Population Dynamics Necessary to Avert Unpopular Norms

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Abstract. People lives in the society abide by different norms and sometime these norms are unpopular. Usually, these norms develop within small local community, but later spread out to entire population. It is evidenced that the people not only abide by these norms but also start enforcing in certain situations. It is imperative to know why people enforce a norm they privately oppose. Furthermore, for the overall societal good, many a times, it is necessary to oppose and possibly avert unpopular norms. To achieve this goal, it is necessary to know the conditions, which enable persistence of the unpopular norms and models that support possible aversion of them. This study attempts to elaborate the conditions and reasons for the emergence, spreading and aversion of unpopular norms in society, using theory-driven agent-based simulation. The simulation results reveal that in addition to agents actively participating in averting the unpopular norm, incorporating a rational decision-making model in the population of agents is necessary to achieve a dominant norm aversion.

Keywords: Agent-based modeling · Unpopular norms
Emperors dilemma · Norm aversion · Population dynamics

1 Introduction

Norms, practices and processes in a society develop over a period of time [25]. Each society has its own norms and behavior and level of acceptance. Social norms have a historical perspective, which evolves into traditions and standards to which a society can relate and act. Societal norms, such as, way of doing things, greetings, festivals celebrations, dressing and code of conduct have a pivotal role in development of social order [27]. An individual in a community is expected to behave according to the societal norms. However, following a norm and believing in it are two different things. There may be other conditions and incentives that force an individual to follow a social norm [23], even when one does not believe in it.

Social norms can be unpopular; a situation in which majority of people do not agree. In fact, people personally do not conform to these so-called "unpopular norms", but follow them and sometimes unintentionally enforce others to

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follow them as well. In a sociology, such situations are dealt through a dilemma, named as **Emperor's Dilemma** as given in [26]. It relates to a tale in which everyone shows fake admiration for the 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 dumb. The fear of being punished, and identified as having inferior societal traits, no one spoke the truth, but in fact, the emperor was naked.

Unpopular Norm (UN) can be classified into three types; the classification is based on three different causal mechanism [34] - herd behavior (mainly studied by economists), pluralistic ignorance (mainly studied by psychologists) [22,28] and false enforcement.

Herd behavior [2,3] is a reaction to widespread uncertainty that lead people to follow others' decision assuming that they have more accurate and/or reliable information, but in reality they are following the herd believing that "this many people cannot be wrong" [21]. Other examples of herd behavior can be observed in financial markets, such as bubbles and crashes [15] and bank runs [1]. **Pluralistic ignorance** term first used by Katz [10], describes the situation where majority of people reject the norm privately, but assume (incorrectly) that the majority accept it. Like herd behavior, pluralistic ignorance is based on false belief resulted in self-reinforcing. In herd behavior, people copy others behavior assuming (wrongly) to have better information, while in pluralistic ignorance people suppress their disagreement and copy others behavior assumed (again wrongly) to follow the majority.

Silently following an unpopular norm at an individual level is one thing. But, when a large population adopts it, following an unpopular norm becomes a kind of default behavior and influence the section of the population, which does not follow or remains neutral. As a consequence, it has been observed that people even start enforcing unpopular norm to which they personally disapprove. This behavior can be termed as **false enforcement** [20,34] have focused on discovering the reason of wrong enforcement. The authors opinion that people falsely enforce unpopular 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 people who enforced a norm, even against their actual belief, in fact, criticized deviants of the norm (the alternates of the unpopular norm). These outcomes indicate how social pressure can lead to false enforcement of an unpopular norm.

In many places around the world, manifestations of Emperor's dilemma are evident. Whether it is foot-binding in neo-Confucian China or inter-cousin marriages and dowry in Asia (indicated by Blake in [4] and Hughes in [9], respectively). People do not reveal what they believe due to the fear of being identified as ignorant or anti-social. However, there are evidences that a minority of activists can make a big difference if the environment is conducive as indicated by Khondker in [11]. Hence, the question *"Can a minority of activists change an unpopular norm adopted by the majority?"* becomes relevant.

Essentially, norms propagation and transformation are co-relate to each other. Norms propagate through diffused influence. Since the subjects being influenced may have their 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 reciprocally") has been a subject of complex adaptive systems using agent-based modeling as given by Macy and Flache in [16,17]. Understanding the emergence of norms in a society of agents is a challenge and an area of ongoing research [33].

To avert unpopular norms, it is necessary to understand the conditions that help to stop propagation of these norms. Especially, it is imperative to find the conditions necessary to establish the **alternative norm** (a reciprocal norm of prevailing unpopular norm) and the conditions that enforce others (people other than activists) to follow the alternative norm. Towards this, the social interaction model of unpopular norm, proposed in [6] is customized and extended.

Studying norms in society has been one of the research focus of agent-based modeling community. However, there is limited work on how unpopular norms can be averted. To the best our knowledge, we found not a single agent-based model on this topic except for our previous work [35]. In this paper, we propose a model of (unpopular) norm aversion. The agent-based model is simulated asking important "what-if" questions to elaborate the conditions and reasons for the emergence, spreading and aversion of unpopular norms.

The rest of the paper is organized as follows. Section 2 presents background work related to the research area, followed by Sect. 3 presents the motivation of the proposed model, followed by the proposed and extended model. In Sect. 4, the simulation scenarios and analysis of simulation results is presented. The paper ends with conclusions of the study presented in Sect. 5.

2 Background Work

Studying norms in a society has been one of the research focus of agent-based modeling community. Theoretical studies on norms such as those conducted by Conte and Castelfranchi [7] and Meneguzzi et al. [19] explored that agent are supposed to comply with social norms. The sense of punishment from the society is evident as the predominant factor behind compliance of norms [5]. Studies conducted by Sanchez-Anguix et al. [29] and Sato and Hashimoto [30] focused on the emergence of norms and they described strategies show how norms prevail in a society. This is basically governed by societal influence. Agents set their goals and frequently change their behavior based on societal influence until a global equilibrium in achieved [33]. In [8] argued that norms implementation in some expert system such as norm-based reasoners are commonly used. Also, social norms have received considerable attention in other similar domains such as social and logical philosophy. Norms can be views as emergent properties of agents' behaviors, which do not depend on their goals and beliefs. In [32] have studied the implementation of norm enforcement and issues that highly affect such enforcement and how these norms should be operationally implemented in MAS.

Willer et al. have pointed out many "empirical cases in which individuals are persuaded to publicly support behaviors or beliefs that they privately question" [34]. The term, Preference falsification, coined by Kuran [14] is defined as "the act of misrepresenting one's genius wants under perceived social pressures". According to him, an equilibrium is the sum of three utilities namely, intrinsic, expressive, and reputation. The intrinsic utility is about individual's personal satisfaction being part of the society. The expressive utility is about an individual gain in response of presenting himself/herself to be what is expected. The utility that is acquired through the reaction of others is termed as reputation utility.

The concept of unpopular norm is very close to the concept of preference falsification, in which individuals publicly lie about their privately held preferences [13]. According to Makowsky and Rubin [18], such societies are "prone to cascades of preference revelation if preferences are interconnected - where individuals derive utility from conforming to the actions of others". Further, "ICTs and preference falsification complement each other in the production of revolutionary activity. The former facilitates the transmission of shock while the latter increases the magnitude of change that arises after a shock." Utility acts in two different ways in the propagation of unpopular norms. At one end, it can force an individual to follow an unpopular norm, or even falsely enforce it. On the other end, it can propagate an opposite sentiment as a result of private preference revelation. There are evidences that a minority of activists (capable of revealing their private preferences on will) can make a big difference, but in a conducive environment [11].

3 The Proposed Extended Model

To avert UN, it is important to understand conditions that might help to stop the propagation of these norms. Particularly, it is imperative to find the conditions necessary to establish an alternative norm - a reciprocal norm of prevailing UN, and the conditions that enforce people other than activists to follow the alternate norm. This section first introduces the social interaction model for following UN proposed by Centola et al. [6]. It, then, provides briefly our previous extension to this model followed by the proposed extension in this paper.

3.1 Centola's Model of Norm Aversion

In Centola model [6], agents decide whether to comply or follow the norm, which is supported by few individuals while majority opposed it. Depending on agents' horizon, if it is limited to immediate neighbors, resulting in emergence of an unpopular norm locally and later spread. Such examples can be seen in our daily lives; where work carried out by the prestigious scholars are widely acceptable publicly, and cannot be criticized due to the fear of being labeled as "unfit for office"/"incorrigibly stupid", while privately people find them entirely inappropriate. This is true in case of naked emperor, where majority can see him naked, but due to fear prefer to go along with the charade and admire the emperor, hence reinforcing the same false belief.

Centola used agent-based modeling to study the consequences of false enforcement as a signal of sincerity on the population level. Using theory driven approach, this model is capable of elaborating the conditions behind the emergence, spreading, and the aversion of UN. A majority of agents who do not believe in the UN and can be represented as Dis-Believers (DB's), while agents believe in the UN can be represented as True Believer (TB's). Each agent let say i has a binary private belief (Bi) and defines agent either as TB or DB. In case of TB (Bi = 1), while for DB (Bi = −1). Irrespective of the social pressure not to comply, a small group of TB's always comply with the norm. When these agents are not satisfied with the compliance level by the others, they may enforce them, and this is called "true enforcement", because the agent is enforcing compliance with its true belief i.e. Bi = 1. The rest of the population (DB's), who opposed the norm in private, but less conviction in comparisons with TB's. This opposition can result in deviating from the norm and even convenience other to deviate as well. This is again "true enforcement". Due to the weak strength of this convocations as compared to the TB, DB may be pressurized to support the norm in public. This support not only includes to comply with the norm, but also to pressurize others to comply as well. This is "false enforcement" because the agent enforcing the norm contradict with agent's private belief.

Initially, all TB's comply with the UN represented as compliance = 1, while DB's not complying with the UN represented as compliance = −1. The compliance is based on the level and the direction of the social pressure, which is relative to the strength of an agent's conviction i.e. how truly agent believe in norm. Social pressure is the sum of enforcement decisions by the i*'s* neighbor i.e. each neighbor j enforcement of the norm increases pressure on i to comply and vice versa. A positive value means that more pressure on the agent to comply and a negative value results in encouraging deviation. By default, TB's alway comply even if all their neighbors enforce deviation. In case of DB's, due to the weak conviction may change subject to the sufficient positive social pressure. More formally, An agent i's belief is a static value. The value of compliance may change using Eq. 1.

$$compliance_i = \begin{cases} -belief_i \quad if \ (\frac{-belief_i}{N_i} \times NE_i) > strength_i \\ belief_i \quad otherwise \end{cases} \tag{1}$$

Where, NE_i = count of (Moore's) neighbors enforcing opposite belief and N_i = count of (Moore's) neighbors. This means that an agent's decision to comply with UN or not is dependent on enforcement of opposite belief by the neighborhood. If NE_i is greater than the strength of a DB, the agent would comply against its belief. Since, TBs compliance (which equals their belief about a UN) and strength are already equal to 1, Eq. 1 would not change the compliance value of TBs.

$$enforcement_i = \begin{cases} -belief_i, \ if \ (\frac{-belief_i}{N_i} \times NE_i) > (strength_i + k) \bigwedge (belief_i \neq compliance_i) \\ belief_i, \ if \ (strength_i \times enforcement\_need_i > k) \bigwedge (belief_i = compliance_i) \\ 0, \quad otherwise \end{cases} \tag{2}$$

Enforcement is an agent influence on the neighborhood and it could be true or false, starting with a default value of 0, it can be either 1 or −1. In case of false believers, who secretly opposed the norm, they do not pressurize others to comply with the norm, but in case of true believers who support to promote compliance. The propensity to falsely enforce is directly propositional to increase in social pressure to support the norm and decreases with increased conviction, same in case with the decision to comply.

Equation 3 is used to compute $enforcement\_need_i$ - that is the need of enforcement reflecting influence of neighborhood compliance.

$$enforcement\_need_i = \frac{(1 - \frac{belief_i}{N_i}) \times NC_i}{2} \tag{3}$$

Where, NC_i = number of (Moore's) neighbors whose compliance is different than agent's belief.

3.2 Our Previous Extension

Since, DBs compliance in basic centolla's model is undesirable, in our previous work [35], published in recent conference [24] we extended it and introduced a special kind of DBs (called Activists (ACTs)) with more desire to avert (act against) a UN. These ACTs are triggered by the presence of TBs in the surrounding, particularly who are enforcing. Their strength is progressively incremented proportional to the intensity of enforcement from TBs. The strength of an ACTs is calculated using Eq. 4.

$$strength_i = strength_i + (\frac{E_{jb}}{N_i}) \tag{4}$$

where, E_{jb} = is the number of enforcing TBs.

3.3 The Model Extension

In this paper, the model is further extended to incorporate the decision-making of a DBs as a result of neighborhood condition. It is proposed that TBs (who are not ACTs) should not be considered as entirely a numb entity. We propose a decision-making model represented in Eq. 5. In this model, the strength of DBs (who are not ACTs) is changed (increased or decreased) based on its type being either "optimistic" or "pessimistic". The difference between percentage of enforcing TBs (termed as, P_{jb}) and percentage of complying DBs (termed as, P_{jd}) is

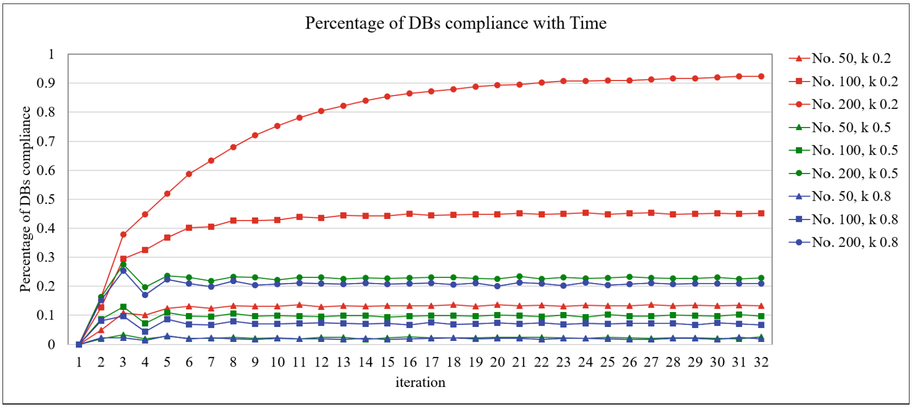

Fig. 1. Simulation results of the basic Centolla's model for various scenarios based on number of agents (considered 50, 100, and 200) and threshold value k - showing an agent's desire to comply (considered 0.2, 0.5, and 0.8).

divided by neighborhood density (N_i) times the fraction of DBs of that type (consider *opt* for an optimistic and "$1-opt''$ for a pessimistic DBs). If an agent belongs to the optimistic category, its strength would be increased/decreased based on the difference of "true enforcement" (represented as P_{jb}) and "false compliance" (represented as P_{jd}). When fast compliance is more then the strength will decrease. On the other hand, when true enforcement is more then the strength will increase.

$$strength_i = \begin{cases} strength_i + (P_{jb} - P_{jd})/(N_i \times opt), & if\ i\ is\ optimistic \\ strength_i + (P_{jb} - P_{jd})/(N_i \times (1 - opt)), & otherwise \end{cases} \quad (5)$$

4 Simulations and Results

4.1 Simulation Environment

Netlogo [31] - a popular agent-based simulation tool with a support for grid based spaces, is used to simulate the work presented in this paper. The agents reside on cells of a spatial grid. We have used the concept of Moore's neighborhood to represent the surrounding of an agent - a very popular strategy in many cell-based spatial configurations [12]. For a coarse grained evaluation, we used a simulation space consisting of a torus of 17×17 cells.

4.2 Results and Discussion

Previous Findings. Due to the spatial nature of neighborhood, it was expected that a more dense population is susceptible to more DBs compliance. This fact is evident from the results shown in Fig. 1. Further, DBs compliance is inversely

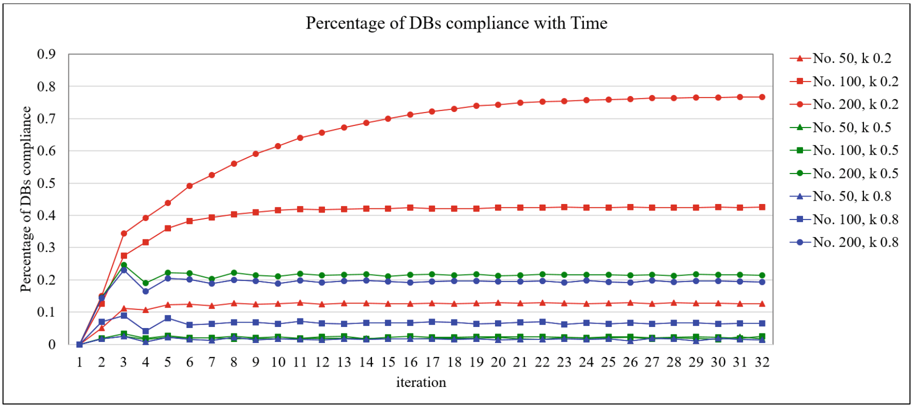

Fig. 2. Simulation results of our previous extension to Centolla's model for various scenarios based on number of agents (considered 50, 100, and 200) and threshold value k - showing an agent's desire to comply (considered 0.2, 0.5, and 0.8).

proportional to the value of k - an agent's desire to comply. Ironically, in all cases depicted in Fig. 1, the population achieves stability always being attracted towards various fixed points. In our previous work [35], it was observed that in highly dense conditions with a large number of norm aversion ACTs, the aversion of unpopular norms can be achieved. This fact is highlighted in Fig. 2. There is a striking similarity between the basic model and our previously extended model whose results are presented in Figs. 1 and 2 in corresponding order. It is learnt that the cases comprises of smaller values of k and large number of agents are worst than the rest of the cases. A marginal improvement was achieved by introducing the ACTs where comparatively less number of DBs were witnessed complying with a UN.

Current Findings: A Brief Analysis. This model uses optimistic DBs that are intrinsically believing in averting the UN. Simulation work conducted in this paper uses three different numbers of these optimistic DBs which are counted as 10, 20 and 30% of the total population. It is learnt that the proposed model significantly reduces the number of DBs complying with a UN. Even the scenario considered as a worst one (the one comprises of 200 agent and a threshold value k = 0.2) achieved a 100% improvement by dropping compliance rate from 70% to 35%. This is illustrated in Figs. 2 and 3.

When the proposed model is compared with previous model, it was noted that DBs compliance comparatively get worse as the number of agents' increases irrespective of the value of k. The cases where the number of agents are 200 always perform worst than other cases (comprising of 50 or 100 agents). This can be noticed while comparing the results presented in Fig. 2 with 3). Overall, with an increase in the number of optimistic DBs, the results get improved as witnessed by comparing the results given in Figs. 3, 4, and 5).

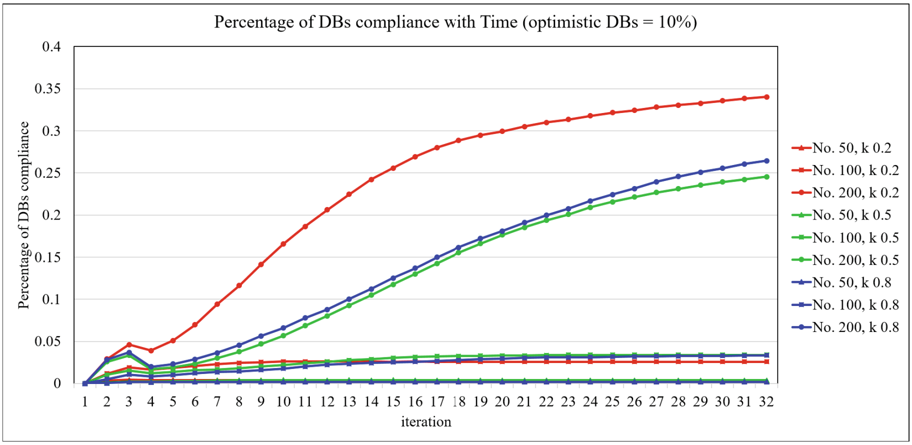

Fig. 3. Simulation results of the proposed extension (with 10% agents of total population being optimistic) to Centolla's model for various scenarios based on number of agents (considered 50, 100, and 200) and threshold value k - showing an agent's desire to comply (considered 0.2, 0.5, and 0.8).

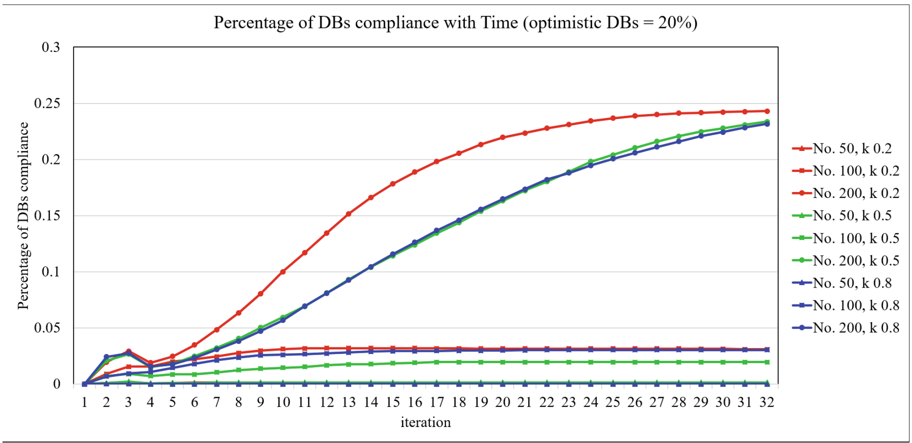

Fig. 4. Simulation results of the proposed extension (with 20% agents of total population being optimistic) to Centolla's model for various scenarios based on number of agents (considered 50, 100, and 200) and threshold value k - showing an agent's desire to comply (considered 0.2, 0.5, and 0.8).

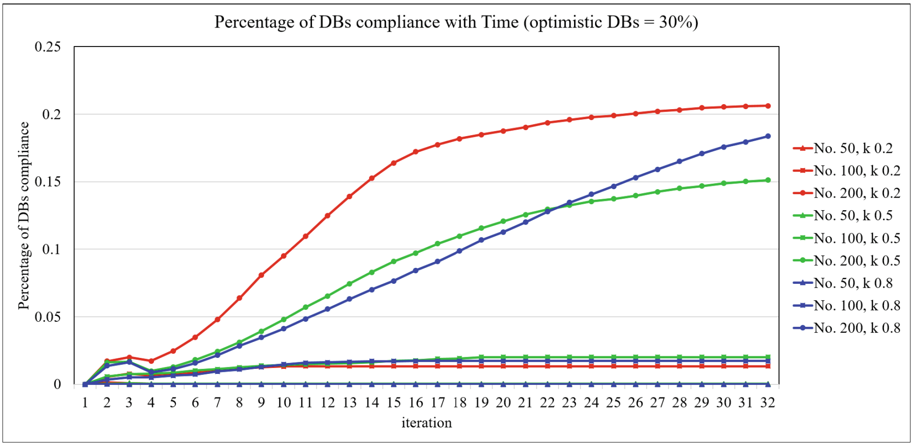

Fig. 5. Simulation results of the proposed extension (with 30% agents of total population being optimistic) to Centolla's model for various scenarios based on number of agents (considered 50, 100, and 200) and threshold value k - showing an agent's desire to comply (considered 0.2, 0.5, and 0.8).

5 Conclusion

It is argued that for societal good, it is necessary to oppose and possibly avert unpopular norms. This work is an attempt to realise the conditions that result in the emergence of unpopular norms, and define situations under which these norms can be changed and averted. It presented an agent-based simulation for unpopular norm aversion. It utilised the reciprocal nature of persistence and aversion of norms 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. Further, it is learnt that the inclusion of true believers and activists play a significant role in norm aversion dynamics. In short, this study revealed that more educated and socially active individuals are key to reduce undesirable norms in a society. The significance of this fact is also applicable to digital societies primarily created by social networking applications now-a-days.

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