Towards Social Norm

Daniel VILLATORO and Jordi SABATER-MIR
IIIA, Artificial Intelligence Research Institute
CSIC, Spanish National Research Council
Bellatera, Barcelona, Spain
{dvillatoro,jsabater}@iiia.csic.es

Abstract. Social Norms proliferate in societies as a mechanism for self-organization. This kind of norms are not enforced by a central authority and the individuals of the society are those responsible for their generation and maintenance. The maintenance process is what is known as *norm support* and is supported by several mechanisms like for example laws, social proof, dominance, etc. We believe that agent based simulation is a suitable technique for investigating this topic. In this paper we present an overview of the work we have been developing in this area. The 'Find and Share (and Exchange)' game is introduced as the environment where to prove our hyphotheses on social norms. After that, we present an initial categorization on the possible social norms in our environment. Finally, some mechanisms are studied to observe its effectiveness solving the norm suport problem.

Keywords. Multi-agent Systems, Social Norms, Simulation

1. Introduction and Related Work

Social norms are part of our everyday life. They help people self-organizing in many situations where having an authority representative is not feasible. On the contrary to institutional rules, the responsibility to enforce social norms is not the task of a central authority but a task of each member of the society. From the book of Bicchieri [2], the following definition of social norms is extracted: "The social norms I am talking about are not the formal, prescriptive or proscriptive rules designed, imposed, and enforced by an exogenous authority through the administration of selective incentives. I rather discuss informal norms that emerge through the decentralized interaction of agents within a collective and are not imposed or designed by an authority". Social norms are used in human societies as a mechanism to improve the behaviour of the individuals in those societies without relying on a centralized and omnipresent authority. In recent years, the use of these kinds of norms has been considered also as a mechanism to regulate virtual societies and specifically societies formed by artificial agents ([11], [14], [6]). From another point of view, the possibility of performing agent based simulation on social norms helps us to understand better how they work in human societies.
One of the main topics of research regarding the use of social norms in virtual societies is how they emerge, that is, how social norms are created at first instance. This has been studied by several authors ([1], [12], [8], [5]) who propose different factors that can influence this emergence. We divide the emergence of norms in two different stages: (a)

how norms appear in the mind of one or several individuals and (b) how these new norms are spread over the society until they become accepted social norms. We are interested in studying the second stage, the spreading and acceptance of social norms, what Axelrod [1] calls *norm support*. Our understanding of norm support deals with the problem of which norm is established as the dominant when more than one norm exists for the same situation.

Our model, in contrast to those solving coordination problems ([12], [8]), can deal with social norms that are not representable in a decision table and the rewards for following a certain norm are not known a priori. A similar approach can be found in the work of Cecconi and Parisi [3], where they also deal with a simulated resource consuming society. In their work, agents do not know beforehand how good the sets of social norms they follow are, even though the authors only consider two well differentiated sets of social norms (individual strategy or collective strategy of resource consumption). However, a society can have several (more than just two as we have already seen in the literature) sets of social norms abided by different members of the society. In the work of Sen [13], we observe that the authors present 6 different strategies (or sets of social norms), but they study the behaviour of mixed populations of these kinds of agents. Specifically, we study the situation where **while having initially different sets of social norms in a society, after some time, one of these sets (the one that maximizes the common goal of the society) prevails over the rest**.

For the sake of simplicity, we assume that all agents pursue the same global objective while trying to satisfy, as a second instance, its own objective. As we said, we want to study the situation where a single set of social norms, after some time, prevails over the rest. In order to achieve that task, we need to know beforehand the quality of a set of norms in a society, assuming that all the agents share the same set of social norms. Once a ranking of the different set of social norms is fixed, we can observe how the mechanisms we plan to apply in the norm support problem behave.

This is the first step that should allow us to study in the future more complex situations where different sets of norms sharing the same social space, with similar levels of satisfaction at the individual level, can achieve a better global result than a single dominant set. In the study presented in this paper we use a social evaluation mechanism as the image (which is the own believed evaluation of the others) as the main mechanism to facilitate the process of *norm support*. We also introduce the concept of 'visionary' individuals as a special kind of individual that by means of local simulations of the environment can foresee how a set of norms should work in the society if they were adopted as the dominant set.

2. Reference Scenario

In order to design an scenario where the usage of social norms is significant, we are inspired by real life examples ([10], [4]), where the usage of social norms is crucial for the survival of the society. The society we use for our experiments is a resource-gatherer distributed and decentralized society. All the members of the society survive by consuming resources that appear randomly in the environment and exchanging the resources among them by **abiding to a set of social norms**. Depending on the quality of these social norms, the society succeeds in the task of increasing the average life expectancy of its

members.
The application domain of this research is directly related to an ongoing research which is carried out by a group of archaeologists. We are presented an ancient historic society, already extinguished, known as *'the Yámanas'*. This society was located in Southern Argentina and is one of the groups of the societies commonly known as 'canoeros'. They lived there for around 6000 years in a very hostile environment. The main success, and reason of study, of this peculiar society is their ability of auto-organization: the *Yámanas* were able to auto-organize themselves as a hunter-gatherer society. The archaeologists consider as a hypothesis that the key of success of this society was due to their strong respect for a known set of social norms (represented as a set of myths). These social norms regulated, among other behaviours, the resource exchange between the *Yámanas*. From the study of Gusinde [7], we extract that social norms for resource exchange regulation only made sense in such societies when the resources to be exchanged would appear sporadically although of a large contribution when they appear (e.g. finding a whale on the beach was a huge amount of resources but it would not happen frequently). Therefore, we adapt the parameters of the simulation to this scenario.
We want to stress that even though we inspired our simulations by the previously described society, the simulation scenario is a simplification of it. Consequently, we do not intend to affirm that the results obtained out of our simulations, as they are now, are directly applicable to real societies. Notwithstanding, the results are relevant for societies of virtual agents.

3. Statement of the Problem

The problems to be faced in the following sections are two:

- Categorizing the sets of social norms in our scenario.
- Study the effectiveness of certain mechanisms in the norm support problem.

Firstly, the problem of the categorization is performed in order to know, as designers, how to define the experimental setting for the norm support problem and, also, interpret the results. We perform an exhaustive analysis of every possible set of social norms in our resource-gatherer society, forcing each time all the members to share the same set of social norms. This analysis provides us with the necessary information to **establish a classification of sets of social norms depending on their quality**. The quality measure used in our experiments is the Average Life Expectancy of the agents. Having fixed the ranking, we observe the characteristics that make a set of social norms optimal, with the intention of applying this characteristics to different scenarios in the future work. Secondly, and making an step forward, we relax the assumption of all agents sharing the same set of social norms. Suppose now an initial population of virtual agents where each agent possesses a set of social norms although all of them pursue the same global objective. Each agent might have a different set of norms from the rest of agents. However, from [9] we extract that *'everyone conforms, everyone expects others to conform, and everyone has good reason to conform because confirming is in each person's best interest when everyone else plans to conform'*. Therefore we are interested in scenarios where agents might converge to a common and optimum set of norms, as they pursue the same objective. Different mechanisms are supposed to ease and accelerate this process

when malicious agents are present. We will focus on how image affects the process of norm stability.

4. Simulation Model

We use a multi-agent system for our simulation. A detailed description of this model can be found in [15], although a brief description is done. Our experimental scenario is based on a society with no central authority where all the agents survive by consuming resources found in the environment. When two agents meet, they abide by their social norms in order to decide whether to share resources or not. The fact of donating resources provide the other agent with extra resources that make it survive for a longer period of time. When one agent exhausts its resources, it 'dies'. After dying, agents are able to reset themselves with initial resource conditions(after recalculating its *Average Life Expectancy* (ALE)). Therefore, the goal of our agents is to improve the ALE of the society. Moreover, agents have a period of time where they can exchange their social norms in order to obtain different results. Malicious agents can lie during the communication process, trying to take advantage of innocent agents. We will verify the effectiveness of some mechanisms for the convergence of the optimal set of social norms when untrusted agents coexist in the society.
The simulation is divided into three periods that will be repeated until exhausting the number of initially defined time steps:

1. **Exchange Period**: During this period agents meet and exchange their sets of social norms.
2. **Execution Period**: The interactions among agents are done always in pairs, and both agents have to choose an action when interacting in this period. This decision is taken following the *set of social norms* that each agent has internalized. The set of norms in this scenario specifies if the agent has to give or not to give resources to the other agent, depending on both agent's resource level (*Plenty(X)* means X's resource level ≥ 100 *Normal(X)* means X's resource level ≥ 26 and ≤ 99, and *Starving(X)* means X's resource level ≤ 25). When two agents meet, each agent is able to observe its own level of resources and its opponent's level. Table 1 represents the whole list of possible situations (formed by two observables) in which an agent may find itself.

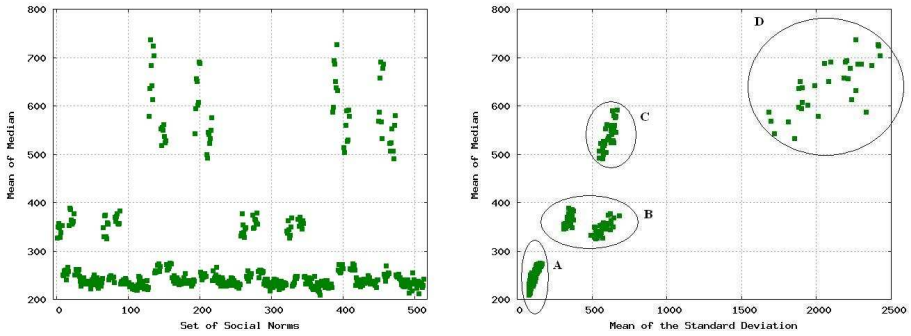
3. **Evaluation Period**: Agent have the option to recover the set of norms they previously have had. During this period agents will decide if they want to recover them.

5. Experiments and Results

We present two different set of experiments in this section. Firstly results on the categorization of social norms are presented. Secondly, some mechanisms are studied in the simulation scenario to observe their effectiveness on the norm support problem.

Situation		Action
Starving(Me)	Starving(You)	Give / Not Give
Starving(Me)	Plenty(You)	Give / Not Give
Starving(Me)	Normal(You)	Give / Not Give
Plenty(Me)	Starving(You)	Give / Not Give
Plenty(Me)	Plenty(You)	Give / Not Give
Plenty(Me)	Normal(You)	Give / Not Give
Normal(Me)	Starving(You)	Give / Not Give
Normal(Me)	Plenty(You)	Give / Not Give
Normal(Me)	Normal(You)	Give / Not Give

Table 1. *Situations and Actions. Structure of a set of social norms.*



(a) Median Average Life Expectancy using different sets of social norms.

(b) Median Average Life Expectancy VS Mean of Standard Deviation

Figure 1. Categorization of Social Norms

5.1. Social Norm Categorization

In this experiment we want to fix a ranking of all the possible sets of social norm available to the agents. All the experimental parameters are fixed. The population of agents will share the same set of social norms in each simulation. As we have already said, this might seem a very ideal situation (all agents sharing the same set of social norms), but, it is the situation that the norm support problem plan to reach after solved. After running an exhaustive test over all the possible set of social norms, we can observe the results in figure 1(a). The horizontal axis represents each one of the 512 possible sets of social norms. The vertical axis represents the mean of the median average life expectancy of the society from each of the 20 simulations.

From the experimental results we can observe that in same environmental conditions, different sets of social norms produce different results in the agents average life expectancy (ALE). In Figure 1(a), we can perfectly distinguish between three different levels: the one we define as **Bad** sets of social norms (median ALE lower than 300), the one we define as **Average** sets of social norms (median ALE between 300 and 400), and the one we define as **Good** sets of social norms (median ALE higher than 400). In Figure 1(a), and in the levels aforementioned, we constantly refer to the mean of the median ALE. This median ALE represents information from only one member of the society, and does not provide us a with precise idea of how the rest of the society has behaved. It could happen that in two different societies with the same median ALE, the distance

between the best and the worst member of the society was very different: one very large, representing a heterogeneous society; and one very small, representing a homogeneous society. In order to observe the homogeneity of each society, produced by the sets of social norms, we observe also the Average Standard Deviation of the simulations. If the Average Standard Deviation is low, this shall mean that all the agents have obtained similar results, obtaining consequently, an homogeneous society.

In Figure 1(b), we can observe four different data clusters. These clusters represent the homogeneity of the each society using a specific set of social norms. The cluster A represent the most homogeneous society, followed by B, C, and D, that is the most heterogeneous. The sets of norms that show a good (high) performance deserve a deeper study. Consequently we extract such sets of norms and analyze the characteristics of both high clusters (C and D).
The sets of norms obtained in the heterogeneous cluster are the ones with the following IDs: 128 - 135, 192 - 199, 384 - 391, 448 - 455. All these set of norms share some common characteristics. These characteristics are extracted the theory of Karnaugh Maps, obtaining the following generalization:

If $Plenty(Agent_A)$ **Then** Do Not give Resources to $Agent_B$
If $Normal(Agent_A)$ **Then** Give Resources to $Agent_B$

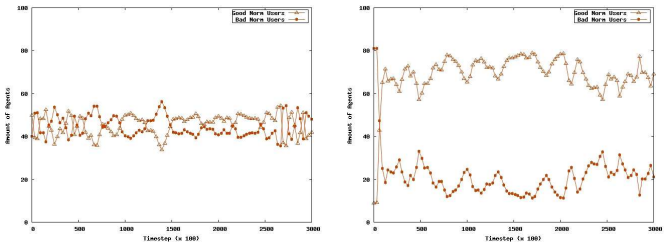
One conclusion that we may extract from this experiment is: when being an agent in resource-scarce environments, do not consider the others state, give only when you are normal and do not give when you are plenty of resources. This kind of norms promote the enrichment of those who are *Plenty*, favouring from those that continuously die and resurrect, and not returning anything to the society. Thus, we have obtained a selfish society, but remembering that obtains good results although in an heterogeneous manner. We still have to analyze the homogeneous cluster. The norms extracted from the homogeneous-high cluster are the following:

If $Normal(Agent_A)$ **Then** Give Resources to $Agent_B$
  Else Do Not give Resources to $Agent_B$
If $Plenty(Agent_A)$
  If $Normal(Agent_B)$ **Then** Give Resources to $Agent_B$
  Else Do Not give Resources to $Agent_B$

On the other hand, these norms, in contrast to the heterogeneous norms, do pay attention on the other agents state to decide the action to take. Possibly, this refinement in the decision process is the cause of the homogeneity.

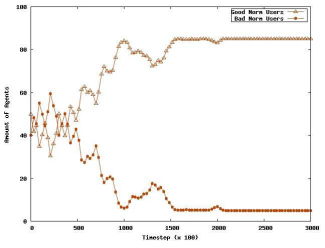
5.2. Norm Support Problem

In this section we analyze the factors that make that a certain set of social norms becomes the dominant set in a society where initially, individuals were using different sets of social norms. From now on we will refer to good, average or bad agents as agents that use a good, average or bad set of norms respectively (as defined in section 5.1).
We believe that when agents are self-interested and are donated with certain mechanisms, they can self-organize themselves to the best configuration available to them. In this case, agents are able to change their social norms for other set of norms transmitted to each of



(a) Image System Off.

(b) Image System On. 9 Good VS 81 Bad.



(c) Image System On. One Visionary Agent

Figure 2. Norm Support. Five Liars Present in every experiment.

them. The problem arrives when we deal with a insincere population. Therefore, agents need an extra mechanism, as it can be the Image System, to control fraudulent behaviour. Image is the own believed evaluation that one agent have of another agent, therefore, our agents are donated with a memory of what the other agents said to them and then an internal evaluation of the degree of truth of the information transmitted to them. In case the agent source of information is a liar, our agents will block interactions with that agent by adding its identity to its own black list.

In figure 2(a) we can see how the presence of liar agents introduce a great instability into the system, making impossible to the other agents to reach any stable state. In figure 2(b) we observe how the possibility of the agents to have a certain social control allows them to stabilize better.

Finally, and in order to accelerate the process of convergence into the best configuration, we introduce the concept of 'Visionary' agent. This kind of agent is able to load mental simulations of the information that arrives to it. If any agent informs it about, for example, that the effectiveness of a set of social norms is very good, the visionary agent is able to load this mental simulation that will give it an approximate value and then compare it with the transmitted information. In this way, instead detecting liar agents and avoid them, the visionary agent also detects the best set of social norms and ease its transmission through the rest of the society. The result can be seen in figure 2(c).

6. Conclusions and Future Work

We have presented in this article a simulated society and an exhaustive study of social norms oriented to share resources that members of such society might use. From this analysis, we have established a quality scale of the different sets of social norms when acting separately. In addition, and relaxing the hypothesis of all the agents sharing the same set of social norms, we have studied several mechanisms that ensures a society with different sets of social norms to self-organize to the best set of norms. Special attention has been paid to the Image System, that in future versions will be extended with a reputation mechanisms. Finally, the visionary agent has been presented as a mechanisms that accelerates the process of norm support.
All the techniques applied in this kind of simulated self-organized society can be directly translated to real-world applications. One of these applications are the open peer-to-peer information exchange systems. Social norms can help ensuring the equality of all the members, stabilizing in the most efficient set of norms, and detecting fraudulent agents. As part of the future work, after proving that the Norm Support Process is improved by the addition of a reputation mechanism, we plan to apply the same mechanisms into a peer-to-peer information exchange system. Our long-term objective is the implementation of a fair, balanced, trusted and self-organized peer-to-peer network, through the usage of social norms, reputation theory and agent-based simulation. As another long-term objective, our research will serve as a simulation platform where to confirm some hypotheses in the archaeological field about how *'the Yámanas'* self-organized and what mechanisms they used.

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