Terror Management ABM Documentation

# Overview[[1]](#footnote-1)

This model is a basic ABM developed to model the resulting increase in “religiosity” (as energy) during and after the presence of some threat related input. It is designed in order to be scalable and reusable and hopes to be able to address different environmental stressors from the Hazard Precaution literature as well as the literature concerning religious ritual participation. It serves as an agent based instanton of the general terror management model developed as an SDM as published in Shults et al. (Submitted)

## Purpose

The purpose of this ABM is to act as a general framework for investigating the population level effects of threats and ritual participation given the dynamics of the TMT system. It also serves to be an extendable framework for use in other, more general, cognitive architectures addressing religious beliefs and behaviors in the future.

## State Variables and Scales

The agents have two main states the model. The first is regular ritual engagement. The second is Enhanced ritual Engagement.

|  |  |  |
| --- | --- | --- |
| Variable Name | Description | Type |
| anthropomorphic\_promiscuity | the agent's level of anthropomorphic promiscuity | double |
| Available | whether or not the agent is already engaged in a ritual action | boolean |
| C\_Check | is there a contagion hazard in the agents immediate environment | boolean |
| contagion\_probability | probability the agent is contagious to outgroup members | double |
| contagion\_tolerance | tolerance for outgroup contagion | double |
| contagionH\_distance | the group's average contagion distance from the agent | double |
| group\_distance\_anthropomorphic | the group's average anthropomorphic distance from the agent | double |
| group\_distance\_sociographic | the group's average sociographic distance from the agent | double |
| group\_ID | the agent's group ID | int |
| Largest\_Group\_Size\_for\_Ritual | the largest group of mutually engaged ritual agents | double |
| N\_Check | is there a natural hazard in the agents immediate environment | boolean |
| natural\_tolerance | the agent's tolerance for natural hazards in the environment | double |
| Number\_of\_Rituals | the number of rituals an agent engages in | int |
| P\_Check | is there a predation hazard in the agents immediate environment | boolean |
| predation\_tolerance | the agent's tolerance for predation hazards in the environment | double |
| prior\_anthropomorphic\_promiscuity | the agent's initial level for anthropomorphic promiscuity | double |
| prior\_sociographic\_prudery | the agent's initial level for sociographic prudery | double |
| S\_Check | is there a social hazard in the agents immediate environment | boolean |
| social\_probability | the probability that the agent represents a social hazard to an outgroup agent | double |
| social\_tolerance | the agent's tolerance for outgroup social hazards | double |
| socialH\_distance | the group's average social distance from the agent | double |
| sociographic\_prudery | the agent's level of sociographic prudery | double |

Table 1 State Variables

### Additional information

The variables included in the table above are initialized with parameters given in Table 3 Initialization Parameters below.

## Process overview and scheduling

During the model, the agents follow the state chart as provided in Figure 1 below. They all initialize as in a state of Regular\_Ritual\_Engagement. At this period they are wandering their environment randomly with no manipulation to their levels of religiosity. It can be considered a base state.

At each time point they enter an Assessment state where they search their environment for predators (Predation\_Check), natural hazards (Natural\_Check), contagion hazards (Contagion\_Check), and/or social hazards (Social\_Check). If any of these checks reveal that there is an entity in the environment with a probability (contagion\_probability, social\_probability, etc.) greater than the agent’s tolerance level (contagion\_tolerance, social\_tolerance, etc.) the agent enters a state of Hyper\_Vigilance. If no threat is found, they move and reenter this loop.

While in the state of Hyper\_Vigilance, agents scan their environment for other agents with their group identity, that are close to their own level of sociographic prudery and anthropomorphic promiscuity,[[2]](#footnote-2) and are not currently engaged in a ritual (Available = true). They continue searching until at least 2 other agents are found. If these conditions are not satisfied agents move until they are satisfied. When the conditions are satisfied the agents enter a single timestep period of Enhanced\_Ritual\_Engagement, at which point their levels of anthropomorphic promiscuity and sociographic prudery are set to a level between their pre-engagement levels and that of the average of their ritual group.

After this period of Enhanced\_Ritual\_Engagement, they enter an observation period where they check to see that the threat has been subsided. If it has not, they re-enter the period of Enhanced\_Ritual\_Engagement. If it has subsided, they will move and reenter the loop at the top of the state chart, returning to a state of Regular\_Ritual\_Engagement.

C:\Users\jelane\Dropbox\MRP\Clusters - CTM (ABM, SDM, VM)\Drafts in preparation\Terror Management Model\Figures\Figure_4_ABM.tif

Figure 1 Agents state chart

# Design concepts[[3]](#footnote-3)

|  |  |  |
| --- | --- | --- |
| ***Concept*** | ***Present*** | ***Description*** |
| Emergence | X | There are emergent properties of fundamentalism in the model. It seems that agents who are of high priors can reach maximum variable levels that are unseen in agents with low priors. |
| Adaptation | X | In a sense, agent behavior adapts to environments. However, the environment changes so rapidly given other agent movements that this may be debatable as to the permanence of these adaptations. |
| Objectives | X | Agents mediate complex environments using religious ritual engagement. |
| Learning |  |  |
| Prediction |  |  |
| Sensing | X | Agents have the ability to sense the hazard levels of other entities in their environment |
| Interaction | X | Agents interact with outgroup members as hazards and in-group members as potential ritual cooperators. |
| Stochasticity | X | Agent religiosity levels are calculated based on sociographic prudery and anthropomorphic promiscuity which changes at each ritual engagement based on the average of whatever group they can construct. |
| Collectives | X | While group identities are assigned, ad hoc congregations form to mediate hazards in the environment |
| Observation |  |  |

Table 2 Design Concepts

# Details

## Initialization

The model is initialized with N=100 agents on a 500x500 continuous 2-dimensional grid. The agents are broken into two groups based on the variable group\_ID\_percentOfPopInGroup1. Initialization does not use a random seed setting and therefore is always imbued with some randomness in the initial conditions regarding which agents are assigned to which groups and where in the simulation environment they are placed. Initial values are chosen using arbitrary scales that can easily be mapped onto one another (e.g. from 0-1 or 1-10). General variable settings such as parameter distributions for use at initialization were chosen using consultation with subject-matter experts.

All other variables are initialized with the variable value settings as follows:

|  |  |  |
| --- | --- | --- |
| Variable | Description | Initialization value |
| anthropomorphic\_promiscuity\_max | maximum value of the distribution of values for agent level variable anthropomorphic\_promiscuity | 10 |
| anthropomorphic\_promiscuity\_min | minimum value of the distribution of values for agent level variable anthropomorphic\_promiscuity | 0 |
| anthropomorphic\_promiscuity\_mode | mode of the distribution of values for agent level variable anthropomorphic\_promiscuity | 5 |
| chanceForNaturalHazardToOccur | the chance that a natural hazard will be triggered at any given timestep of the model | 50 |
| contagion\_probability\_max | maximum value of the distribution of values for agent level variable contagion\_probabilty | 100 |
| contagion\_probability\_min | minimum value of the distribution of values for agent level variable contagion\_probability | 0 |
| contagion\_probability\_mode | mode of the distribution of values for agent level variable contagion\_probability | 50 |
| contagion\_tolerance\_max | maximum value of the distribution of values for agent level variable contagion\_tolerance | 100 |
| contagion\_tolerance\_min | minimum value of the distribution of values for agent level variable contagion\_tolerance | 0 |
| contagion\_tolerance\_mode | mode of the distribution of values for agent level variable contagion\_tolerance | 50 |
| group\_distance\_anthropomorphic\_max | maximum value of the distribution of values for agent level variable group\_distance\_anthropomorphic | 10 |
| group\_distance\_anthropomorphic\_min | minimum value of the distribution of values for agent level variable group\_distance\_anthropomorphic | 1 |
| group\_distance\_contagionHazard\_max | maximum value of the distribution of values for agent level variable contagionH\_distance | 10 |
| group\_distance\_contagionHazard\_min | minimum value of the distribution of values for agent level variable contagionH\_distance | 1 |
| group\_distance\_socialHazard\_max | maximum value of the distribution of values for agent level variable socialH\_distance | 10 |
| group\_distance\_socialHazard\_min | minimum value of the distribution of values for agent level variable socialH\_distance | 1 |
| group\_distance\_sociographic\_max | maximum value of the distribution of values for agent level variable group\_distance\_sociographic | 10 |
| group\_distance\_sociographic\_min | minimum value of the distribution of values for agent level variable group\_distance\_sociographic | 1 |
| group\_ID\_percentOfPopInGroup1 | percent of the population which will be initialized into the social group ID 1 | 50 |
| natural\_tolerance\_max | maximum value of the distribution of values for agent level variable natural\_tolerance | 100 |
| natural\_tolerance\_min | minimum value of the distribution of values for agent level variable natural\_tolerance | 0 |
| natural\_tolerance\_mode | mode of the distribution of values for agent level variable natural\_tolerance | 50 |
| predation\_probability\_max | depreciated replaced by uniformly distributed variable chanceToMeetPredator initialized during state P\_Check | \*100\* |
| predation\_probability\_min | depreciated replaced by uniformly distributed variable chanceToMeetPredator initialized during state P\_Check | \*0\* |
| predation\_probability\_mode | depreciated replaced by uniformly distributed variable chanceToMeetPredator initialized during state P\_Check | \*50\* |
| predation\_tolerance\_max | maximum value of the distribution of values for agent level variable predation\_tolerance | 100 |
| predation\_tolerance\_min | minimum value of the distribution of values for agent level variable predation\_tolerance | 0 |
| predation\_tolerance\_mode | mode of the distribution of values for agent level variable predation\_tolerance | 50 |
| prior\_anthropomorphic\_promiscuity\_max | maximum value of the distribution of values for agent level variable prior\_anthropomorphic\_promiscuity | 10 |
| prior\_anthropomorphic\_promiscuity\_min | minimum value of the distribution of values for agent level variable prior\_anthropomorphic\_promiscuity | 1 |
| prior\_anthropomorphic\_promiscuity\_mode | mode of the distribution of values for agent level variable prior\_anthropomorphic\_promiscuity | 5 |
| prior\_sociographic\_prudery\_max | maximum value of the distribution of values for agent level variable prior\_sociographic\_prudery | 10 |
| prior\_sociographic\_prudery\_min | minimum value of the distribution of values for agent level variable prior\_sociographic\_prudery | 1 |
| prior\_sociographic\_prudery\_mode | mode of the distribution of values for agent level variable prior\_sociographic\_prudery | 5 |
| social\_probability\_max | maximum value of the distribution of values for agent level variable social\_probability | 100 |
| social\_probability\_min | minimum value of the distribution of values for agent level variable social\_probability | 0 |
| social\_probability\_mode | mode of the distribution of values for agent level variable social\_probability | 50 |
| social\_tolerance\_max | maximum value of the distribution of values for agent level variable social\_tolerance | 100 |
| social\_tolerance\_min | minimum value of the distribution of values for agent level variable social\_tolerance | 0 |
| social\_tolerance\_mode | mode of the distribution of values for agent level variable social\_tolerance | 50 |
| sociographic\_prudery\_max | maximum value of the distribution of values for agent level variable sociographic\_prudery | 10 |
| sociographic\_prudery\_min | minimum value of the distribution of values for agent level variable sociographic\_prudery | 0 |
| sociographic\_prudery\_mode | mode of the distribution of values for agent level variable sociographic\_prudery | 5 |

Table 3 Initialization Parameters

## Input

During a simulation run, no input data is necessary.

During an experimental run, no input data is necessary.

## Sub-models and processes

There are no sub-models embedded within the model described here.

# Experiments

Experiments are documented in Shults et al. (Shults et al., Submitted). They were run using the same software as the model was developed in (The AnyLogic Company, 2015). By setting the memory settings in Main in the development environment, one should be able to run the simulation on any modern desktop or laptop. However, greater memory requirements may be necessary for running larger simulations such as the Monte Carlo Experiment described Shults et al. (Shults et al., Submitted). Results are included in the folder ~/data\_files.

# References

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Shults, F. L., Lane, J. E., Lynch, C., Padilla, J., Mancha, R., Diallo, S., & Wildman, W. J. (n.d.). Modeling Terror Management Theory: A computer simulation of hte impact of mortality salience on religiosity. *Religion, Brain & Behavior*.

The AnyLogic Company. (2015). AnyLogic Professional 7.2. St. Petersburg, Russia: The AnyLogic Company. Retrieved from http://www.anylogic.com/

1. For a description of the formatting of this document and any definitions, see (Grimm & Railsback, 2005; Grimm et al., 2006; Railsback & Grimm, 2011) [↑](#footnote-ref-1)
2. This introduces homophily or preferential attachment into the model that is not an explicit state or variable. [↑](#footnote-ref-2)
3. For definitions see appendix at end of document. [↑](#footnote-ref-3)