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Research on Analysis and Dynamic Evolution of Deviant Tourists Behavior

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Abstract

Deviant tourist behavior not only has direct influences on management cost of organization, but related to travel perception of tourists. Existing related researches consider less the evolution of deviant behavior. The article proposes a decision-making rule of deviant behavior which makes tourists as decision subjects and develops the evolution model of deviant tourist behavior. Then, the evolution simulation of deviant tourist behavior based on dual-agent is implemented using NetLogo simulation platform and the simulation experiment which is aimed at studing the influence of manager density and conformity preference on deviant tourist behavior, which reveals strategies of optimizing the evolution result of deviant behavior. By simulation experiment, we show that herd behavior characteristic of attractions for tourists could promote the consistency of group civilized behavior, and setting attractions manager density at 4% reasonably could contain large-scale outbreak of deviant tourist behavior.

Key words: Tourists; Manager density; Conformity preference; Deviant behavior; Simulation research

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INTRODUCTION

Tourism activity affects destinations in many ways: economically, socially and environmentally (Ganglmair-Wooliscroft & Wooliscroft, 2016). The tourism industry is an essential economic sector for developing and developed countries, with more and more domestic and internatinal tourists. Deviant tourism behavior has range of well-documented negative environmental consequences. Few governments take regulatory action to prevent such negative effects, possibly because it may reduce tourism demand, and simultaneously tourism revenues (Juvan & Sara, 2016). Meanwhile, Consumers have also an increasing interest in behaviour of civilized traveling. Tourists can help to reduce this negative impact by making environmentally sustainable vacation decisions and behaving in an environmentally sustainable manner while at the destination (Ibid.).

The phenomenon of deviant tourist behavior involves practices undertaken in a tourism-related context that operates at the fuzzy edge of social legitimacy or legality (Ryan & Kinder, 1996). The exsiting researches on deviant tourist behaviors are mainly focused on exploring the patterns, causes, measurement and correction of deviant tourist behavior (Juvan & Dolnicar, 2016). The empirical research on relationship between respondents' social expectations tendency and environmentally sustainable tourists behavior found that the incidence of environmental sustainable tourist behavior is up to 74% under the condition of higher social expectation (Ibid.). Lin (2013), on the other hand, based on the qualitative analysis method and the object of Chinese southern minority nationalities, draws the conclusion of humanistic quality's effect on the phenomenon of deviant tourism behavior. Ganglmair-Wooliscroft and B. Wooliscroft's (2016) research establshed Rash model to link deviant tourist behavior and consumer innovation by virtue of empirical research on normal tourists sample. From the perspective of psychoanalysis and interview method, Uriely et al. (2011) suggested that different tourism and tourism activities will spur deviant tourism behavior unconsciously. From the perspective of marketing, Brunt and Brophy (2004) discussed the relevance with deviant tourist behavior level and resort's marketing ways through empirical research, found that some marketing means repeatedly involved parties, stimulating nightlife, and relaxed atmosphere will lead to more deviant behavior, even criminal behavior. Combined with the moral development of theory, Li (2015) supposed a framework of deviant tourist behavior and theoretically elaborated causes of deviant behavior from individual, others, groups and society, and this research found bad habits and the destruction for tourism resources or equipments is the main form of deviant behavior. Majority of literature has not explained how the tourists' deviant behavior evolves and how to change the evolution results. Therefore, this research establishes a decision-making model of deviant tourist behavior, constructs the evolution model of deviant tourist behavior by using Agent simulation modeling technology, and studies the strategies of optimal evolution results.

By lab experiments, Kirchler et al. (2016) have verified that threat of punishment could improve the moral level. This means that during the evolution process of deviant tourist behavior, the role of scenic spot managers on supervision and punishment over tourists should not be ignored. On the other hand, the individual, as a member of group, has a very strong inclination to follow and imitate others. Therefore this paper takes the difference characteristic of conformity preferences as well as the complex interactions between tourists and scenic spot managers into consideration, and utilizes simulation modeling software, NetLogo simulation platform to construct the simulation model of deviant tourist behavior evolution. This model is based on two kinds of agents, scenic spot tourists and managers. And due to difference characteristic of tourist, it divides the tourists into three types of agents according to conformity preferences. The individual will conduct self-decisions by following other individuals within his view according to conformity preferences and commit self-adjustment and self-improvement according to density distribution of scenic spot managers and frequency of punishment. This research is aimed at exploring the influences of density proportion of scenic spot managers and conformity preferences of tourists on deviant tourists quantities at the end of simulation, simulating the behavior of double-intelligent agents, tourists and managers and their interactions, constructing the simulation model of deviant tourist behavior evolution, and analyzing and simulating the optimization of experimental results to reveal the strategy of optimizing deviant behavior evolution results.

1. BEHAVIOR RULES

The evolution model of deviant tourist behavior built by this paper takes the scenic spot as a complete complex system, and the scenic spot includes two kinds of agents, tourists and managers. The tourists could choose to conduct not-deviant behavior or deviant behavior according to decision resources of tourists themselves and decision rules. Tourists will make judgments about whether they conduct deviant behavior or not based on whether the difference between expected utility and expected cost of conducting deviant behavior is greater than behavior threshold value T or not. Expected utility is composed of behavior motivation and civilized awareness of the tourists which refer to the measurement of the agent (scenic spot tourist) to satisfy his need through deviant behavior. For example, the tourists satisfy their convenience need by damaging environmental health and satisfy their vanity need through carving and painting on facilities. Expected cost is made up of probability of being caught and reputation cost, and refers to the measurement of the cost brought by deviant behavior. Interim procedures for managing the records of deviant tourist behavior stipulates, if necessary, records of deviant tourist behavior should be reported to public security, customs, immigration inspection, transportation and people's bank credit investigation institutions, which undoubtedly increase the reputation and moral cost of deviant tourist behavior.

Behavior motivation means the interior driving forces that cause behavioral agent to conduct deviant behavior and wishes and intentions that cause the agent to conduct deviant behavior in specific environment of the scenic spot. The larger an agent's behavior motivation is, the larger his expectation and driving force to cause him to conduct deviant behavior are. And it is easier for him to decide to conduct deviant behavior.

Civilized awareness is tourists' knowledge about their deviant behavior, that is their understanding of definition, punishment, importance and necessity of deviant behavior. With stronger civilized awareness, it means stronger wish and habituation to conduct civilized behavior, and it is easier for him to decide to conduct civilizd behavior.

Reputation cost is reputation loss cost caused by agent deviant behavior generated by reputation mechanism covered by laws and regulations. It could constrain the opportunistic behavior of an agent to some extent. The higher an agent's reputation cost is, the stronger the constraint that causes this agent to conduct not-deviant behavior is. And it is easier for this agent to decide to conduct civilizd behavior.

The probability of being caught is the probability of supervising and punishing tourists who are conducting deviant behavior produced by the obligation of scenic spot managers to supervise and punish deviant tourist behavior. The probability of being caught is judged through the ratio between managers and tourists in the surrounding environment. That this ratio is very high indicates the higher probability of being caught and stronger constraint and vice versa.

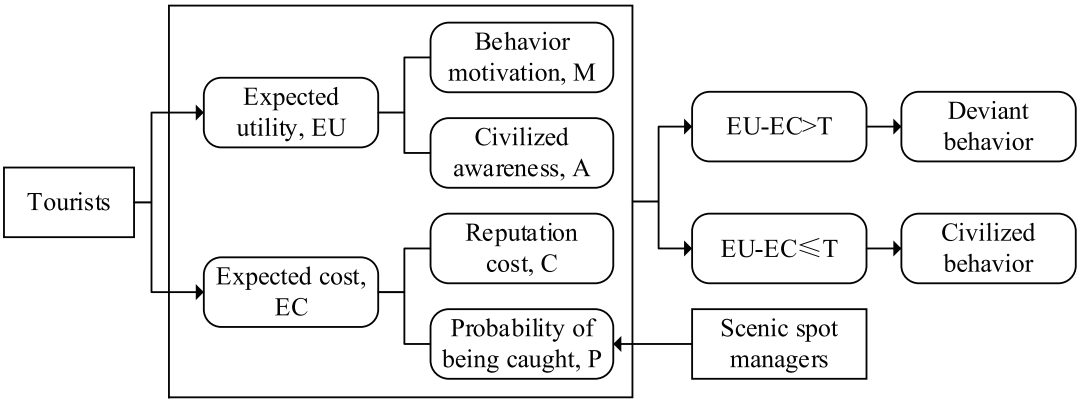


Figure 1
Behavior Rules for Tourists

Scenic spot managers play the role of supervising and punishing the deviant behavior of tourists. They could immediately arrest and punish tourists who are conducting deviant behavior within their visible range, which has an impact on the probability of being caught, so as to increase the expected cost of tourists for their deviant behavior and limit their deviant behavior. This paper also takes into consideration difference characteristic of conformity preferences of individuals and divides tourists into different attributes according to conformity preferences: independent type, adaptive type and conformity type. Tourists of conformity type only make judgments about whether they choose to conduct deviant behavior or not according to conformity value, that is, the choice of most of tourists in the neighborhood. There are interactions between scenic spot tourists and managers in the system of a scenic spot and not-deviant and deviant behaviors evolve under the rules of decision to finally constitute the evolution model of deviant tourist behavior.

2. MODEL BUILDING

Two assumptions are given before building the model:

Assumption a behavior decisions of other individuals are observable in the system of a scenic spot.

Assumption b in the system of a scenic spot, different behavioral agents have different resources which have heterogeneity.

A complex system is a system generated by agents with different goals and capabilities and interactions among these agents. Emerging behavior of a complex system is determined by several factors, including agent behavior, evolution rules, agent interaction network and available information structure of agents (Tsai, 2013). Therefore the model built by this paper takes a scenic spot as a complete complex system, and tourists and managers contained in this scenic spot are two kinds of individuals. Evolution of individual behavior, and interactions and relations among individuals constitute the development of this whole system. This paper, through construction of evolution model of deviant tourist behavior, analyzes the decision choice of a single tourist agent between not-deviant and deviant behavior under the addition of scenic spot managers, and then makes a summary of tourists who belong to the same behavior status in accordance with decision situation of agents, and analyzes the respective number of not-deviant tourists and deviant tourists included in this whole system, so as to study on evolution of deviant tourist behavior and strategy of optimizing evolution results. Decision analysis starts from individual decision whose logical basis is to construct a frame model based on expected utility theory to analyze the decision choice of each individual (Kirchler et al., 2016). Therefore, this paper, from the perspective of tourists' decisions of conducting not-deviant behavior or deviant behavior, evaluates whether tourists will conduct deviant behavior or not based on difference value between expected utility value and expected cost value, to finally obtain deviant behavior level of the whole system. Because avoidable supervision is easier to cause deviant behavior, power given to the supervised to influence supervision will encourage people to conduct deviant behavior (Chick & Gans, 2009). Therefore, tourists and managers involved in the model of this paper do not have any overlap relation. The model supposes that scenic spot managers are selfless, and they are not influenced by the tourists to indulge their deviant behavior.

Based on above assumptions and definitions, deviant tourist behavior decision model formula is as follows:

$$f = (V_r, L_r, U, N, F). \tag{1}$$

Decisions made by tourists to conduct deviant behavior are determined by five variables, namely, the systematic environment of the whole scenic spot, tourists themselves, managers, and evolution rules, in which f is evolution model; V_r is tourists of a scenic spot; L_r is the whole system of this scenic spot which is a complex system composed of all agents in this scenic spot; U is scenic spot managers; N is Moore neighborhood; F is evolution rules that do not take into consideration other agent factors within Moore neighborhood. The results of F are only two kinds, not-deviant behavior or deviant behavior. Whether tourists would choose to conduct deviant behavior or not is determined by the difference between expected utility and expected cost, based on the description of the above decision model, which is denoted as:

$$F=\begin{cases}V^{l}, if\ EU-EC>T\\ V^{h}, if\ EU-EC\leq T\end{cases}. \quad (2)$$

In which, V_l denotes that the evolution result of agent behavior is deviant behavior and correspondingly, V^h denotes that the result of evolution result of agent behavior is not-deviant behavior. T is behavior threshold value of man-made setting, T =0.1. Take a scenic spot as a system, and use the evolution model formula of deviant tourist behavior to evaluate behavior decision of each tourist agent, then deviant level of this scenic spot could be calculated by the ratio between the total number of deviant tourists and the total number of not-deviant tourists and deviant tourists. Deviant level of a scenic spot is denoted as ω:

$$\omega=\frac{\sum_{i=1}^{n}V^{l}}{\sum_{i=1}^{n}V^{h}+\sum_{j=1}^{m}V^{l}}. \quad (3)$$

Each agent is a behavior decision-maker, and his decisions are influenced not only by his own decision-making factors, but also behaviors of other decision-makers in surrounding him. A part of behavior agents will give up their own decisions and choose to be consistent with group selection under the influence of the decisions of surrounding groups. This is a kind of conformity behavior. Because conformity preference degree of each tourist is different, the tourists could be divided into three types, independent type, adaptive type and conformity type in accordance with conformity preferences which are respectively represented $V_{i,S1}$, $V_{i,S2}$ and $V_{i,S3}$. This model considers the corresponding evolution rule agents for each type agents.

(a) Independent tourist

Independent type denotes that in decision model formula, $f(V,Li,U,N,F)$, tourists of this type are not affected by N, namely the influence of behavior decisions of tourists in the surrounding neighborhood. They only follow their own evolution rule to determine whether to conduct deviant behavior or not. The evolution rule for deviant behavior of independent tourists $V_{i,S1}$ is:

$$f(V_{i,S_1}^{t+1})=\begin{cases}V^{l}, if\ EU-EC>T\\ V^{h}, if\ EU-EC\leq T\end{cases}. \quad (4)$$

(b) Adaptive tourists

Whether an adaptive tourist decides to conduct deviant behavior or not is determined not only by F, but also by N. He may choose behavior based on evolution rule F, or behavior decisions of most tourists surrounding him, or the combination of the two factors. It depends whether decision of an agent is contained in decision set within N. Deviant behavior evolution rule for independent tourists $V_{i,S2}$ is:

$$f(V_{i,S_2}^{t+1})=\begin{cases}Y^{*}(V_{iL}^{t}), if\ f(V_{i,S_2}^{t+1})\subseteq f(V_{iL}^{t})\\ f(V_{i,S_1}^{t+1}), 当 f(V_{i,S_2}^{t+1})\not\subset f(V_{iL}^{t})=\begin{cases}V^{1}, if\ EU-EC>T\\ V^{h}, if\ EU-EC\leq T\end{cases}\end{cases}. \quad (5)$$

In which $Y^*(V_{iL}^t)$ represents the mode of decision set within neighborhood N.

(c) Conformity tourists

In the decision model formula f=(V_i,Li,U,N,F), conformity tourists are bot affected by F and they only follow behavior decisions of most tourists in the surrounding neighborhood to determine whether to conduct deviant behavior or not. If most tourists in the surrounding neighborhood (set as over half tourists) choose to conduct deviant behavior, tourists of this type will also decide to conduct deviant behavior and vice versa. The deviant behavior evolution rule for conformity tourists $V_{i,S3}$ is:

$$f(V_{i,S_3}^{t+1})=Y^{*}(V_{iL}^{t}). \quad (6)$$

3. SIMULATION EXPERIMENT

3.1 Simulation Agents

Simulation technology based on computer is able to help managers to understand more organization processes through less training cost and also gives accurate solutions for organization improvement (J. Mayfield & M. Mayfield, 2013). Simulation method is commonly suitable for studies on complex systems in whose simulation models acquisition cost of optimum estimated values is very expensive (Chen & Fu, 2008). The basic task of the simulation study is to find out a set of systematic decision variables that could maximize or minimize the measurement standard of expected goal (Keeney, 2016). In consideration of complexity of the environment of the scenic spot, higher cost for changing the ratio of managers and big difficulty in controlling tourists, this paper adopts simulation modeling method based on agents. Simulation modeling method based on agents can attach great importance not only to agents of the individual system, but also to interactions among agents (J. Mayfield & M. Mayfield, 2013). The deviant tourist behavior evolution model built by this paper is based on two kinds of intelligent agents, tourists and managers, and divides and defines agents according to individual differences into independent tourists, adaptive tourists and conformity tourists (Yang, 2009).

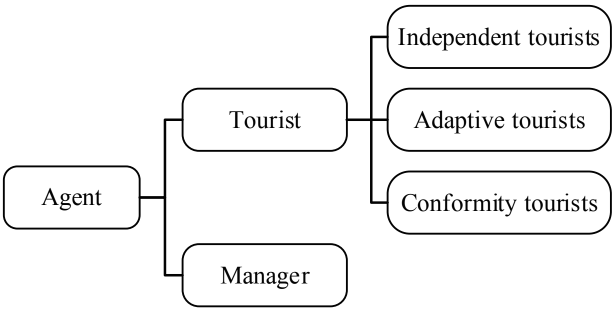


Figure 2
The Simulation Subject

3.2 Simulation Evolution Algorithm

Suppose that each agent has some learning ability, and these agents usually could realize the dynamic adaptation to the environment base on their judgments about surrounding environment and by decision adjustments through learning mechanisms. There are two methods to achieve decision adjustments: reactive reinforcement learning and anticipatory reinforcement learning. In this model, through anticipatory reinforcement learning, an agent (a tourist) could predict his behavior consequence so as to choose the optimal action, adjust his decision and choose the next decision behavior on the basis of situation of scenic spot managers of the current surrounding environment.

Before behavior evolution of each agent, we need to define the attributes of agents at the first step. Different agent attributes correspond to different evolution rules, and accordingly show different decision choices. The agents have two kinds of decisions: not-deviant behavior or deviant behavior. For Agent of the same category, their choices of different decisions will produce different behaviors, which will have impacts on the deviant level of the scenic spot. Therefore, here is the agent behavior evolution model as shown in Figure 3.

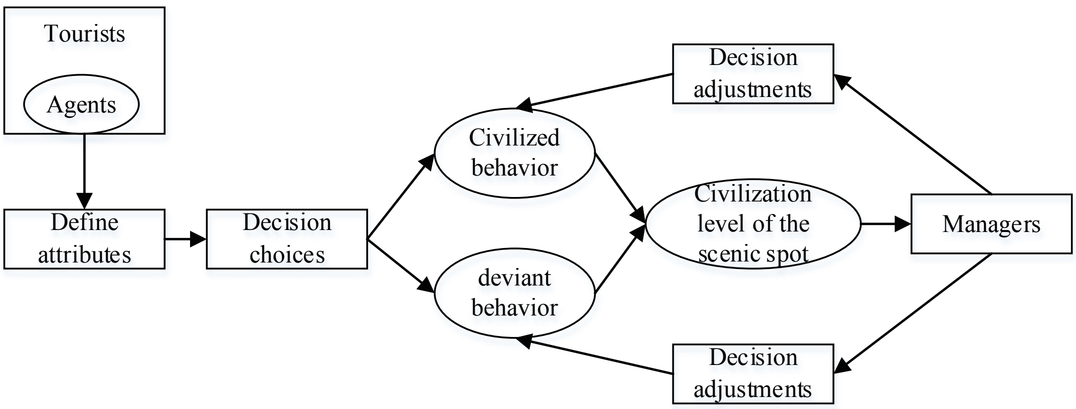


Figure 3
Behavior Evolution Model of Tourists

The expected utility is described by behavior motivation and civilized awareness:

$$EU=M(1\text{-}A). \quad (7)$$

The expected cost is measured through the probability of being caught and reputation cost:

$$EC=P\times C. \quad (8)$$

Besides the probability of being caught is related to the ratio between scenic spot managers U and tourists V in Moore neighborhood. It is expressed by exponential function:

$$P=1\text{-}e^{[-k(Un/Vn)v]}. \quad (9)$$

In which k value is a constant that guarantees the rationality of p value. Subscript V denotes the maximum integer that is less than or equal to this figure. CV denotes the ratio between total number of deviant tourists and total number of tourists in Moore neighborhood, namely the mode of decision set of other decision-makers in neighborhood.

3.3 Parameter Setting

The deviant tourist behavior evolution model is based on NetLogo 5.3.1 simulation platform.

Firstly, Set the number of tourist agents of each type at controllable range of 0%-100% controlled by slider and initialize the decisive choices of agents. In simulation experiment 1, 2 and 3, as well as the experiment of civilized awareness, all agents are initialized to conduct not-deviant behavior. In simulation experiment 4, 5, and 6, in order to study the effect of conformity preferences on deviant behavior, we randomly set that 20% of agents are deviant tourists. Secondly, reputation cost and behavior motivation have randomness and their values are between 0 and 1 randomly produced by simulation procedures. Civilized awareness is controlled by the experimenter, with its value between 0% and 100%. The initial value of visible range k is 7 and threshold value T is set at 0.1. Thirdly, according to deviant tourist behavior decision rules, we simulate each tourist's decision of conducting not-deviant behavior or deviant behavior, namely V^h and V^l. Based on current agent decision and decision adjustment rules, agents determine the optimal behavior that should be selected for the next phase.

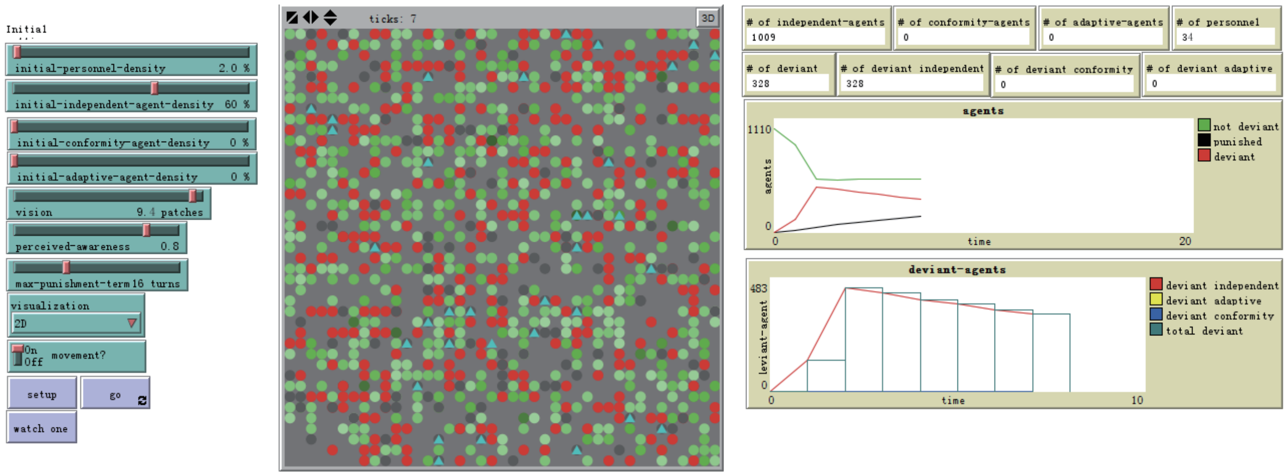


Figure 4
Simulation Interface

4. SIMULATION RESULT

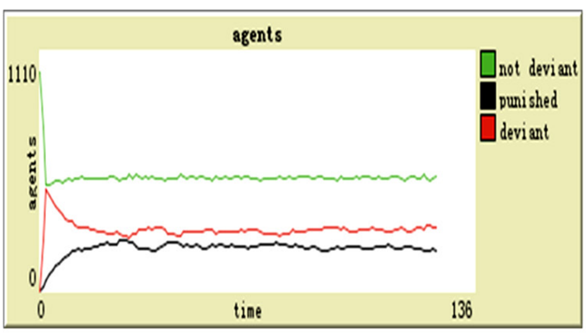
For a fixed simulation with limited alternatives, the simulation duration of each alternative must be determined at first and the result of each simulation experiment must be given (Chick & Gans, 2009). The duration of the following simulation experiments is respectively 120, 200, and 300 clocks. This paper will give change trajectory graphs of the number of deviant tourists for each status (not-deviant, deviant and punished) and each type (independent, adaptive, conformity) of each experiment.

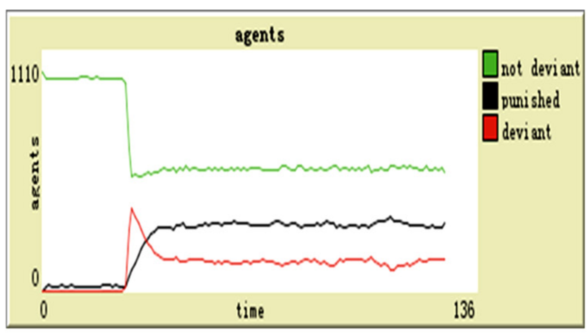
4.1 Experimental Simulation and Analysis Under the Continuous Increase of Managers Density

The deviant tourist behavior evolution situation under the continuous increase of the managers density is explored by simulation experiment 1, 2, and 3, with constant civilized awareness, k value and density of tourists, and simulation duration of all simulation experiments are set as 120 clocks and the number of tourists is 1,009. Three experiments are conducted according to different densities of scenic spot managers to study the optimization density ratio of scenic spot managers which can significantly reduce the number of deviant tourists. The density of scenic spot managers V in experiment 1, 2 and 3 is respectively 2%, 3% and 4%.

Table 1
Experiment Parameter Table Under Continuous Increase of Managers Density

Experiment parameter	K	Tourists density			Managers density	Civilized awareness
		Independent tourists	Adaptive tourists	Conformity tourists		
Experiment 1	7	60%	0	0	2%	0.8
Experiment 2	7	60%	0	0	3%	0.8
Experiment 3	7	60%	0	0	4%	0.8





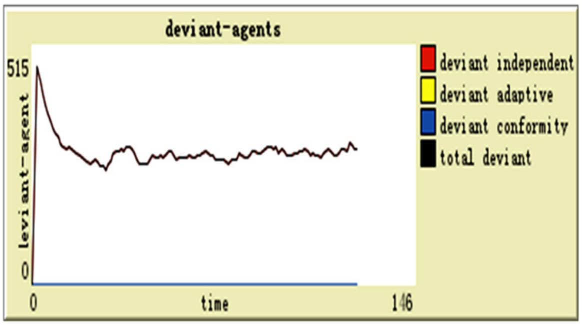


Figure 5
The Curve Shows the Dynamic Curve Graphs of Tourists and Deviant Tourists for Each Status When V=2% in Experiment 1

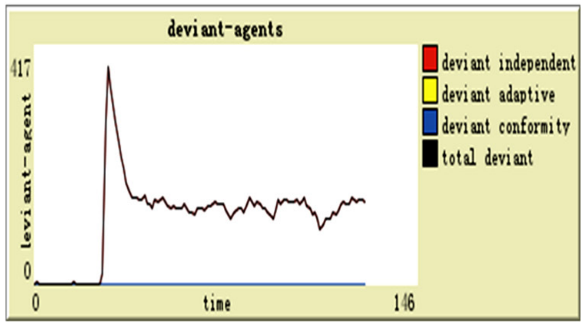


Figure 6
The Curve Shows the Dynamic Curve Graphs of Tourists and Deviant Tourists for Each Status When V=3% in Experiment 2

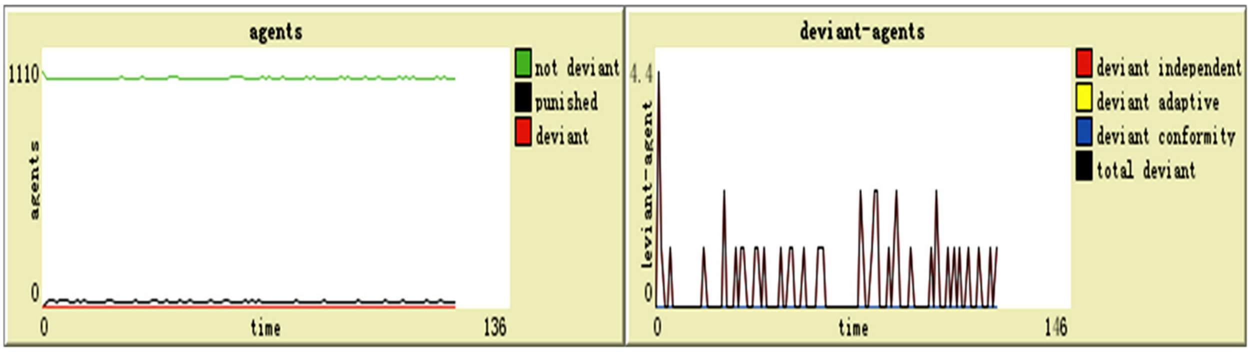


Figure 7
The Curve Shows the Dynamic Curve Graphs of Tourists and Deviant Tourists for Each Status When V=4% in Experiment 3

Table 2
Descriptive Statistical Analysis of Simulation Experiments Under Continuous Increase of Managers Density

Managers density	Number of deviant tourists			
	Max	Min	Mean	Std.D
0.5%	490	444	452.70	7.08
1%	490	386	406.59	14.80
2%	446	203	265.45	31.33
3%	399	0	125.40	73.84
4%	2	0	0.44	0.65

In experiment 1 (as shown in Figure 5), deviant tourists quantity presents a right-skewed distribution. They increase and then decrease and reach the peak value (accounting for 44.2% of the scale of tourists) with a fast rate of convergence during a shorter time at the beginning. And finally the number of deviant tourists tends to be stable. From comparison among the number of not-deviant, deviant and punished tourists, it is found that the number of not-deviant tourists sharply decreases at the beginning while the punished tourists gradually increase. However, the three kinds of tourists all tend to be stable over time. It is easier for tourists to conduct more deviant behavior when the density of scenic spot managers is lower.

When V is 3%, the number of deviant tourists at first keeps constant and later suddenly increases and reaches the peak value (accounting for 39.54% of the scale of the tourists). Then it sharply declines and finally tends to be stable (accounts for 14.1% of the scale of the tourists). The number not-deviant tourists at first keeps constant and then decrease. The number of punished tourists grows along with the growing number of deviant tourists. However, the three types of tourists all tend to be stable over time. When the managers density is at the middle level, deviant tourist behavior will lurk for a period of time and then suddenly breaks out.

From the comparison of the results of the above experiments, we see that peak value of deviant tourists accounts for about 40% and the stable value is still greater than 10%. The effect is obvious. However, when V=4%, Figure 7 shows that the numbers of deviant tourists, not-deviant tourists and punished tourists are all at a relatively stable status. Deviant behavior frequently appears at a very small cardinal number and peak value is only 2. The density of scenic spot managers at a relatively appropriate value (4%) can restrain the outbreak of large scale of deviant tourist behavior. Though deviant behavior still happens, the civilized level of the scenic spot has almost reached 100%.

Through statistical calculation of the number of deviant tourists at each unit time when the managers density is respectively 0.5%, 1%, 2%, 3% and 4%, we obtain Table 2. The following conclusions can be made from Table 2): a) when the density of scenic spot managers is ≤2%, the deviant tourists present a right-skewed distribution, and they all increase at first and then decrease and finally reach the stable status. And the ratio of deviant tourists is always lower than the ratio of not-deviant tourists. The lower the density of scenic spot managers is, the higher the peak value of deviant tourists is (namely, the larger the ascensional range is), and the higher the stable state value is (namely, the smaller the falling range is). And the number of punished tourists is smaller than the number of deviant tourists. b) When the density of scenic spot managers is ∈ (2%, 4%), the number of deviant tourists always at first keeps constant and later increases and then decrease, and finally reach the stable status. The higher the density of scenic spot managers, the longer the lurking time of deviant tourists is. c) When the density of scenic spot is ≥4%, deviant tourists decrease sharply. They do not sharply rise, but appear at intervals by small scale. The average value is less than 1 person. When $V \succ 4\%$, the higher the density of scenic spot managers, the lower the occurrence frequency of deviant behavior is, and the smaller the number of deviant tourists at the same moment is. However, even though the ratio between scenic spot managers and tourists is set at 1:1, deviant behavior does occur. Therefore, it is not enough to completely eliminate the deviant tourist behavior by only depending on supervision and management of scenic spot managers. It also requires other measures.

4.2 Experimental Simulation and Analysis Under Different Conformity Preferences

Experiments (experiment 4, 5, 6) are made to explore the influences of different conformity preferences on deviant tourist behavior evolution results, in which the initial density of deviant tourists is set as 20%, total density of tourists is 60%, density of initial managers is 2%, civilized awareness is 0.8 and the number of tourist is 1,009. Three experiments are conducted to study the relation between the ratio of three kinds of conformity behavior and the deviant tourist behavior evolution. The conformity preferences of experiment 4, 5 and 6 are respectively $\phi=\{1,0,0\}$, $\phi=\{0.5,0.25,0.25\}$, $\phi=\{0,0,1\}$. The simulation operates 300 duration units, and the simulation results are as shown in the following figures (the horizontal axis expresses unit time, and vertical axis expresses the number).

Table 3
Simulation Experiment Parameter Under Different Conformity Preferences

Experiment parameter	K	Tourists density			Managers density	Civilized awareness
		Independent tourists	Adaptive tourists	Conformity tourists		
Experiment 4	7	60%	0	0	2%	0.8
Experiment 5	7	30%	15%	15%	2%	0.8
Experiment 6	7	0	0	60%	2%	0.8

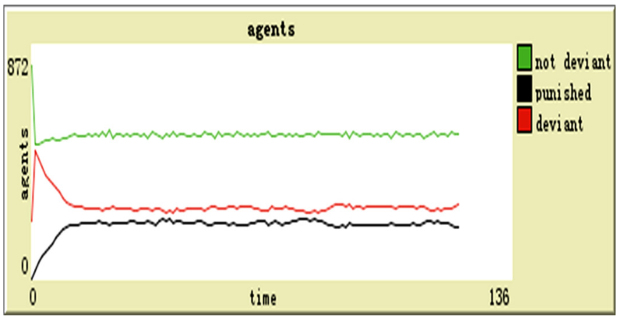


Figure 8
It Shows the Dynamic Curve Graph of Tourists for Each Status When the Ratio Is (1,0,0) in Experiment 4

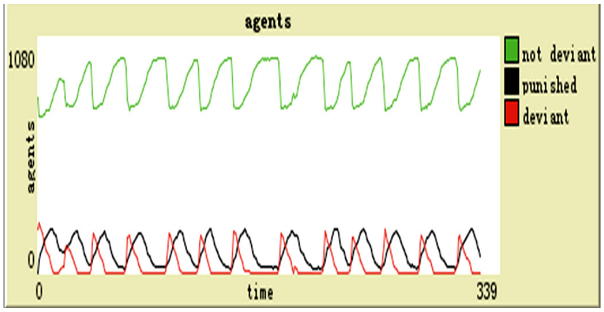


Figure 9
It Shows The Dynamic Curve Graph of Tourists For Each Status When the Ratio Is (0.5,0.25,0.25) in Experiment 5

Figure 10
It Shows the Dynamic Curve Graph of Tourists for Each Status When the Ratio Is (0,0,1) in Experiment 5

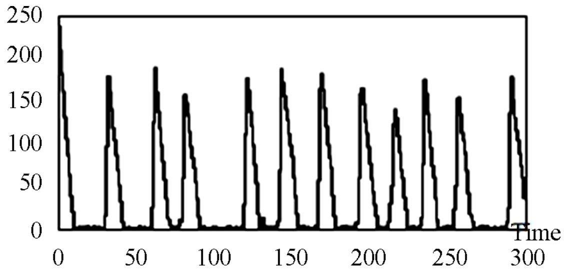


Figure 11
Dynamic Curve Graph of Independent Deviant Tourists in Experiment 6

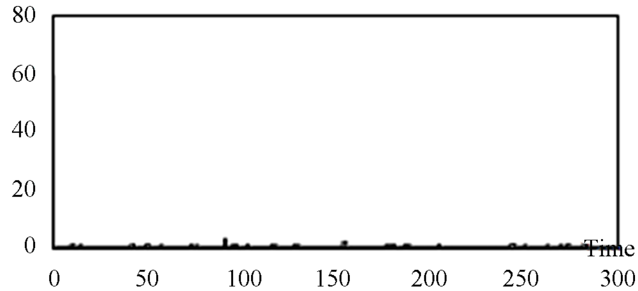


Figure 12
Dynamic Curve Graph of Adaptive Deviant Tourists in Experiment 6

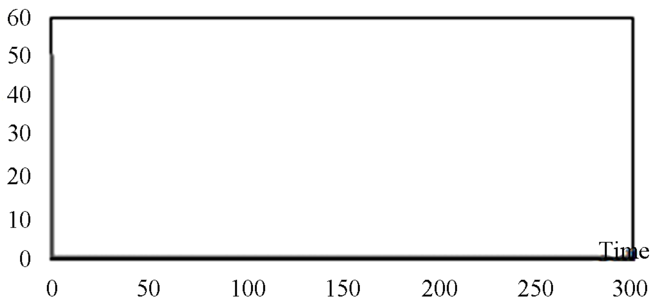


Figure 13
Dynamic Curve Graph of Conformity Deviant Tourists in Experiment 6

Table 4
Descriptive Statistical Analysis of Simulation Experiment Under Different Conformity Preferences

Experiment	Deviant tourists	Max	Min	Mean	Std.D
Experiment 5 (1,0,0)	Independent tourists	475	248	272.36	34.56
	Adaptive tourists	-	-	-	-
	Conformity tourists	-	-	-	-
	Total tourists	475	248	272.36	34.56
Experiment 6 (0.5,0.25,0.25)	Independent tourists	237	0	42.49	58.09
	Adaptive tourists	59	0	0.33	3.41
	Conformity tourists	50	0	0.17	2.88
	Total tourists	237	0	42.98	58.79
Experiment 7 (0,0,1)	Independent tourists	0	0	0	0
	Adaptive tourists	-	-	-	-
	Conformity tourists	-	-	-	-
	Total tourists	0	0	0	0

When conformity preference is $\phi=\{1,0,0\}$ (as shown in Figure 8), independent deviant tourists are of right-skewed distribution. During the period of the first simulation, deviant tourists sharply increase and have doubled (accounting for about 40% of the total tourists). Later during the period of second simulation, deviant tourists decline to a stable level (accounting for 26.13% of the total tourists). Independent not-deviant tourists, during the period of the first simulation, sharply decrease to the minimum (accounting for 49.85% of the total tourists), and then converge to this stable level with a fast rate of convergence). Independent punished tourists gradually increase, and keep stable after a period of time. Finally the three kinds of tourists reach a stable level and keep constant. In the group of conformity tourists, the number of not-deviant tourists is always greater than the number of deviant tourists.

Experiment 5 simulates the conformity preference $\phi=\{0.5, 0.25, 0.25\}$, and obtains the result as shown in figure 9. Among agents, most tourists choose to conduct not-deviant behavior. Not-deviant tourists, deviant tourists and punished tourists change by following certain cycle: they increase at first and then decrease, and finally keep constant, in which, Figures 11, 12 and 13 are obtained through deviant tourists of different types. Independent deviant tourists change in cycles of increasing at first and then reducing with a peak value of outbreak and seldom appearance of one or two agents. Conformity deviant tourists quickly reduce to 0 and then change little. Adaptive tourists rapidly reduce and later a small number of tourists choose to conduct deviant behavior at intervals.

Experiment 6 simulates extreme conformity behavior. In Figure 10, for conformity tourists, not-deviant tourists quickly increase, and deviant tourists sharply increase to almost 0. Punished tourists at first increase slightly and then reduce. After a period of time, the three kinds of tourists reach the stable level, in which deviant tourists keep 0. In this extreme situation, tourists converge very quickly and all choose to conduct not-deviant tourist with one accord.

The following conclusions can be reached through comparison and analysis of the computational results of simulation experiment 4, 5 and 6. Firstly, deviant independent tourists always at first increase, and then decrease. They change in a cycle of increasing at first, and later decreasing, and finally keeping constant with the addition of conformity tourists. Secondly, conformity deviant tourists always quickly reduce to 0. The reason may be that a certain ratio of conformity members in a group will promote the consistency of the group and further advance the generation of optimization strategies. If conformity group, at the beginning, choose optimization behavior or behavior accepted by most people, the convergence rate of group decision will be obviously improved. Thirdly, adaptive tourists are the change of comprehensive independent tourists and conformity tourists. Forthly, Table 4 is obtained through the descriptive statistical analysis of the results of experiment 4, 5 and 6. It is found that when there are only independent tourists in a group, the ratio of deviant tourists fluctuates from 24% to 47% with the average value of 272.36 (accounting for 26.99% of the total tourists), and the variance of 34.5 which indicates that the number of deviant tourists is greater than the initial number; when there are only conformity tourists in a group, the ratio of deviant tourists is 0; when $\phi=\{0.5, 0.25, 0.25\}$, the ratio of deviant tourists fluctuate from 0% to 23%, with the average value of 42.98 and the standard variance of 58.79. At this time, the number of deviant tourists only accounts for 4.26% of the total tourists, but change in cycle whose maximum value and minimum value are very different. Therefore, from the variance, we can see a large fluctuation range. Conformity tourists will promote the consistency of group choice which can make the observable deviant tourist in real life reduce by 21%, but the fluctuation range increases almost 1.7 times from the standard variance. It can be judged that under favorable initial condition (the number of initial not-deviant tourists is greater than that of deviant tourists), a certain ratio of conformity tourists in a group can promote consistency of group to some extent, reduce deviant behavior, and further promote the generation of optimization strategy of civilized behavior.

CONCLUSION

Existing related researches consider less evolution of deviant behavior and strategies of optimizing evolution results, this research proposes the simulation model of deviant tourist behavior based on two kinds of intelligent agents, scenic spot tourists and managers. This model puts forward the decision model and decision rules of deviant tourist behavior and utilize simulation modeling software, NetLogo simulation platform, on the basis of two kinds of agents, tourists and managers. Tourist are divided by conformity preferences into independent tourists, adaptive tourists and conformity tourists. And the density variable of scenic spot managers is introduced as well. This research simulates the evolution process of self-decisions of tourists to conduct not-deviant behavior or deviant behavior according to their surrounding environment status, and adjust the appropriate value through changing decision variable value, and dig out the problem of optimizing deviant tourist behavior, and finally reveal the optimization strategies of deviant tourist behavior. Through simulation, the following strategies are proposed to optimize deviant tourist behavior.

On the one hand, appropriately set the density of scenic spot managers to constrain the outbreak of deviant tourist behavior. The conclusions of simulation study show that the optimization density ratio of scenic spot managers should not be less than 4% (when the density of tourists is 60%). The ratio of scenic spot managers directly concerns the breakout peak value, latency time and emerging frequency of deviant tourist behavior. In the system of a scenic spot, increasing the density ratio of scenic spot managers can increase the expected cost of deviant tourist behavior, and reduce the peak value of outbreak, latency time and emerging frequency of deviant behavior to restrain the outbreak of the large scale of deviant tourist behavior. A scenic spot needs to properly set the density of scenic spot managers, establish and improve the system of deviant tourist behavior “blacklist” and punishment system. These lists and rules should be open to the whole society, and accept social supervision and cultivate the tourists’ knowledge to conduct civilized behavior, and also provides evidence for scenic spot managers to give warnings or punishments.

On the other hand, create civilized environment of scenic areas and guide the conformity thinking of tourists so as to promote the consistency of civilized behavior of the group. Analysis of conformity preferences has proved that in the situation of more initial civilized tourists, in the group of tourists without conformity behavior, deviant tourists present a right-skewed distribution and larger peak value of outbreak. And a certain ratio of conformity group could reduce the peak value of outbreak of deviant behavior. Deviant behavior in conformity group sharply declines to 9, which shows on the condition that initial civilized behavior is the choice of most tourists, conformity behavior can promote the group consistency and advance the generation of civilized behavior strategies. Therefore, a scenic spot needs to create civilized environment of scenic areas and properly guide the conformity thinking of tourists to conduct civilized behavior, increase the number and ratio of civilized tourists. Only in this way, can civilized behavior subtly be the optimization strategy choice of tourists.

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APPENDIX 1 PROCEDURE FOR SILULATION EXPERIMENT 1, 2, AND 3

```
breed [independent-agents independent-agent]
breed [adaptive-agents adaptive-agent]
breed [conformity-agents conformity-agent]
breed [personnel a-personnel]
globals [
  k              ; factor for determining probability of being caught
  threshold      ; by how much must EU >E C to make someone deviant?
]
independent-agents-own [
  reputation-cost        ; R, ranging from 0-1 (inclusive)
  Motivation             ; M, also ranging from 0-1 (inclusive)
  deviant?               ; if true, then the tourist commit deviant behaviors
  punishment-term        ; how many turns in punishment remain? (if 0, the agent is not in punishment)
]
adaptive-agents-own [
```

```
  reputation-cost     ; R, ranging from 0-1 (inclusive)
  motivation          ; M, also ranging from 0-1 (inclusive)
  deviant?            ; if true, then the tourist commit deviant behaviors
  punishment-term     ; how many turns in punishment remain? (if 0, the agent is not in punishment)
]
conformity-agents-own [
  reputation-cost     ; R, ranging from 0-1 (inclusive)
  Motivation          ; M, also ranging from 0-1 (inclusive)
  deviant?            ; if true, then the tourist commit deviant behaviors
  punishment-term     ; how many turns in punishment remain? (if 0, the agent is not in punishment)
]
patches-own [
  neighborhood        ; surrounding patches within the vision radius
]
to setup
  clear-all
  ;; set globals
set k 7
set threshold 0.1
ask patches [
  ;; make background a slightly dark gray
  set pcolor gray - 1
  ;; cache patch neighborhoods
  set neighborhood patches in-radius vision
]
;; create personnel
create-personnel round (initial-personnel-density * .01 * count patches) [
  move-to one-of patches with [not any? turtles-here]
  display-personnel
]
;; create agents
create-independent-agents round (initial-independent-agent-density * .01 * count patches) [
  move-to one-of patches with [not any? turtles-here]
  set heading 0
  set reputation-cost random-float 1.0
  set motivation random-float 1.0
  set deviant? false
  set punishment-term 0
  display-independent-agent
]
    create-adaptive-agents round (initial-adaptive-agent-density * .01 * count patches) [
  move-to one-of patches with [not any? turtles-here]
  set heading 0
  set reputation-cost random-float 1.0
  set motivation random-float 1.0
  set deviant? false
  set punishment-term 0
  display-independent-agent
]
    create-conformity-agents round (initial-conformity-agent-density * .01 * count patches) [
  move-to one-of patches with [not any? turtles-here]
  set heading 0
  set reputation-cost random-float 1.0
  set motivation random-float 1.0
  set deviant? false
```



```
      set punishment-term 0
      display-independent-agent
    ]
    ;; start clock and plot initial state of system
      reset-ticks
    end
    to go
      ask turtles [
        ; Rule M: Move to a random site within your vision
        if (breed = independent-agents and punishment-term = 0) or (breed = adaptive-agents and punishment-term = 0)
or (breed = conformity-agents and punishment-term = 0) or breed = personnel
    [ move ]
    ;  Rule determine-behavior1, determine-behavior2, determine-behavior3: Determine if each agent should be deviant
or quiet
    if breed = independent-agents and punishment-term = 0 [ determine-behavior1 ]
    if breed = adaptive-agents and punishment-term = 0 [ determine-behavior2 ]
    if breed = conformity-agents and punishment-term = 0 [ determine-behavior3 ]
    ; Rule C: Personnel catch a random deviant agent within their radius
    if breed = personnel [ enforce ]
    ]
    ; punishmented agents get their term reduced at the end of each clock tick
    ask independent-agents
      [ if punishment-term > 0 [ set punishment-term punishment-term - 1 ] ]
    ask adaptive-agents
      [ if punishment-term > 0 [ set punishment-term punishment-term - 1 ] ]
    ask conformity-agents
      [ if punishment-term > 0 [ set punishment-term punishment-term - 1 ] ]
    ; update agent display
    ask independent-agents [ display-independent-agent ]
    ask adaptive-agents [ display-adaptive-agent ]
    ask conformity-agents [ display-conformity-agent ]
    ask personnel [ display-personnel ]
    ; advance clock and update plots
    tick
    end
    ;; AGENT AND PERSONNEL BEHAVIOR
    ;; move to an empty patch
    to move ;; turtle procedure
    if movement? or (breed = personnel) [
      ;; move to a patch in vision; candidate patches are
      ;; empty or contain only punishmented agents
      let targets neighborhood with
          [not any? personnel-here and all? independent-agents-here [punishment-term > 0] and all? adaptive-agents-here
[punishment-term > 0] and all? conformity-agents-here [punishment-term > 0]]
      if any? targets [ move-to one-of targets ]
    ]
    end
    ;; AGENT BEHAVIOR
    to determine-behavior1
      set deviant? (expected-utility - reputation-cost * estimated-caught-probability > threshold)
    end
    to-report expected-utility
      report motivation * (1 - perceived-awareness)
    end
    to-report estimated-caught-probability
      let C count personnel-on neighborhood
```

```
let A 1 + count (independent-agents-on neighborhood) with [deviant?] + count (adaptive-agents-on neighborhood) with [deviant?] + count (conformity-agents-on neighborhood) with [deviant?]
;; See Info tab for a discussion of the following formula
report 1 - exp (- k * floor (C / A))
end
to determine-behavior2
set deviant? (expected-utility - reputation-cost * estimated-caught-probability > threshold and conformity-value = 0) or (expected-utility - reputation-cost * estimated-caught-probability > threshold and conformity-value > 0 and conformity-value > 0.5) or (expected-utility - reputation-cost * estimated-caught-probability <= threshold and conformity-value < 1 and conformity-value > 0.5)
end
to determine-behavior3
  set deviant? (conformity-value > 0.5)
end
to-report conformity-value
  let DN count (independent-agents-on neighborhood) with [deviant?] + count (adaptive-agents-on neighborhood) with [deviant?] + count (conformity-agents-on neighborhood) with [deviant?]
  let TN count independent-agents-on neighborhood + count adaptive-agents-on neighborhood + count conformity-agents-on neighborhood
  report DN / TN
end
;; COP BEHAVIOR
to enforce
if any? (independent-agents-on neighborhood) with [deviant?][
  ;; arrest suspect
  let suspect one-of (independent-agents-on neighborhood) with [deviant?]
  ask suspect[
    set deviant? false
    set punishment-term random max-punishment-term
]
move-to suspect ;; move to patch of the punishment agent
]
if any? (adaptive-agents-on neighborhood) with [deviant?][
  ;; arrest suspect
  let suspect one-of (adaptive-agents-on neighborhood) with [deviant?]
  ask suspect[
    set deviant? false
    set punishment-term random max-punishment-term
  ]
move-to suspect ;; move to patch of the punishment agent
]if any? (conformity-agents-on neighborhood) with [deviant?][
  ;; arrest suspect
  let suspect one-of (conformity-agents-on neighborhood) with [deviant?]
  ask suspect[
    set deviant? false
    set punishment-term random max-punishment-term
  ]
move-to suspect ;; move to patch of the punishment agent
  ]
end
;; VISUALIZATION OF AGENTS AND COPS
to display-independent-agent ;; agent procedure
  ifelse visualization = "2D"
    [ display-independent-agent-2D ]
    [ display-independent-agent-3D ]
```



```
End
to display-adaptive-agent ;; agent procedure
  ifelse visualization = “2D”
    [ display-adaptive-agent-2D ]
    [ display-adaptive-agent-3D ]
end
to display-conformity-agent ;; agent procedure
  ifelse visualization = “2D”
    [ display-conformity-agent-2D ]
    [ display-conformity-agent-3D ]
end
to display-independent-agent-2D ;; agent procedure
  set shape “circle”
  ifelse deviant?
    [ set color red ]
    [ ifelse punishment-term > 0
      [ set color black + 3 ]
[ set color scale-color green motivation 1.5 -0.5 ] ]
End
to display-adaptive-agent-2D ;; agent procedure
  set shape “square”
  ifelse deviant?
    [ set color orange ]
    [ ifelse punishment-term > 0
      [ set color gray + 3 ]
[ set color scale-color blue motivation 1.5 -0.5 ] ]
end
to display-conformity-agent-2D ;; agent procedure
  set shape “pentagon”
  ifelse deviant?
    [ set color pink ]
    [ ifelse punishment-term > 0
      [ set color brown + 3 ]
      [ set color scale-color violet motivation 1.5 -0.5 ] ]
end
to display-independent-agent-3D ;; agent procedure
set color scale-color green motivation 1.5 -0.5
ifelse deviant?
  [ set shape “person active” ]
  [ ifelse punishment-term > 0
    [ set shape “person jailed” ]
    [ set shape “person quiet” ] ]
end
to display-adaptive-agent-3D ;; agent procedure
  set color scale-color blue motivation 1.5 -0.5
  ifelse deviant?
    [ set shape “person active” ]
    [ ifelse punishment-term > 0
      [ set shape “person jailed” ]
      [ set shape “person quiet” ] ]
end
to display-conformity-agent-3D ;; agent procedure
  set color scale-color violet motivation 1.5 -0.5
  ifelse deviant?
    [ set shape “person active” ]
```



```
    [ ifelse punishment-term > 0
      [ set shape "person jailed" ]
      [ set shape "person quiet" ] ]
end
to display-personnel
  set color cyan
  ifelse visualization = "2D"
    [ set shape "triangle" ]
    [ set shape "person soldier" ]
end
```

APPENDIX 2 PROCEDURE FOR SILULATION EXPERIMENT 4,5, AND 6

```
breed [independent-agents independent-agent]
breed [adaptive-agents adaptive-agent]
breed [conformity-agents conformity-agent]
breed [personnel a-personnel]
globals [
  k               ; factor for determining probability of being caught
  threshold       ; by how much must EU >E C to make someone deviant?
]
independent-agents-own [
  reputation-cost      ; R, ranging from 0-1 (inclusive)
  Motivation           ; M, also ranging from 0-1 (inclusive)
  deviant?             ; if true, then the tourist commit deviant behaviors
  punishment-term      ; how many turns in punishment remain? (if 0, the agent is not in punishment)
]
adaptive-agents-own [
  reputation-cost      ; R, ranging from 0-1 (inclusive)
  motivation           ; M, also ranging from 0-1 (inclusive)
  deviant?             ; if true, then the tourist commit deviant behaviors
  punishment-term      ; how many turns in punishment remain? (if 0, the agent is not in punishment)
]
conformity-agents-own [
  reputation-cost      ; R, ranging from 0-1 (inclusive)
  Motivation           ; M, also ranging from 0-1 (inclusive)
  deviant?             ; if true, then the tourist commit deviant behaviors
  punishment-term      ; how many turns in punishment remain? (if 0, the agent is not in punishment)
]
patches-own [
  neighborhood         ; surrounding patches within the vision radius
]
to setup
  clear-all
  ;; set globals
  set k 7
  set threshold 0.1
ask patches [
  ;; make background a slightly dark gray
  set pcolor gray - 1
  ;; cache patch neighborhoods
  set neighborhood patches in-radius vision
]
;; create personnel
create-personnel round (initial-personnel-density * .01 * count patches) [
```



```
    move-to one-of patches with [not any? turlles-here]
    display-personnel
  ]
  ;; create agents
    create-independent-agents round (initial-independent-agent-density * .01 * count patches) [
    move-to one-of patches with [not any? turtles-here]
    set heading 0
    set reputation-cost random-float 1.0
    set motivation random-float 1.0
    set deviant? (random 100 < 20)
    set punishment-term 0
    display-independent-agent
  ]
    create-adaptive-agents round (initial-adaptive-agent-density * .01 * count patches) [
    move-to one-of patches with [not any? turtles-here]
    set heading 0
    set reputation-cost random-float 1.0
    set motivation random-float 1.0
    set deviant? (random 100 < 20)
    set punishment-term 0
    display-independent-agent
  ]
      create-conformity-agents round (initial-conformity-agent-density * .01 * count patches) [
    move-to one-of patches with [not any? turtles-here]
    set heading 0
    set reputation-cost random-float 1.0
    set motivation random-float 1.0
    set deviant? (random 100 < 20)
    set punishment-term 0
    display-independent-agent
  ]
  ;; start clock and plot initial state of system
  reset-ticks
  end
  to go
    ask turtles [
      ; Rule M: Move to a random site within your vision
      if (breed = independent-agents and punishment-term = 0) or (breed = adaptive-agents and punishment-term = 0)
or (breed = conformity-agents and punishment-term = 0) or breed = personnel
    [ move ]
     ; Rule determine-behavior1, determine-behavior2, determine-behavior3: Determine if each agent should be
deviant or quiet
  if breed = independent-agents and punishment-term = 0 [ determine-behavior1 ]
  if breed = adaptive-agents and punishment-term = 0 [ determine-behavior2 ]
  if breed = conformity-agents and punishment-term = 0 [ determine-behavior3 ]
    ; Rule C: Personnel catch a random deviant agent within their radius
    if breed = personnel [ enforce ]
  ]
  ; punishmented agents get their term reduced at the end of each clock tick
  ask independent-agents
  [ if punishment-term > 0 [ set punishment-term punishment-term - 1 ] ]
  ask adaptive-agents
    [ if punishment-term > 0 [ set punishment-term punishment-term - 1 ] ]
    ask conformity-agents
    [ if punishment-term > 0 [ set punishment-term punishment-term - 1 ] ]
```

```
; update agent display
ask independent-agents [ display-independent-agent ]
ask adaptive-agents [ display-adaptive-agent ]
ask conformity-agents [ display-conformity-agent ]
ask personnel [ display-personnel ]
; advance clock and update plots
tick
end
;; AGENT AND PERSONNEL BEHAVIOR
;; move to an empty patch
to move ;; turtle procedure
  if movement? or (breed = personnel) [
    ;; move to a patch in vision; candidate patches are
    ;; empty or contain only punishmented agents
    let targets neighborhood with
      [not any? personnel-here and all? independent-agents-here [punishment-term > 0] and all? adaptive-agents-here [punishment-term > 0] and all? conformity-agents-here [punishment-term > 0]]
if any? targets [ move-to one-of targets ]
]
end
;; AGENT BEHAVIOR
to determine-behavior1
  set deviant? (expected-utility - reputation-cost * estimated-caught-probability > threshold)
end
to-report expected-utility
  report motivation * (1 - perceived-awareness)
end
to-report estimated-caught-probability
  let C count personnel-on neighborhood
  let A 1 + count (independent-agents-on neighborhood) with [deviant?] + count (adaptive-agents-on neighborhood) with [deviant?] + count (conformity-agents-on neighborhood) with [deviant?]
;; See Info tab for a discussion of the following formula
report 1 - exp (- k * floor (C / A))
end
to determine-behavior2
  set deviant? (expected-utility - reputation-cost * estimated-caught-probability > threshold and conformity-value = 0) or (expected-utility - reputation-cost * estimated-caught-probability > threshold and conformity-value > 0 and conformity-value > 0.5) or (expected-utility - reputation-cost * estimated-caught-probability <= threshold and conformity-value < 1 and conformity-value > 0.5)
end
to determine-behavior3
  set deviant? (conformity-value > 0.5)
end
to-report conformity-value
  let DN count (independent-agents-on neighborhood) with [deviant?] + count (adaptive-agents-on neighborhood) with [deviant?] + count (conformity-agents-on neighborhood) with [deviant?]
let TN count independent-agents-on neighborhood + count adaptive-agents-on neighborhood + count conformity-agents-on neighborhood
report DN / TN
end
;; COP BEHAVIOR
to enforce
if any? (independent-agents-on neighborhood) with [deviant?][
  ;; arrest suspect
  let suspect one-of (independent-agents-on neighborhood) with [deviant?]
```



```
   ask suspect[
   set deviant? false
      set punishment-term random max-punishment-term
   ]
   move-to suspect ;; move to patch of the punishment agent
]
if any? (adaptive-agents-on neighborhood) with [deviant?][
;; arrest suspect
let suspect one-of (adaptive-agents-on neighborhood) with [deviant?]
ask suspect[
   set deviant? false
   set punishment-term random max-punishment-term
]
move-to suspect ;; move to patch of the punishment agent
]if any? (conformity-agents-on neighborhood) with [deviant?][
;; arrest suspect
let suspect one-of (conformity-agents-on neighborhood) with [deviant?]
ask suspect[
      set deviant? false
      set punishment-term random max-punishment-term
   ]
   move-to suspect ;; move to patch of the punishment agent
]
end
;; VISUALIZATION OF AGENTS AND COPS
to display-independent-agent ;; agent procedure
ifelse visualization = "2D"
   [ display-independent-agent-2D ]
   [ display-independent-agent-3D ]
End
to display-adaptive-agent ;; agent procedure
ifelse visualization = "2D"
   [ display-adaptive-agent-2D ]
   [ display-adaptive-agent-3D ]
end
to display-conformity-agent ;; agent procedure
ifelse visualization = "2D"
   [ display-conformity-agent-2D ]
   [ display-conformity-agent-3D ]
end
to display-independent-agent-2D ;; agent procedure
set shape "circle"
ifelse deviant?
   [ set color red ]
   [ ifelse punishment-term > 0
      [ set color black + 3 ]
[ set color scale-color green motivation 1.5 -0.5 ] ]
End
to display-adaptive-agent-2D ;; agent procedure
set shape "square"
ifelse deviant?
   [ set color orange ]
   [ ifelse punishment-term > 0
      [ set color gray + 3 ]
[ set color scale-color blue motivation 1.5 -0.5 ] ]
```

```
end
to display-conformity-agent-2D ;; agent procedure
set shape “pentagon”
ifelse deviant?
  [ set color pink ]
  [ ifelse punishment-term > 0
    [ set color brown + 3 ]
[ set color scale-color violet motivation 1.5 -0.5 ] ]
end
to display-independent-agent-3D ;; agent procedure
set color scale-color green motivation 1.5 -0.5
ifelse deviant?
  [ set shape “person active” ]
  [ ifelse punishment-term > 0
    [ set shape “person jailed” ]
    [ set shape “person quiet” ] ]
end
to display-adaptive-agent-3D ;; agent procedure
set color scale-color blue motivation 1.5 -0.5
ifelse deviant?
  [ set shape “person active” ]
  [ ifelse punishment-term > 0
    [ set shape “person jailed” ]
    [ set shape “person quiet” ] ]
end
to display-conformity-agent-3D ;; agent procedure
set color scale-color violet motivation 1.5 -0.5
ifelse deviant?
  [ set shape “person active” ]
  [ ifelse punishment-term > 0
    [ set shape “person jailed” ]
    [ set shape “person quiet” ] ]
end
to display-personnel
  set color cyan
ifelse visualization = “2D”
  [ set shape “triangle” ]
  [ set shape “person soldier” ]
end
```