

The model shows that agent based models may be very useful when modelling religious phenomena, because there are small scale dynamics – one to one interactions –, but also large scales dynamics like the social unrest and religious-political controversy.

The rules were created inspired on Latin-American countries with high percentages of religious belief, but the rules may be changed to model countries with less percentages of religious belief.

For doing future research using this model, agents may have more attributes, for example a level of tolerance for each other religious group. Also, the model may be changed to have two religions of similar types (i.e. Christians and Muslims) or of very different types (i.e Christians and Buddhists).

Religion still plays an important role in society, and affects millions of people's lives worldwide. As the world becomes more complex, it is important to use computational models to analyze and predict the future dynamics of religion.

REFERENCES

- [1] U. Wilensky and W. Rand, "An Introduction to Agent Based Modelling", The MIT Press.
- [2] M. Afzal Upal, "Simulating the Emergence of New Religious Movements", Journal of Artificial Societies and Simulation, vol. 8, no. 1.

APPENDIX

The Netlogo code of the model is:

```
;----VARIABLES
patches-own [
  rationality
  religion
  commitment
  clustering

  neighbor-rel-1
  neighbor-rel-2
  neighbor-rel-3
  neighbor-rel-4

  neighbor-com-1
  neighbor-com-2
  neighbor-com-3
  neighbor-com-4
]

globals [
  polarization
  cluster-coeff
  total-clustering

  simulate-peace
  simulate-unrest
  simulate-controversy

  temp-rel-1
  temp-rel-2
  temp-rel-3
  temp-rel-4

  temp-com-1
  temp-com-2
  temp-com-3
  temp-com-4
]

;----SETUP
to setup-random
  clear-all

  set simulate-peace 1
  set simulate-unrest 1
  set simulate-controversy 1

  ask patches [
    set rationality random-float 1
    set religion random 4 ; Believers and Practitioners
  ]
  reset-ticks
end

;----MAIN PROGRAM
to go
  ;movie-start

  ; Random rational controversy
  if random-rational-controversy? [
    ifelse random-float 1 > 0.5 [ set rational-controversy rational-
controversy + 0.01 ][ set rational-controversy rational-controversy - 0.01 ]
    if rational-controversy > 1 [ set rational-controversy 1 ]
    if rational-controversy < 0 [ set rational-controversy 0 ]
  ]
  ; Random emotional unrest
```

```

if random-emotional-unrest? [
  ifelse random-float 1 > 0.5 [ set emotional-unrest emotional-unrest +
0.01 ] [ set emotional-unrest emotional-unrest - 0.01 ]
  if emotional-unrest > 1 [ set emotional-unrest 1 ]
  if emotional-unrest < 0 [ set emotional-unrest 0 ]
]

ask patches [ check-neighbors ]
set total-clustering 0
ask patches [ flow ]
ask n-of 1 patches [ set-religion random 4 ]
set polarization (count patches with [ religion = 0 or religion = 3]) / (count
patches)
set cluster-coeff total-clustering / (count patches)

tick
if ticks >= 5000 [ stop ] ;; stop after 500 ticks
end

;-----PROCEDURES
to check-neighbors
ask patch-at 1 0 [ set temp-rel-1 religion set temp-com-1 commitment ]
set neighbor-rel-1 temp-rel-1
set neighbor-com-1 temp-com-1

ask patch-at 0 1 [ set temp-rel-2 religion set temp-com-2 commitment ]
set neighbor-rel-2 temp-rel-2
set neighbor-com-2 temp-com-2

ask patch-at -1 0 [ set temp-rel-3 religion set temp-com-3 commitment ]
set neighbor-rel-3 temp-rel-3
set neighbor-com-3 temp-com-3

ask patch-at 0 -1 [ set temp-rel-4 religion set temp-com-4 commitment ]
set neighbor-rel-4 temp-rel-4
set neighbor-com-4 temp-com-4
end

to flow
; Interact with neighbour
interact-neighbor neighbor-rel-1 neighbor-com-1
interact-neighbor neighbor-rel-2 neighbor-com-2
interact-neighbor neighbor-rel-3 neighbor-com-3
interact-neighbor neighbor-rel-4 neighbor-com-4

; Clustering
let temp religion
set clustering count neighbors with [ religion = temp ]
set total-clustering total-clustering + clustering
end

to interact-neighbor [neighbor-rel neighbor-com ]
; Peace dynamics
if simulate-peace = 1 [
  if religion = 0 and rationality < 0.9 [ set commitment commitment - 0.01
]
  if religion = 1 [
    if neighbor-rel = 0 [ set commitment commitment - 0.01 ]
    if neighbor-rel = 2 or neighbor-rel = 3 [ set commitment commitment +
0.01 ]
  ]
  if religion = 2 [
    if neighbor-rel = 0 or neighbor-rel = 1 [ set commitment commitment -
0.01 ]
    if neighbor-rel = 3 [ set commitment commitment + 0.01 ]
  ]
  if religion = 3 and rationality < 0.9 [ set commitment commitment - 0.01
]
]
]

```

```

; Rational controversy dynamics
if simulate-controversy = 1 [
  if random-float 10 < rational-controversy [
    if religion = 0 [ set commitment commitment + 0.05 ]
    if religion = 1 and rationality > 0.5 [ set commitment commitment -
0.05 ]
    if religion = 2 and rationality > 0.5 [ set commitment commitment +
0.05 ]
  ];if religion = 3 [ set commitment commitment + 0.05 ]
]

; Emotional unrest dynamics
if simulate-unrest = 1 [
  if random-float 10 < emotional-unrest [
    if religion = 0 [ set commitment commitment + 0.07 ]
    if religion = 1 and rationality < 0.5 [ set commitment commitment +
0.07 ]
    if religion = 2 and rationality < 0.5 [ set commitment commitment +
0.07 ]
  ];if religion = 3 [ set commitment commitment + 0.01 ]
]

; CONVERSIONS
; Go up
if religion = 0 and commitment <= 0.26 and random-float 1 > 0.5 [ set-
religion 1]
if religion = 1 and commitment >= 0.74 and random-float 1 > 0.5 [ set-
religion 2]
if religion = 2 and commitment >= 0.74 and random-float 1 > 0.5 [ set-
religion 3]
; Go down
if religion = 3 and commitment <= 0.26 and random-float 1 > 0.5 [ set-
religion 2]
if religion = 2 and commitment <= 0.26 and random-float 1 > 0.5 [ set-
religion 1]
if religion = 1 and commitment <= 0.26 and random-float 1 > 0.5 [ set-
religion 0]
; Correct commitment
if commitment > 1 [ set commitment 1 ]
if commitment < 0 [ set commitment 0 ]
end

to set-religion [z]
if z = 0 [ ; Non-believer
  set religion 0
  set pcolor black
]
if z = 1 [ ; Low committed
  set religion 1
  set pcolor yellow
]
if z = 2 [ ; Committed
  set religion 2
  set pcolor orange
]
if z = 3 [ ; Highly committed
  set religion 3
  set pcolor red
]
set commitment 0.5
end

```