Simulation Assignment: Agent Based Modelling STA5071Z

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Abstract

Does the Prosperity of Tribal Societies Necessitate Religion & God?

Religion & God are omnipresent throughout human culture - often a subject of great philosophical consideration, still to this day there exists no known human society or culture that does not have some divine belief structure. This does not say that all individuals are religions, but rather there is no society that is completely free from religion.

Regardless of your belief system this is an interesting phenomena that warrants investigation. It appears innate to the human condition to conceptualise a higher order - a deity.

Obviously, we do not see the same belief structure emergent in other, less complex and less intelligent, animals - it's not unreasonable to postulate that our complexity & theological inclination are tightly intertwined.

Religion also appears to have served many different purposes throughout history, however a period of particular interest is the Neolithic Revolution - in which societies exploded in size and functionality. Societies needed new structural & organisational tools to avoid extinction. Societies needed governance. Specialised roles were required for societies to scale (economies of scale in a decentralised manner). Religion served this purpose.

Religion provided a behavioural structural archetype, the framework in-which to live & how to live well. Religion usually requires a God to give it meaning.

Our Netlogo model illustrates that religious doctrine - coupled with deep in-group trust and severe out-group hatred (i.e. tribalism) - can result in an emergent behaviour of a society that dominates other groups. Thus we provide a theory of the emergence of religion as a consequence of evolution - more specifically group selection - that allows some groups (tribes) to drive others into extinction.

Here we examine two cases of interest, that were repeated many times, the full theoretical and practical model details are provided in the *info* section of the implementation.

Scenario A: Severe Tribalism & Religion leading to Group Selection

Experimental Setup

Altruistic attributes of all agents in all tribes are set to their mean, default, values - aside from the Delta tribe. Faith is set slightly below par, the agents are required to build up religious culture before great cooperation can emerge.

The Delta tribe exhibits innate distrust for the 'other', all other tribes, as it begins with a out-group altruism of 0. It also begins with great coherence and camaraderie, deeply trusting in-group members (in-group altruism is maximized) and belonging to a mature religious culture (faith is maximized).

Outcome & Conclusion

At the point of the screenshot Omega and Theta had been fully pushed to extinction by tribal warfare; Gamma was moments before extinction - only two members remaining; whilst Delta continued to thrive.

The final trust probabilities of Omega & Theta are given as N/A as all their members have been whipped out. We can see - however - that agents are learning trust on the go. Delta members completely trust each other (probability of 1 of being altruistic within-group). Delta has also gain some trust towards Theta & Omega, oddly enough not Gamma, as a consequence of those tribes exhibiting some altruism towards Delta.

The average energy of the Delta tribe is lower than that of many other tribes during certain periods - indicative of self sacrifice for the greater good of the tribe. The individual may be worse off however the emergent victory of the group follows.

This model, repeated & tested rigorously, was able to exhibit the power of tribalism coupled with a high order belief structure (to warrant self-sacrifice) to push non religious groups to extinction.

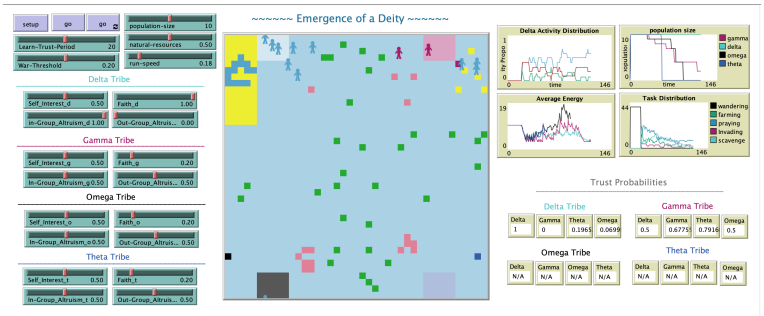

Figure 1: Scenario A: a tribe with high signs of tribalism and great religious faith drive it's cooperative counterparts to extinction.

Scenario B: Lacking Tribalism & Religion leading to Cooperation

The only difference here is that Delta exhibits great outward altruism.

The tribes stabilize, and are not pushed to extinction as they have learnt to trust one another & thus negate the probability of invasion to some extent.

In this particular run, the Delta tribe was able to "befriend" all other tribes as a consequence of it's altruism. We can observe this as it's altruism towards other is very high (though lower than it's starting point) and the altruism towards Delta in the other groups is also significantly high - minimizing the probability of being invaded.

Also note that the Delta tribe is the only tribe with a population of 10 - the others have all entered war of some sort and have lost members due to being invaded against.

The Delta tribe also ends, though marginally, with the highest average energy as it's internal altruism and strong faith cause it to sacrifice for it's tribe members, having a strong agriculture focus (although it's farmland has been depleted on the time of taking the screenshot).

Note that Gamma - that is the only tribe without a strong religion - is the closest to extinction.

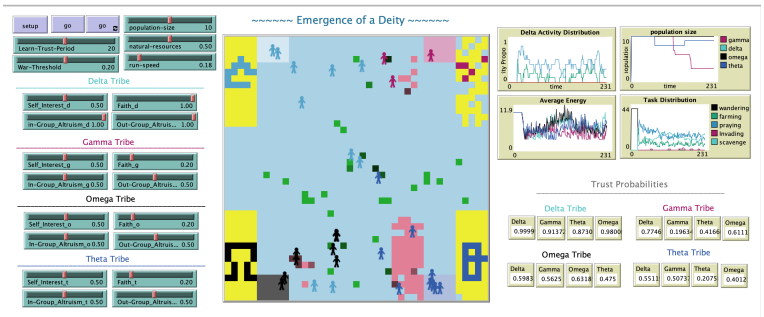

Figure 2: Scenario B: a tribe with high signs of tribalism and great religious faith drive it's cooperative counterparts to extinction

Closing Thoughts

We showed that religion can serve as a powerful tool to get members of the tribe to act for the good of the tribe, often to their own detriment, serving the collective & thus on average leading to prosperity. Coupled with in-group out-group tendencies, which are so omnipresent even in modern culture, religion can lead to group organization that drives the 'other' to extinction by requiring self-sacrifice on the part of the individual.

1 Appendix: Policy Probability Functions

The model requires updating a policy (posterior) - that dictates the action space of each agent as a function of their biological makeup (priors) & interactions with the environment (likelihoods). At each time-step the agent samples it's policy to probabilistically determine it's next action. Here I define the functions that update these action probabilities (policies).

1.1 Policy Probability

The (non-normalized) probabilities of each action $\{Scavenge,\ Pray\ Farm\ Invade\}$ are given by:

$$\pi(farm_i^t) = \frac{1}{4} faith_i^t + \frac{3}{4} trust_{i:In-Group}^t$$

$$\pi(pray_i^t) = \frac{3}{4} faith_i^t + \frac{1}{4} trust_{i:In-Group}^t$$

$$\pi(invasion_i^{tk}) = \frac{5}{10}(1-trust_{i:Out-Group-K}^{tk}) + \frac{2}{10} trust_{i:In-Group}^{tk} + \frac{2}{10} faith_i^{tk} + \frac{1}{10}(1-Selfishness_i^{tk})$$

1.2 Trust Function

Trust is learnt through interaction with other agents.

1.2.1 Initialization

Trust functions are initialized with the in-group & out-group altruism hyperparameters.

1.2.2 Updating

Once initialized the function is updated by computing the mean overall interactions. Means are computed recursively to save on computation & memory (negating the need to store long lists of previous interactions). Thus the mean of period t is given by:

$$\bar{X}_{trust}^t = \frac{1}{t} X_{trust}^t + \frac{t-1}{t} \bar{X}_{trust}^{t-1}$$

Where $\bar{X}_{trust}^t \in [0, 1]$