EasyChair Preprint

№ 1909

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Arshad Muhammad, Kashif Zia, Dinesh Kumar Saini and Zoofishan Zareen

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November 9, 2019

Agent-Based Simulation of Socially-Inspired Model of Resistance against Unpopular Norms

Arshad Muhammad[1], Kashif Zia[1], Dinesh Kumar Saini[1], Zoofishan Zareen[2]

[1] Faculty of Computing and Information Technology, Sohar University, Oman
[2] Department of Software Engineering, Bahria University, Islamabad, Pakistan

Abstract. People live in society adhering to different type of norms. Some of these norms are unpopular. Sometimes, for the overall societal good, it is necessary to oppose and possibly avert the unpopular norms. To achieve this goal, it is important to know the conditions which enable persistence of unpopular norms and models that support possible aversion of these. This study attempts to elaborate the conditions and reasons behind the emergence, spreading and aversion of unpopular norms in a society using theory-driven agent-based simulation. The simulation results revealed that, in addition to agents actively participating in averting the unpopular norm, incorporating a rational decision making model for normal agents is necessary to achieve a dominant norm aversion.

Keywords: Agent-based Modelling and Simulation; Unpopular Norms; Emperors Dilemma; Norm Aversion.

1 Introduction

Social norms are concepts and practices prevalent in society [5]. Social norms have historical perspective. These evolve into traditions and standards to which a society can relate and act. Generally, an individual in a society is expected to behave according to societal norms. However, the equation is not that simple. Even following a societal norm does not mean accepting it from within. There may be other conditions and incentives that force a person to follow a social norm [11].

Social norms can be unpopular; a situation in which majority of people do not agree. In fact, people personally do not agree with these so-called “unpopular norms”, but still stick to them and even enforce others to follow them. In sociology, such situations are dealt through a dilemma, named as **Emperor’s Dilemma** [12]. Emperor’s dilemma relates to a tale in which everyone shows fake admiration for new gown worn by an emperor even though the emperor was naked. The cunning gown designers announced that the (non-existent) gown would not be visible to those who are not loyal to the emperor or who are really dumb. The fear of being identified as having inferior societal traits, no one spoke the truth. The truth that the emperor is in fact naked.

It has been observed that people enforce unpopular norm to which they privately disapprove. In [17], the authors have focused on discovering the reason of false enforcement. The authors are of the opinion that people enforce norms to create an illusion of sincerity rather than conviction. The study has been tested in two experiments of wine tasting and text evaluation. Both experiments reveal that the people who enforced the norm, against their actual belief, under social pressure criticised the deviants of the norm. These outcomes indicate how social pressure can lead to false enforcement of an unpopular norm.

In many places around the world, the manifestation of so-called Emperor's dilemma are evident. Whether it is foot-binding in neo-Confucian China [1] or inter-cousin marriages and dowry in Asia [6], the nature of thought process is the same. People do not reveal what they really believe from fear of being identified as ignorant or anti-social. However, always, there are few people in all societies who actively participate to change the things. There are evidences that a minority of activists can make a big difference, if the environment is conducive [7]. More specifically, in terms of Emperor's dilemma, maybe, a minority of activists can change an unpopular norm adopted by the majority.

Essentially, norms propagation and transformation co-evolve with each other. Norms propagate through diffused influence. Since the subjects being influenced may have their own perspective, they may decide to adhere or reject it. As a consequence, reciprocating influence of the subjects may transform the norm itself. Exploration of the scenarios of such nature ("being influenced and influencing in a reciprocal manner") has been a subject of complex adaptive system using agent-based modelling [9].

Studying norms in a society has been one of the research focus of agent-based modelling community. A lot of theoretical work has been done on norms in which agents are supposed to comply the social norms [4] [10]. The sense of punishment from the society is evidenced as the predominant factor behind compliance of norms [2]. There are other examples which focused on emergence of norms and described strategies that shows how norms prevail in any society [14] [13]. This is basically governed by societal influence. Agents set their goals and frequently change their behaviour based on societal influence [15], until a global equilibrium in achieved.

By contrast there is limited work on how unpopular norms can be averted. To avert unpopular norms, it is important to understand conditions that help to stop propagation of these. Particularly, efforts are made to focus on finding the conditions necessary to established the alternative norm (a reciprocal norm of prevailing unpopular norm) and what are the conditions that enforce others (people other than activists) to follow the alternative norm.

In this work, it is argued that for societal good, it is necessary to oppose and possibly avert the unpopular norms. Hence, an attempt is made to realise the conditions that result in emergence of unpopular norms and define situations under which these norms can be changed and averted. To achieve it, the social interaction model proposed by Centola, et.al. [3] is extended in the paper.

The rest of the paper is organised as follows. In the next section, the motivation of the proposed model is explained. The proposed model follows this motivation. Then, the simulation scenarios and analysis of the results is presented. The paper ends with conclusions of the study.

2 Models

2.1 Motivation

In [3], authors state the Emperors Dilemma as:

"Hans Christian Andersen ... tells the story of three rogues who sell a foolish monarch a nonexistent robe that they claim cannot be seen by those who are "unfit for office" or "incorrigibly stupid." Fear of exposure leads the emperor, and in turn, each of the citizens, to express admiration for the new clothes, which then reinforces the illusion of widespread support for the norm. The spell is broken when a child, innocent of the norm, laughs at the naked old man."

There are two type of agents; **true believers** (TB) are those agents who comply with and enforce the unpopular norm, and **disbelievers** (DB) are agents who do not genuinely believe in the sanctity of the norm. The *belief* of an agent corresponds to its true feeling about the unpopular norm; 1 for TB and -1 for DB. Based on their beliefs, agents adopt a *compliance* behaviour. The initial value of compliance of the norm is also set to 1 for TB, and -1 for DB. The *strength* of an agent is directed by relationship of belief and compliance; hence, its value is equal to 1 for TB and a low random floating point number (0.0 to 1.0) for DB. A complying agent can also *enforce* a norm. The enforcement is a by-product agents interaction in the their proximity and dependent on *enforcement need*.

Each agents' decision to comply with the norm is given by a binary value which is dependent on the social pressure exerted by the neighbours and strength of its own conviction.

$$Ci = \begin{cases} -Bi \;\; if \; \frac{-Bi}{Ni} \sum_{j=1}^{Ni} Ej > Si \\ \;\; Bi \qquad\qquad otherwise \end{cases} \tag{1}$$

The agents' willingness to comply with the unpopular norm can lead to norm enforcement. Agent enforcement can be true enforcement or false enforcement, depending upon the situation.

$$Ei = \begin{cases} -Bi \;\; if \; (\frac{-Bi}{Ni} \sum_{j=1}^{Ni} E\,j > (Si + k)) \bigwedge (Bi \neq Ci) \\ \;\; +Bi \qquad\qquad if \;\; (SiWi > k) \bigwedge (Bi = Ci) \\ \;\;\;\; 0 \qquad\qquad\qquad\qquad otherwise \end{cases} \tag{2}$$

Need for enforcement is amount of agent's neighbours whose behaviours does not match with agent's belief.

$$Wi = \frac{1 - (\,\frac{Bi}{Ni}) \sum_{j=1}^{Ni} Cj}{2} \tag{3}$$

2.2 The Proposed Model

As it is evidenced in the model presented above that a TB is not a normal agent; i.e., it would never be affected by whats happening in the surrounding. Our model is based on reciprocity of this behaviour. In the proposed model, a notion of activist is introduced. An activist (ACT) is a DB who is ambitious and aims to avert the unpopular norm. Like TBs, these ACTs will never be affected by their surroundings. Hence they act as reciprocating influence to TBs.

Like a TB, an activist would never be affected by whats happening in the surrounding. Like TBs, they would be ambitious about fulfilling their role which is acting to avert the norm. The role with be triggered by presence of TBs in the surrounding, particularly who are enforcing. An activist would change its belief from -1 to 1 after being encountered by enforcement of norms from neighbourhood. This is achieved by progressive increment of the value of S_i by a constant k. If this value reaches to 1 or greater, the belief of the agent is changed from -1 to 1, which means that now the agent believes in aversion of the unpopular norm and acts to avert it.

In our recent work [18], it is proposed that high density conditions of agent population with a high percentage of norm aversion activists, the aversion of unpopular norms can be achieved. In this paper, the model is further extended to incorporate the decision-making of a DB as a result of neighbourhood condition.

It is proposed that DBs (who are not ACTs) should not be considered as entirely a numb entity. We propose a probabilistic decision-making model. Algorithm 1 outlines the proposed model.

2.3 The Model Extension

Algorithm 1 Extended decision-making model of DBs

```
for each DB which do not comply with unpopular norm do
  S ← set_of_neighbours
  N ← count(S)
  RLikes ← count(DB_l)/N {"l" is a DB which does not comply}
  RComp ← count(DB_c)/N {"c" is a DB which complies}
  RCompAll ← count(DB_ca)/N {"ca" is a DB which complies including
  activists}
  if (RLikes > 0.5&RComp > 0.25) then
    payoff ← 20
  else
    if (RLikes > 0.5&RComp <= 0.25) then
      payoff ← 40
    else
      if (RComp >= 0.5) then
        payoff ← 50
      else
        if (RCompAll > 0.5) then
          payoff ← 90
        else
          payoff ← 70
        end if
      end if
    end for
end
```

Model is invoked by all the DBs which are not complying with the unpopular norm. These are the DBs which do not comply with the "unpopular norm", but still follow it. These are the DBs which are mere *followers* and in such a cognitive state which can be termed as "unsure". It is assumed that these *followers* would be affected by influence of the surrounding. If *N* is count of all the neighbours in 8 adjacent cells, *RLikes* represents the ratio of neighbouring DBs which are of same kind. *RComp* is the ratio of neighbouring DBs which comply to unpopular

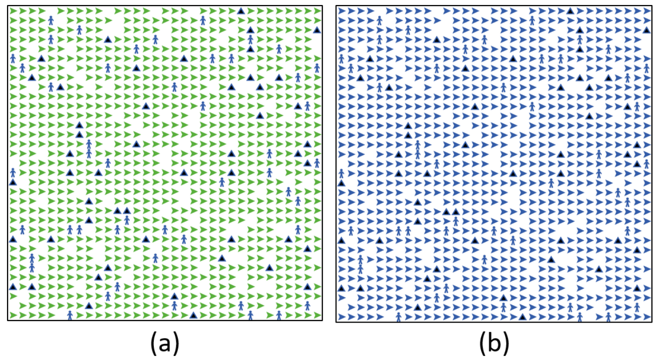


Fig. 1. NetLogo Simulation. (a) Setup of 1000 agents with 5% TBs and 5% DBs. Agents represented as filled blue triangles are TBs, whereas agents represented as blue persons are ACTs. The rest are DBs (in green). (b) Application of model Centola proposed [3]. The situation after equilibrium with respects to state changes is achieved. All DBs comply with the unpopular norm B against their belief.

norm. Whereas, *RCompAll* is the ratio of neighbouring DBs which comply to unpopular norm including ACTs. Hence, *RCompAll* also includes influence of ACTs in the surrounding. The attribute *payoff* is a calculated probabilistic factor which would avert a *follower* so that it starts complying to the "alternate norm". The following are the rules of change:

– **R1:** If majority of agents in the neighbourhood of a follower are also followers, and also there is a significant number of complying DBs, the value of payoff is 20%. The incentive to deviate in this case is quite low as majority is either followers or DBs which comply to the unpopular norm.
– **R2:** If majority of agents in the neighbourhood of a follower are also followers, and there is not a significant number of complying DBs, the value of payoff is 40%. The incentive to deviate in this case is a little bit high because there are not many complying DBs in the neighbourhood.
– **R3:** If majority of agents in the neighbourhood of a follower are not followers but complying DBs, the value of payoff is 50%. The incentive to deviate in this case is purely random.
– **R4:** If majority of agents in the neighbourhood of a follower are not followers and complying DBs, then there must be significant number of ACTs in the neighbourhood. Hence, the payoff increases; more in case of more ACTs (90%), and less in case of less ACTs (70%).

3 Simulations and Results

The simulation is performed in Netlogo [16], a popular agent-based simulation tool with grid space support. The agents reside on cells of a spatial grid. We have used Moores neighbourhood to represent the surrounding of an agent which

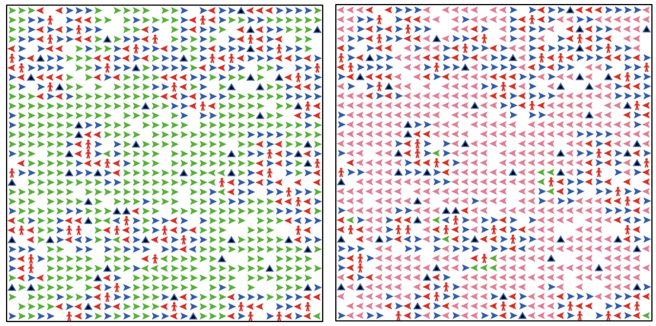
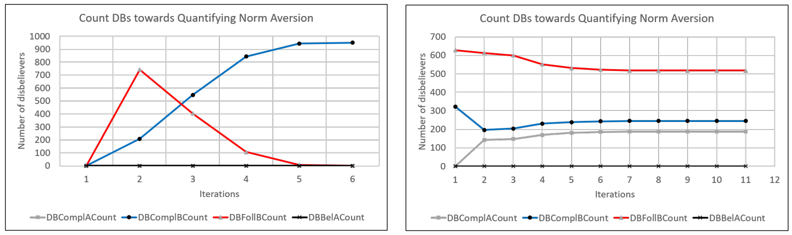

(a) (b)

Fig. 2. NetLogo Simulation. (a) Setup of 1000 agents with 5% TBs and 5% DBs. Agents represented as filled blue triangles are TBs, whereas agents represented as blue persons are ACTs. The rest are DBs. Application of model Zareen proposed [18]. The situation after equilibrium with respects to state changes is achieved. DBs in the neighbourhood of ACTs start following (blue) and complying (red) norm A against their belief. (b) Application of proposed model extension. The situation after equilibrium with respects to state changes is achieved. In addition to DBs in the neighbourhood of ACTs start following (blue) and complying (red) norm A against their belief, most DBs start complying norm A with a belief in it (represented in pink colour).

has been a popular strategy in many cell-based spatial configurations [8]. The simulation space consist of a torus of 33×33 cells. 1000 agents are placed on cells without overlapping. Figure 1 (a) illustrates simulation setup.
The simulation results are analysed based on four quantities:

- **DBComplBCount**: The count of disbelievers which comply with the unpopular norm B against their belief.
- **DBFollBCount**: The count of disbelievers which do not comply with the unpopular norm B, but follow it against their belief.
- **DBComplACount**: The count of disbelievers which comply with the alternate norm A, but still do not believe in it.
- **DBBelACount**: The count of disbelievers which comply with the alternate norm A, and believe in it.

The purpose and intention of the proposed model is to reduce the value of **DBFollBCount**, because these agents are unsure and their belief can potentially be averted. The possible aversion may transform agents from following status to those which are complying with the alternate norm (**DBComplACount**).
The model Centola proposed [3] only formulates the spread of unpopular norm. The results of application of the model settles in an equilibrium after 5^{th} iteration. The graph corresponding to visualisation of Figure 1 (b) is shown in Figure 3 (a). It is evident from the graph that all DBs after started following the unpopular norm, quickly, start complying it.
After all DBs start complying with norm B, a change in strategy is tested. The ACTs start playing their role as proposed in [18]. The results of application of the



(a) (b)

Fig. 3. Graphs of Number of DBs in different states vs. Simulation Time. (a) Results of model Centola proposed [3]. (b) Results of model proposed in [18].

model settles in an equilibrium after $10-12^{th}$ iteration. The graph corresponding to visualisation of Figure 2 (a) is shown in Figure 3 (b). It is evident from the graph that DBs start complying with alternate norm A under the influence of ACTs. The number of DBs which are merely following again goes up in the start but it does not drop to 0, after transforming to compliance state. The DBs following and complying to norm B stabilises with followers more than agents which are complying. As shown in Figure 2 (a), DBs in the neighbourhood of ACTs start following and complying norm A, against their belief.

The proposed model extension again achieve an equilibrium. The graph corresponding to visualisation of Figure 2 (b) is shown in Figure 4 (a). It is evident from the graph that DBs start complying with alternate norm A under the influence of ACTs. However, a large majority of DBs start complying norm A with a belief in it. And number of DBs following norm B reduces to almost nothing.

Finally, we have compared the above situation with a situation in which there are more TBs and more ACTs than before. By comparing the two graphs (Figure 4 (a) to (b)) it is evidenced that the pattern and rate of state changes is similar, but, aggregate number of DBs in state DBBelACount and DBFollBCount has decreased substantially when compared with aggregate count of DBComplACount and DBComplBCount. It means the DBs which believed in norm A has decreased to almost half as the number of TBs and ACTs is doubled.

4 Conclusion

In this paper, an agent-based simulation model of unpopular norm aversion is presented. The reciprocal nature of persistence and aversion of norms is utilised to define situations under which these norms can be changed and averted. The simulation results revealed that, in addition to agents actively participating in averting the unpopular norm, incorporating a rational decision making model for normal agents is necessary to achieve a dominant norm aversion. It was also learnt that the percentage of true believers and activist play a significant role in norm aversion dynamics.

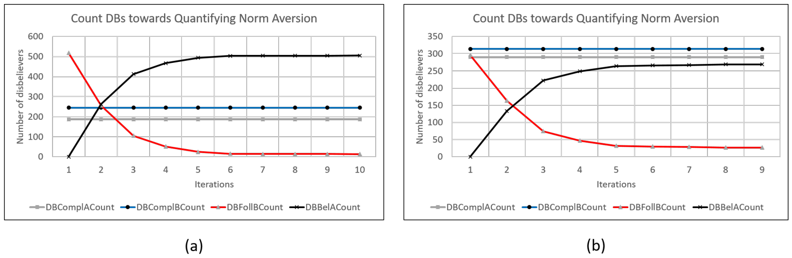


Fig. 4. Graphs of Number of DBs in different states vs. Simulation Time. (a) Results of proposed model extension with 5% TBs and 5% DBs. (b) Results of proposed model extension with 10% TBs and 10% ACTs.

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