The effect of social influence and curfews on civil violence (Extended Abstract)

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ABSTRACT[1]

We investigate the policies of (1) restricting social influence and (2) imposing curfews upon interacting citizens in a community. We compare their effects on the social order and the emerging levels of civil violence. We develop an agent-based model that is used to simulate a community of citizens and the police force that guards it. We find that restricting social influence pacifies rebellious societies, but has the opposite effect on peaceful ones. Curfews exhibit a pacifying effect across all types of society.

Categories and Subject Descriptors

I.6.5 [**Simulation and Modelling**]: Model Development, Modelling methodologies. J.4 [**Social and Behavioural Sciences**]: Sociology.

General Terms

Experimentation, Human Factors,

Keywords

Description level: Experimental/Empirical, Simulations; **Inspiration source:** Social sciences; **Focus:** Comprehensive/Cross-cutting (multi-agent based simulation), Social/Organisational (groups and teams, emergent behaviour), Environment (environment modelling & simulation).

1. INTRODUCTION

Civil unrest, in the form of rioting, has occurred throughout history with the target of unrest being the central authority; examples are 1967 Newark Riots and the 2005 Parisian Riots. Agent based models have been created to simulate instances of civil unrest against a hypothesised centralised authority [1-3].

Epstein's work [1] on civil violence used simple rules leading to macroscopic behaviours is the basis for our work. The original work, and extensions by Goh et al [3], do not account for citizens interaction, such as social influence. No investigation is made into the effectiveness of polices controlling either communication or movement and investigate the effect on levels of outburst.

Social influence has been incorporated in multi-agent models [4] for innovation diffusion, where the strength and importance of relationships are represented by weighted connections between nodes. Within a crowd situation the relationships will be of proportional proximity, with influence models adapted accordingly. Literature searches found no prior curfew models.

2. SIMULATION MODEL

The environment is represented as a 2D grid within which two agent types exist: Citizens and Cops. At each time step agents will move to a randomly selected free location within their Moore Neighbourhood, the boundaries of which are defined by the agent's radius *r*, where *r* is homogeneous and exogenous. Once an agent has moved, it acts according to its specification.

Citizens have two states: active (rebelling) or inactive (peaceful). During each simulation step a citizen will choose the state most favourable by comparing utilities associated with the states: U_{AC} (utility of activity) and U_{IN} (utility of inactivity). U_{IN} is exogenous and homogeneous under the assumption that the benefit of remaining inconspicuous is the same for all citizens. U_{AC} is calculated by each citizen and represents the abstract gain of turning active. When $U_{AC} > U_{IN}$ a citizen will select the active state; when $U_{AC} < U_{IN}$ a citizen will select the inactive state, when $U_{AC} = U_{IN}$ the citizen randomly selects one state.

$$U_{AC} = P_{AR} * U_{AR} + P_{NAR} * U_{NAR}$$

Equation 1: Calculation of a citizen's Utility of Activity.

A citizen's U_{AC} is calculated as shown in Eq. (1). U_{AR} is the utility of getting arrested, the value of which is exogenous and homogeneous, representing the cost of being arrested to a citizen. U_{NAR} is the utility of not getting arrested, drawn from a beta distribution with the mean exogenously set, representing the unique gain each citizen feels by expressing their feelings. P_{NAR}, the probability of not getting arrested, is calculated in Eq. (2). C represents the set of all the cops within the citizen's neighbourhood, and $\propto_i$ represents the number of active citizens within the neighbourhood of cop i; $\propto_i$ includes the citizen as being active, giving the arrest probability *if* the citizen is active.

$$P_{NAR} = \prod_{i \in C} \left(1 - \frac{1}{\propto_i}\right)$$

Equation 2: Citizen's probability of not being arrested.

P_{AR} is the probability of being arrested, calculated in Eq. (3).

$$P_{AR} = 1 - P_{NAR}$$

Equation 3: Citizen's probability of being arrested.

Cops, at each step of the simulation, randomly arrest one active citizen within their movement range r, and remove the citizen from the field for x steps, where x is (0,*J*) with J being the exogenously set max jail term.

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2.1.1 *Social Influence*

The influence model was adapted from innovation diffusion studies [4] and permanently affects the citizen's U_{NAR}. Two extra constants were added for each citizen agent: influence (f) and susceptibility to influence (s). f and s are drawn from a uniform distribution (0,1). A citizen's U_{NAR} is calculated in Eq. (4).

$$U_i^* = (1 - s_i)U_i + s_i \frac{\sum_{j \neq i} U_i f_j \, exp\left(-\frac{d(ij)^2}{\sigma^2}\right)}{\sum_{j \neq i} f_i exp\left(-\frac{d(i,j)^2}{\sigma^2}\right)}$$

Equation 4: The effect of influence on U_{NAR} .

Where U_i is the U_{NAR} of the citizen in question, citizen i, and U_i^* is the calculated new value for U_{NAR} of the citizen i; j represents the index of all the agents within radius r of citizen i; f is the referenced citizens influence; s is the referenced citizens susceptibility; d is the Euclidean distance between i and j; σ is the Gaussian kernel, which is set externally before a simulation run.

2.1.2 *Curfew Model*

Without any studies being carried out on curfews explicitly, we use a dictionary definition to assume a curfew will directly prevent a citizen from moving or interacting with their surrounding neighbourhood. During a curfew citizens do not move or interact with neighbours; cops can move freely and arrest, replicating breaking of a curfew by active citizens.

3. EXPERIMENTS

Experiments investigate the effect communication and mobility has upon the levels of unrest. Model settings for experiments 1 – 4 are given in tables 1 and 2. Each simulation run of a U_{NAR} value was repeated 5 times and the average taken as the result. Curfews lasted for 5 consecutive steps out of every 15 during a simulation.

Table 1. Individual model settings for experimental runs.

Experiment	Influence	Curfew
1	No	No
2	Yes	No
3	Yes	Yes
4	No	Yes

Table 2. Generalised settings for all experimental runs

Variable	Value	Variable	Value
r	4	Cop Density	4%
U_{AR}	0.01	Citizen Density	70%
U_{IN}	0.5	Grid Size	40 x 40
J	30	Gaussian Kernel σ	5
Steps	1500	Topology	Torus

4. RESULTS

U_{IN} marks the turning point between citizens being rebellious and non rebellious, set to 0.5; If the mean U_{NAR} is below U_{IN}, the general population is predisposed towards peace; if the mean U_{NAR} is above $U_{IN}$the population is predisposed towards violence. Fig. (1) shows all experimental results. Comparing experiments 1 and 2, if a ruling authority of a peaceful population enforces a policy restricting free communication, it increases the level of unrest. Restriction in a population predisposed to rebellion decreases the level of unrest. Fig. (2) shows the convergence of citizens' U_{NAR} to the mean as a direct result of the freedom of communication. This phenomenon is due conformity [5], whereby citizens will change their behaviour to match the behaviour of others based upon the perceived consensus of their surroundings. Fig. (1), comparing all experiments shows that irrespective of the actual predisposition of the population towards either rebellious unrest or peaceful living, and whether enjoying free communication or otherwise, a curfew produces a proportional success in reducing the degree of unrest exhibited.

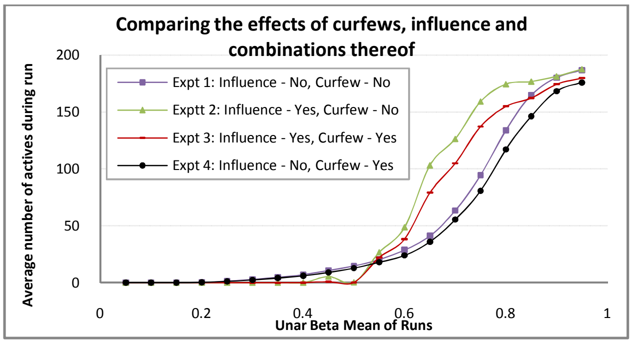

Figure 1: Average active citizens count across the range of U_{NAR} values for all experiments.

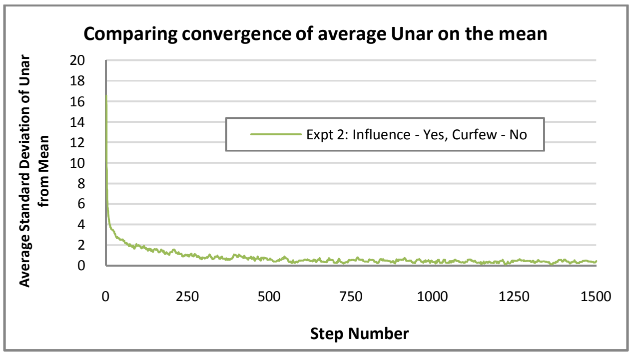

Figure 2: SD of citizens' U_{NAR} converging to the mean of 0.5

5. CONCLUSION

Curfews reduce the incidences of civil unrest proportionally for all society types. Restricting mobility does not create adverse affects, helping to perhaps explain why it is such a popular policy irrespective of the controlling authority which implements it – whereas limitation on the freedom of communication usually occurs under a dictatorship. Communication, however, differs. Free and open societies will find the limitations objectionable, increasing violence levels; volatile societies find some successes in restricting the degree of openness and communication. Free communication effects are based upon the principles of conformity and perceived consensus[5], hence the differing result.

[1] Epstein, J. M. 2002. Modeling Civil Violence: An Agent-Based Computational Approach. In proceedings of the National Academy of Sciences, U.S.A.,Vol. 99, pp. 7243-7250.

[2] Ginkel, J and Smith, A. 1999. So you say you want a revolution: A game theoretic explanation of revolution in repressive regimes, Journal of Conflict Resolution, vol. 43, no.3, 291-316.

[3] Goh, C.K. et al. 2006, Modeling Civil Violence: An Evolutionary Multi-Agent, Game theoretic approach, 2006 IEEE Congress on Evolutionary Computation, Vancouver, BC, Canada, July 2006.

[4] Delre,S.A., Jager, W., Bijmolt, T. and Janssen, M.A. 2007 (in press). Will it spread or not? The effects of social influences and network topology on innovation diffusion. *Journal of Product Innovation and Management.*

[5] Cialdini, R. B. and Goldstein, N. J., Social influence: Compliance and conformity, Ann. Rev. Psychol. 55, 591–621. 2004