PRINT: ISSN 0972-0073 ONLINE: ISSN 2456-6802
Anthropologist, 19(3): 789-810 (2015)
DOI: 10.31901/24566802.2015/19.03.25

Computation Orienting to One Category of Social Science Problems: Complexity Evolution of Population Values Shaping Process in Deep-seated Culture

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KEYWORDS Deep-seated Culture. Values Family. Meme. Social Computing. Complexity Evolution. Computing Experiment

ABSTRACT The research on values has always been a spot in the field of deep-seated culture in social science. In particular, the research on population values shaping is more practical. Model users especially refer to decision makers for population values affairs (UPVs for short) require more effective way of shaping overall population values to maintain the deep-seated cultural safety of the whole population. A non-linear, ring polygon-resembled structure-based characterizing scheme on values orientation difference is proposed in this paper. Based on the idea of social science computing, complex adaptability system theory, Meme theory and agent modeling method, the computing model of the shaping process of population values from bottom to top is built. Through computing experiments, a complex adaptability system which is significant in "in between" feature and can be used to describe the population values shaping process is cultivated. A number of computing experiments proved the effectiveness and important role of "Meme and its three features" and related "shaping ways and means of population values". More importantly, the researchers discovered one important social problem of "Ethnic regime how to shape the population mainstream values effectively" showing some important phenomena in artificial system. Combining these experiments, a series of concepts relating to values family are proposed and some new ideas are put forward on the social science issue. Research work above shows the potentiality of providing new ideas and policy guidance for social science issues in the artificial system cultivated in this paper, which is one of the core goals of social computing.

INTRODUCTION

Culture is basic but important topic in the field of humanities and social science. Because pan-culture is very abstract, it's necessary to do individualized research according to the levels of culture. Up to now, the culture is divided into three layers, which is generally accepted by the academics. From the outside to the inside, the first level, usually called surface culture is mainly related to people's living needs such as clothing, food, and architecture and so on. The second level usually called middle level culture is mainly related to art, literature, custom, institution, religion, law and so on. The innermost third level usually called deep-seated culture mainly refers to the ideas and values of the population. Surface culture and middle layer culture both reflects the culture explicit mode, while deep-seated culture reflects the culture implicit mode. Cultural anthropologists like Kroeber et al. (1952) believe that culture exists in various implicit and explicit modes and get learned and transmitted through the use of symbol, constituting the special achievements of the human population. The basic elements of culture are the ideas and values produced by history derivatives and selection, with the values being the most important. The above view of Kroeber et al.'s support has been accepted by most researchers. Most researchers believe that deep-seated culture is the core of social culture research and the value is the primary part of deep-seated culture research. Value can be divided into two kinds in the view of population and individual. The one which can reflect the group cultural characteristics of the whole population is called population values. Correspondingly, the other one is individual value. The sociological content and meaning of population or individual value is very rich and of wide scope. So there are many perspectives for interdisciplinary research. The complexity evolution of population values shaping process in deep-seated culture is the focus of this paper. So without loss of generality, population values are the mainstream opinions, preferences and orientations when the population is taken as a thing ignoring individuals, while individual value is the independent opinion, preference and orientation that every individual in population holds. For every UPV, the form of common mainstream values inside the country is the core element of national governance system and governance capability. It is taken as the “soul project of sovereign nation”. Common mainstream values are the fundamental guarantee of the normal operation and the maintenance of stable social order in sovereign nation. But if the common mainstream values cannot form effectively, it will get into chaos because of the loss of oriented regulations.

The shaping process of population values in deep-seated culture is a typical social science problem. Because of its importance, the computing model of complexity evolution of population values and its shaping process is proposed in this paper from the perspective of social computing. And how to form, shape and consolidate population values is also discussed. The paper is organized as follows. Related work is analyzed in Section 1. Computing model of population values shaping process is introduced in Section 2. In Section 3, a number of computing experiments are conducted and analyzed in population values evolution, shaping and maintenance. The paper is summarized in Section 4.

ANALYSIS OF RELATED WORK

As the most stable factor in culture, the research on values is always spot and difficult in the field of social science culture research. In recent years, related work based on traditional social science research methods focused on values transmission elements and transmission process, the role government playing in the change of population values and the matching mechanism between population and individual values (Harrison et al. 2000). In essence, the research mentioned above all revolves around population values shaping process. Harrison et al. (2000) believes that problems about cultural values are difficult to solve through the methods used to address such traditional social science as policy and economy, because many variables are involved and many complex factors are needed to be considered.

Under the pressure of the practical “bottleneck” problem mentioned by Harrison et al. (2000), the research paradigm of culture, including the deepest and the most core element as values begins to combine with some new-emerging social science branches. Based on the classical definition of culture of Kroeber et al. (1952) related work in the field of social science can be analyzed from the following two perspectives. The first one is that culture get learned and spread through the use of symbols. Blackmore (2000) published one book named “The Meme Machine”. She thinks that the basic unit of cultural transmission is Meme. The transmission of all the cultural contents, including deep-seated cultural contents, such as ideas, beliefs and values, is fundamentally different from biological evolution. Meme is transmitted through non-genetic way, especially imitation, and determines the social cultural structure eventually. There are three factors influencing the transmission of Meme Blackmore gives, which are fidelity, fecundity and longevity. Based on Meme, Lynch (2008) studied the spreading way of faith in society which is called “idea infection”. The work mentioned above is the foundation of Meme becoming the groundbreaking research paradigm in sociology and culture studies. The second one is that the basic elements of culture are obtained through selection. Hofstede et al. (2010) think that culture including such deep contents as values is a kind of “mental software program”. The programming of individual mental software depends on its nearby individuals and social environment. Similarly, population has group mental programming capability coming from the related rules in social game. However, Hofstede et al. still used such traditional social science research methods as values concept classification based on evidence and typology, culture dimension differences measurements, scene surveys and statistical analysis in the practical research on measuring values.

Based on the analysis of the above two perspectives, the research paradigm is still carried out in the field of social science in essence. The cultural problems research in social science field cannot yet provide complete explanation and profound insight for the social science problem of the universal rule in theory and policy and decision in practice. The reason is that the passive observation and statistical methods make it difficult to conduct active and repeatable experiments on the research object (Wang et al. 2013). Of course, there is also experiment method in traditional social scientific quantitative research methods. But the experiment refers to crowd experiments. In these experiments, people directly participate in experiments. People in experiments are usually divided into reference team and experiment team. By this way, social problems are discovered and solved. But there are a considerable number of social problems cannot be repeated and are difficult to recover. Besides, the practical risk of morality, ethics and law cannot be ignored. So, crowd experiment is limited objectively and difficult to deal with social problems at macro level (Sheng et al. 2013). How to conduct active and repeatable experiments on population values shaping and related policy implementation process in deep-seated culture is difficult to deal with. As the integration of computer science and social science, social computing and parallel execution methodology provides the solution to this difficult problem. Parallel execution methodology refers to the basic framework for social computing based on complex systems method (Wang 2007). In other words, through advanced computing means, the experiments on complex behaviors can be conducted in an artificial society which is non-risk instead of real society. Regarding to the research on culture problem using computing theory, the scholars around the world have made some achievements. Su et al. (2013) and Li et al. (2014) studied several machine learning classification algorithms in cultural modeling. DiPaola et al. (2009) proposed one computing model describing human creativity and discussed the evolution art algorithm with human-resembled creation strategy. Gabora et al. (2008; 2013a) proposed a culture evolution computing theoretical framework based on Meme imitation and realized 3 prototype systems, which are MAV(Meme and Variations)(Gabora 2013b), EVOC (EVOlution of Culture) (Gabora 2013c) and WE (Worldview Evolution) (Gabora et al. 2009). Kandler et al. (2012) studied dynamics research on culture evolution. Yun et al. (2010) and Yun et al. (2013) did the research on human vowel system evolution computing based on Meme, culture evolution and artificial society theory and the research on culture identity evolution computing focusing on culture safety.

Summing up the above, as the core of culture, values are one of the most important research topics in the social computing research focusing on cultural problems. So the related research work should be carried out on it. Second, Meme is culture gene. In the related social computing research on culture problem, the description of its transmission process is necessary and its three important features of fidelity, fecundity and longevity should also be described in detail to be parallel executed in the artificial society. Third, population values shaping process is a complex adaptive social system. In the construction of computing model, it's necessary to fully describe the typical characteristics of complex adaptive social system. Finally, the computing model based on the artificial society should have the potential of providing new ideas and policy guidance when encountering social science problems. In fact, the social complexity theory and computing model based on artificial society is parallel with social data mining and social networks in computing sociology (Cioffi-Revilla 2013). Providing new ideas and policy guidance for social science problems is the main objective of this research branch. There is one classical example. Segregation model proposed by Nobel Laureate Schelling (1971) provides a new insight for apartheid. Apartheid may not due to racial discrimination. Even though a race is willing to accommodate other races and be neighbors, apartheid may also occur

COMPUTING MODEL OF POPULATION VALUES EVOLUTION

Complexity of Population Values Evolution

Santa Fe institute is famous for studying the complexity based on adaptability. Professor Miller et al. (2009) of this institute believes that dynamic, heterogeneity and interaction are the typical features of complex adaptive social system.

1) The Dynamic and Interaction Based on Adaptability: As the core element of culture, values are stable to some extent. But the stability is not static, especially the population values appearing as group phenomenon. Population values based on culture diversity is a typical dynamic evolution. The dynamic here has three meanings. First, values itself are a kind of Meme. The three important factors of Meme are dynamic and adjustable. Meme with high fidelity, high fecundity and long longevity (copies last a long time) is easier to transmit in society through individual interaction. Second, from the perspective of individual in population, individuals get Meme through acquisition and selection based on the interaction with neighboring individuals and social environment. The process of acquisition and selection is dynamic. Third, from the perspective of whole population, population values are the emerging result of individual value interaction in population. At the same time, UPVs can also influence individuals through certain regulation behavior and shape population values dynamically. Finally, the nonlinear dynamic interaction of individuals with neighboring individual and social environment (that is,: the acquisition and selection of value) is the performance of adaptive characteristics of individual itself.

2) Heterogeneity Based on Adaptability: The dynamic evolution of population values is driven by the adaptability and heterogeneity. First of all, as Meme, it is obvious that different values are heterogeneous. Even the same values, they are still heterogeneous because the three factors can be given different values. Second, the individual heterogeneity in the process of adaptation tends to be expressed as the possibility of individual values difference in population, the difference of individual's ability of acquiring and selecting and so on. Third, the interaction between the individuals and their values evolution in population make population values evolution highly non-linear, so different evolution results are heterogeneous. Finally, in one population, it is normal that except for the mainstream values, there are minority individuals holding different values.

In summary, the evolution of population values mentioned in this paper is a complex adaptive social system.

Computability of Population Values Evolution

Computability of complex adaptive social system has already been generally agreed by scholars. But the development of complex culture system is not the sum of intention of each individual. The non-linear interaction between individuals achieves a collective equilibrium, but not the final steady state through invisible hand or reasonable cunning (Mainzer 2007). Therefore, the pure mathematical framework with excellent performance in static, homogeneous and uncomplicated system cannot provide new ideas and policy guidance for social science problems effectively. The proposal of computing experiment method makes it possible to conduct various experiments on complex system by using computing, with the purpose of prediction and assessment of complex systems. Furthermore, approximating reality system is not the sole purpose of computing experiments. The real goal is that the artificial complex system can be an alternative of reality system (Wang 2004).

In summary, the computing model of population values shaping process in this paper will be built in a bottom-up way based on social science computing thinking, culture gene social transmission theory (that is,: Meme theory) and agent modeling. Then, the complex adaptive system is cultivated through computing experiments. Finally, some opinions are put forward in population values shaping based on system parallel execution and experimental evaluation results.

Construction of Computing Model

Description of Values Meme Features and Difference Metric of "In Between"

All kinds of normal values based on non-extreme thinking in population are possible to be accepted, that is to say there is diverse tendencies in individual values in population. While UPVs will make the holistic population values the mainstream values to calibrate all kinds of individual values in population. The purpose is to maintain the deep-seated culture safety of the holistic population. In other words, there is unified tendency in population values. The social phenomena mentioned are facts which are universal in human society. The sign of diverse tendencies of all kinds of normal values based on non-extreme thinking is the non-linear orientation difference rather than linear level difference. In summary, it is concluded in this paper that even though the orientation of all kinds of normal values coexisting in population is different, there is equality inside and linear classification is not reasonable.

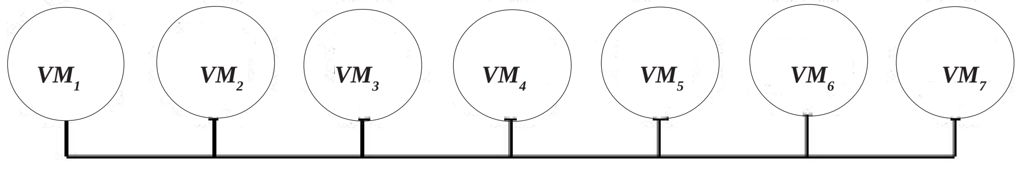
Definition 1 (Values Meme, abbreviated VM) Without loss of generality, $VMi = <FIi, FEi, LEi>$.

- Supposing that *m* VM constitute a set of values set VMS, $VMS = \{VM1, ..., VMi, ..., VMm\}$, where *i* is the unique identifier (ID) in the values set;
- *FIi* is the fidelity factor of *VMi*, $FIi \in (0,1]$. The acquisition success rate is the rate of individuals who successfully learn the *VMi* to the holistic population. *FIi* is used to indicate the influence it makes to the acquisition success rate. *FIi* is monotonically in-

creasing in the interval (0,1). Usually, the fidelity of values meme with simple expression and high affinity is high. Values meme is easier to be memorized, used and transmitted by people.

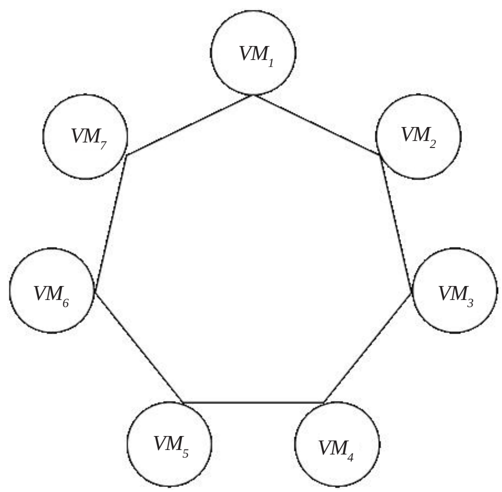
- *FEi* is the fecundity factor of *VMi*, *FEi* ∈ *Q+*. *FEi* is used to describe the improvement of social influence after individuals agreeing with *VMi* in population. Obviously, with the improvement of the individual's social influence, *VMi* will be more widely transmitted. This is the realization of high fecundity.
- *LEi* is the longevity factor of *VMi*, *LEi*∈ *N+*. In order to express social reality as accurate as possible in artificial society, *LEi* is divided into *LEi1* and *LEi2*. *LEi1* represents the determined shortest time period in which the individuals keep the value orientation. *LEi2* represents the variable remaining time after the fixed determined time *LEi1* of *VMi*.

Miller et al. (2009) think that "In Between" is the core theme of the complex adaptive social system. In the modeling process, Agent should be in between "ignorant" and "prophetic", the whole system should be in between the "anarchy" and "control" and modeling method and goal should be between "potential of getting new insights" and "rigorous analysis". "In Between" leads to adaptability. Conversely, adaptability leads to complexity. "In Between" is always taken as the principle in our research work at the macro level. Here, values classification is taken as an example to discuss. Obviously, values difference is one of the characteristics of values diverse tendencies, but difference is just part of the meaning of diverse tendencies. Before discussing the methods for values classification in this paper, there are two details should be noted. First, values are "the opinions, preferences and orientations about something" after being abstracted. Based on the conclusion, what the researchers should put the priority on is to determine the number of values when the researchers discuss diverse values difference. In principle, as long as the number of values in population is more than two, the research can be conducted. The classic literature from Harvard University, Miller (1994) proposes a magical number 7 in human cognitive process. Sometimes, it's slightly larger or smaller. Even though it's disguised, 7 is not a random number. Cognitive ability of human beings is limited between 7-2 and 7+2. The number of values in vast majority of the experiments in this paper is between 5 and 9 and is taken as 7. Taking 7 values for example, they are respectively according to their own identifier named as VM1, VM2. VM3, VM4, VM5, VM6, VM7. The second one is how to characterize and measure the orientation difference among different values. The problem itself is a social problem difficult to resolve indeed. In fact, social problem is difficult to characterize, measure even calculate, which is the reason why humanities computing in the field of social computing cannot develop quickly. To solve the difficulty, scholars from different countries are all looking for solutions. International political and cultural problem expert, Harvard professor Huntington (2000) said that "culture" is a purely subjective definition. If culture means everything, it means nothing. Miller et al. (2009) think that the ability to ignore the details in complex system modeling is crucial. Influence of the subjectivity and psychology on complex system research should be attached importance to (Wang 2004). In this paper, in the case of unable to reflect value difference accurately, seeking a possible alternative becomes necessary. Regarding to value orientation difference characterization and measurement, necessary subjective abstract and reduction are made here. Figure 1 (b) shows the non-linear characterization scheme of values orientation difference. As a comparison, there are two fundamental disadvantages in the linear characterization scheme shown in Figure 1 (a). First, it gives a strong indication that *VM1* and *VM7* are 2 ex-



(a) Linear characterization scheme of values orientation difference
Fig. 1. Characterization of values orientation difference

treme values. Second, the maximum difference between two values is up to 6 (among 7 values). Although the difference is fully described, it gives a strong indication of values grades. The scheme in Figure 1 (b) removes the disadvantages of the scheme in Figure 1 (a). First, the nonlinear polygon structure is ring-resemble. None of values will be considered as an outlier. Second, the maximum difference characterization between two values is three in the structure, referring specifically to the excellent arc feature of ring-resembled shape for 7 values. This scheme can not only meet the need of values difference description but also reduce the risk of "grade theory" saying that values are not equal. In short, the scheme is still pursuing to satisfy the feature of "In Between", the core of complex adaptive social system and its modeling method. The researchers' purpose is to make values orientation difference characterization between "description difference" and "maintaining values equality".



(b) Non-linear characterization scheme of values orientation difference

Fig. 1. Characterization of values orientation difference

(a) Linear characterization scheme of values orientation difference

(b) Non-linear characterization scheme of values orientation difference

More generally, supposing that there are m kinds of values, calculation formula of difference degree measurement factors among values VMi,VMj (i,j ∈ {1,2,…,m}) is shown is (1) according to the nonlinear values difference characterization scheme:

$$At_i^z = G(|N_i - z|) \times \frac{\sum_{agent_j \in NE_i, N_j = z \text{ and } N_i \neq z} IN_j}{\sum_{agent_j \in NE_i} IN_j + IN_i}$$

where $\Delta = |i - j|$, G (Δ) ∈ [0, 1].

The values orientation difference between two values is maximize when G(Δ)=0. Conversely, The values orientation difference between two values is minimize when G(Δ)=1.

Description of Individual's Characteristic in Population and the Determination and Use of Related Computing Factors

Regarding to the research on the transmission mode of values based on pure social science like faith, Chinese scholars in the field of social science also made their contributions. Chen (2011) proposed a 3M mode of belief transmission effects: Message, Model and Might. They are taken as the necessary factors helping producing belief transmitting good results. This view proves the view in this paper. Message is similar to VM in this paper. Might is closed to the method and means through that UPVs shaping the population values. Model is one type of Agent discussed in this section.

Definition 2 (attributes of individuals in population, Agent) without loss of generality, Agenti = <Ci, Ni, IMi, INi>, where

- Ci represents Agenti type. There are two kinds of agents in the cultivated artificial system. The two kinds of agents are model agents and normal agents (without special instruction, Agent means normal agent).
- Ni is the identifier of value VMNi that Agent agrees in the set of values.
- IMi is the immunity of Agent. It represents the immunity against other values after agreeing with value VMNi, Mi ∈ [0,1]. The immunity of Agent is related to the longevity factor LENi of VMNi agreed. IMi = 1 indicates maximum immunity, and IMi = 0 indicates no immunity. In LENi1, IMi is equal to 1 or the immunity of previous iteration. After LENi1, IMi can no longer remain the immunity unchangeable and begin to decrease. The decreasing speed is inversely related to the variable remaining lifetime of VMNi until IMi = 0. Particularly, the immunity of MA is equal to 1 and it is a constant. The calculation formula for IMi is as (2):

$$G(\Delta)=\begin{cases}1, m\le 3;\\ 1-\dfrac{\min\{\Delta, m-\Delta\}-1}{\lfloor m/2\rfloor-1}, m>3\end{cases}$$

In the premise of Agent agreeing with value VM, t is the iterations number of maintaining the agreeing state in the cultivated artificial system.

- INi is the social influence of Agenti, INi $\in Q^*$. INi is related to the high fecundity of VMNi. The reason is that with the social influence (INi) improving, VMi will be transmitted more widely, realizing high fecundity. Obviously, the fact is that even agreeing with the same value, the social influence of different agents is different. Sociology scholar Hao (2012) thinks that the social influence and social status of the whole population is normally distributed. Therefore, the social influence of Agent herein follows the normal distribution whose expected value is the fecundity of the value it agrees.

Without loss of generality, the induction factor ATiZ that Agenti (abbreviated i) agreeing with value VMNi (abbreviated Ni) endures when it is induced by another value VMz (abbreviated z) is shown in formula (3).

$$IM_{i(t)}=\begin{cases}1,\ t=0;\\ IM_{i(t-1)}\ 0<t\le LE_{i1};\\ IM_{i(t-1)}-\dfrac{1}{LE_{i2}},\ LE_{i1}<i \text{ and } IM_{i(t-1)}-\dfrac{1}{LE_{i2}}\ge 0;\\ 0, other\end{cases}$$

Where NEi is the neighbor set of agenti. agentj refers to any one agent in NEk. INj and INi is the social influence of agentj and agenti respectively.

When there is a value set Z={z1, z2,…} $\subset$ VMS and >IMi., agenti will choose a value from Z randomly as its agreed value. The reason why the agent does not choose the value with maximum induction force directly is to make Agent "In Between". In other words, the aim is to make Agent between "very ignorant" and "very smart".

Definition 3 (the model in population, Model Agent, abbreviated MA) Among Model Candidate Agents (abbreviated MCA), the Agent who can resist the induction and keep its value through its own immunity when the maximum induction happens can be taken as model.

•Maximum induction occurs between neighboring values, because quite different value can only produce confrontation and resistance rather than induction. Maximum induction occurs when all the neighbors of the Agent hold values similar to the values the agent holds (G (Δ) = 1). In this case, all the neighboring agents induce the Agent through their social influence, denoted as X. X is the sum of their social influence when all the agents hold the values similar to the values the Agent holds. Now, the value of the induction $\frac{X}{X+IN_{agent}}$

factor the Agent endures is , where IN_{agent} is the social influence of the Agent itself.

- The lifetime of values meme is LE1+LE2. Supposing that agent MCA agreeing with the population mainstream values has iterated for t times in the artificial system when UPVs choose model (MA) from model candidates (MCA).
- In the artificial systems, agent MCA will lose immunity in [t,LE1+LE2]. In the period, the average immunity of agent MCA is calculated as formula (4).

$$At_i^Z$$

$$IM_{MCA}=\begin{cases}\dfrac{(LE_1-t)+\dfrac{LE_2}{2}}{(LE_1-t)+LE_2},\ 0\le t\le LE_1;\\ \dfrac{LE_1+LE_2-t}{2\times LE_2},\ LE_1<t\le LE_1+LE_2;\\ 0,\ t>LE_1+LE_2\end{cases}$$

For each MCA, solve the inequality (5).

$$\frac{X_{MCA}}{X_{MCA}+IN_{MCA}}\le IM_{MCA}$$

• For each MCA, one XMCA is solved. Then, the MCA is sorted by XMCA for UPVs choosing model in accordance with the demand and sequence.

EXPERIMENTS, DISCUSSION AND OPINIONS

Design for Computing Experiments Environment

The computing experiment prototyping platform of population values shaping is completed through Python in this paper. The initial environment of computing experiment is designed like this. The artificial system required to be cultivated evolves in a 20×20 square area. There are 400 agents in this area. The prototyping platform in this paper can provide 10 values. The identifier and coloration is shown as following. The identifier of value 1 is VM1 and it is yellow. The identifier of value 2 is VM2 and it is red. The identifier of value 3 is VM3 and it is green. The identifier of value 4 is VM4 and it is blue. The identifier of value 5 is VM5 and it is purple. The identifier of value 6 is VM6 and it is brown. The identifier of value 7 is VM7 and it is aquamarine.

The identifier of value 8 is VM8 and it is forest green. The identifier of value 9 is VM9 and it is light blue. The identifier of value 10 is VM10 and it is golden rod.

Computing Process, Results Discussion and Opinions of Related Social Science Problems

Experiments on the Independent Evolution Results of Artificial System and "Values Family"

In this section, the results of independent evolution of artificial system are given in the premise of giving different initial number of values. In the independent evolution of artificial system, the number and space distribution of the m values are randomly determined. FIi, FEi, LEi1 and LEi2 (i=1,2,…m) of m values are all equal to 0.5,1,1,20 respectively in an equal way. Focusing on 6,7,8 kinds of values, 50 experiments are conducted with the iteration time is 1000 and 5000 respectively in every experiment. The evolution process and its related analysis are shown in Tables 1 and 2.

From Tables 1 and 2, it can be seen that the results of the independent evolution of the artificial system follow some rules when the number of values is different. With the increasing of the system parallel execution cycle (5000 iterations), "only one left" has become the main result of the independent evolution of the artificial system. But the researchers also noticed that although the proportion of the result of "2 neighboring values coexisting in ring-resembled structure" in 5000 iterations is very small, the proportion is very large after 1000 iterations, that is the number of the results is bigger than the number of "only one left". From the perspective of system execution, "2 neighboring values coexisting in ring-resembled structure" is the neighboring precursor state of "only one left". Furthermore, from the perspective of policy, it is obvious that "2 neighboring values co-existing in ring-resembled structure" and "only one left" are the final two steps in population values shaping with special meaning. The researchers call the result of "2 neighboring values co-existing in ring-resembled

Table 1: Results of independent evolution of cultivated artificial system and related analysis (1)

Initial values number	*Experiment times*	*Iteration times*	*Independent evolution results*			
			Only one left	*2 neighboring values coexisting*	*2 neighboring values and a value non-neighboring to any of the 2 values coexisting*	*Other*
6	50	1000	7	41	0	2
7			10	35	1	4
8			8	37	0	5

Table 2: Results of independent evolution of cultivated artificial system and related analysis

Initial values number	*Experiment times*	*Iteration times*	*Only one left*	*Independent evolution results*		
				2 neighboring values coexisting	*2 neighboring values and a value non-neighboring to any of the 2 values coexisting*	*Other*
6	50	5000	48	2	0	0
7			45	4	0	1
8			45	5	0	0

structure" as "values family". Obviously, the result of "only one left" can be taken as the special situation of "values family". In this case, the number of value in the family is 1.

Comparative Experiments on the Different Strategies and the Evolution Results in the Process of UPVs Shaping Population Values

Except for setting the initial number of values as 7 (VM1,yellow;VM2, red; VM3, green; VM4, blue; VM5, purple; VM6, brown; VM7, blue-green), the researchers assumed the population mainstream values that UPVs committed to shape is VM6 in order to achieve easier description and comparison without loss of generality. According to the description in section 2, the common strategies UPVs use in the shaping (or promotion) of population mainstream values are increasing the desired value FI, FE and LE of the 3 important characteristics of Fidelity, Fecundity and Longevity, or choosing a part of agents agreeing with VM6 as model as expecting the appearance of "model demonstration effect". First, the researchers see the appearance of "heterogeneous values prototype family" and VM6 is one of the components of the "family" in the independent evolution of the artificial system. Apparently, according to the experimental analysis in, the appearance of the results is not determined. But the researchers still noticed the appearance of the evolution results in many experiments. When the artificial system evolves on its own, the number and space distribution of the 7 values is initiated randomly. The FIi, FEi, LEi1 and LEi2 (i = 1,2, ... 7) of the 7 values are all "equally" set: 0.5,1,1,20. The evolution and related analysis are shown in Figure 2 after 1000 iterations, in which 300 iterations as the intermediate observed node of evolution.

From Figure 2 (a3), (b1), it can be seen that "heterogeneous values prototype family" consisting of VM6 and VM7after 1000 iterations appears in the artificial system, where VM6 and VM7 are close neighboring in ring-resembled structure. But from Figure 2 (b2), the researchers can see that the mainstream value VM6 UPVs strive to shape does not show the advantage of number of agents in the "family" consistently. To be honest, the expecting of VM6 being the component of the family is not determined. Figure 2 (b3) shows the number of agents changing its value in each 50 iterations.

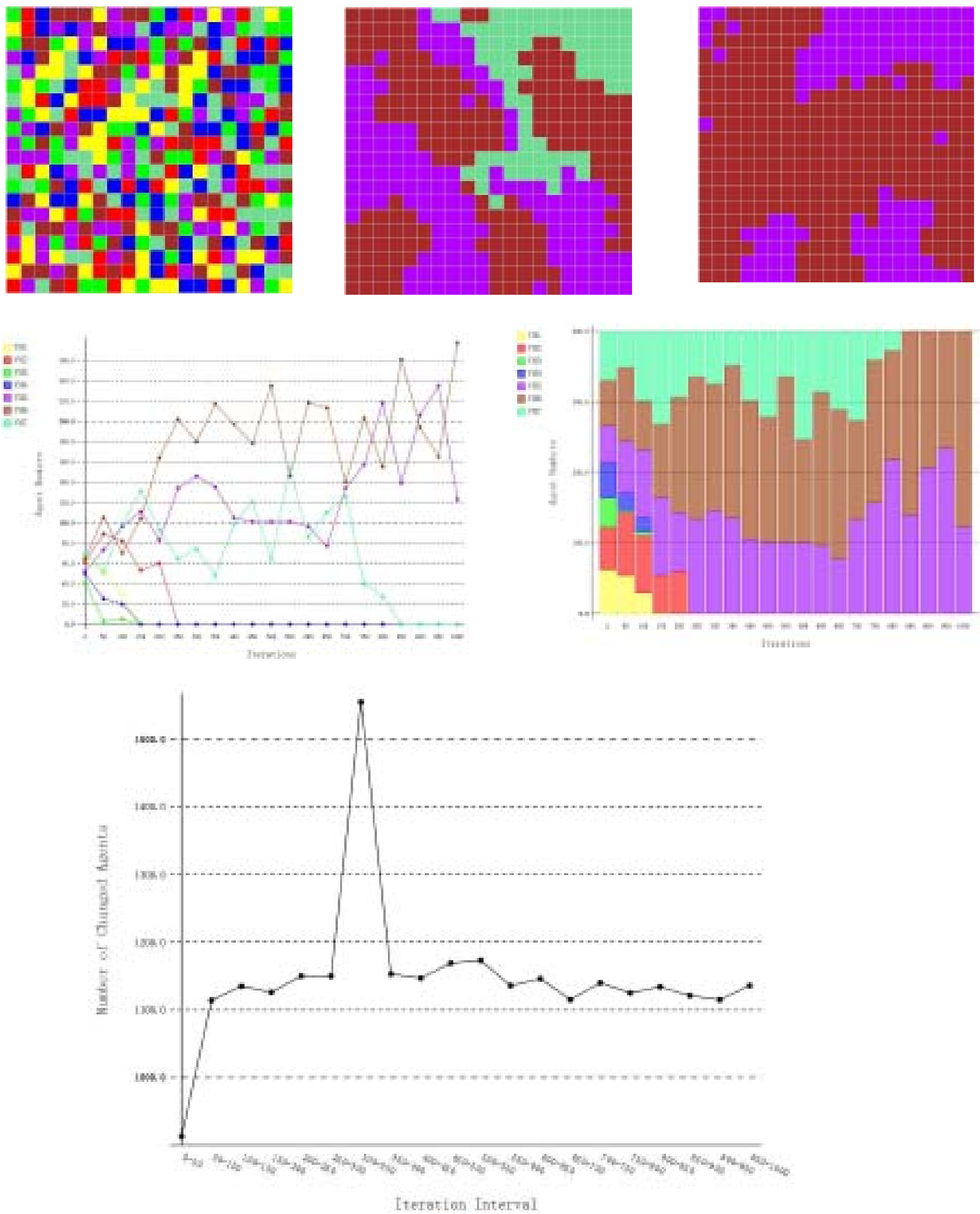
After the artificial system evolved 300 iterations independently, UPVs implemented the mainstream value shaping strategy. In the completed prototype tool, the state of the artificial system can be stored and restored at any time. This is why social computing compared to traditional social science research methods is more attractive. It is manipulatable and controllable. In order to make the experiment continued comparatively, the researchers make the artificial system back to the state in Figure 3 (a2). The changes showed in desired values are the values of FI, FE, LE1 and LE2 of VM6 are set 0.8, 1.5,2,25. And the FIFE, LE1 and LE2 of other values are still 0.5,1,1,20. Evolution and related analysis are shown in Figure 3 after 1000 iterations, in which the 300th iterations as the beginning of UPVs implementing mainstream values shaping strategy.

From the changes and trends shown in Figure 3 (a), (b1), (b2), it can be seen that the "values family" consisting of VM6 as the relative mainstream value and VM7, close to VM6 in the ring-resembled structure, in the artificial system after UPVs implementing effective mainstream value shaping strategy. Different from "heterogeneity value prototype family", the newly produced results not only embodies the "family", but also more importantly shows the "mainstream" feature relatively. The researchers called that "heterogeneity values adaptive family".

Next, the researchers study the evolution when UPVs implement more powerful mainstream value shaping strategy. The changes shown in desired values are that the FI, FE, LE1 and LE2 of VM6 are set 1, 2, 3, 30. The values of FI, FE, LE1 and LE2 of other values are still 0.5,1,1,20.

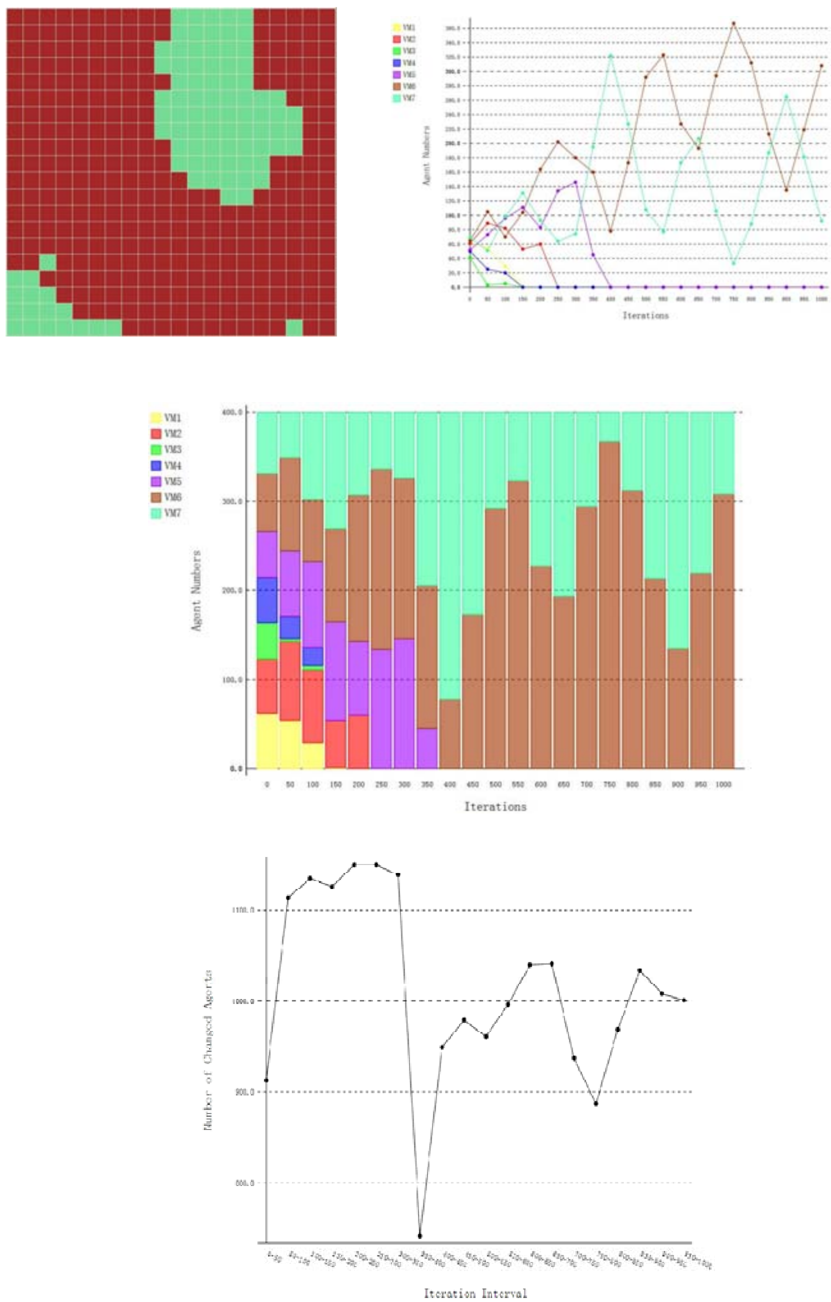
First, the researchers conducted state backtracking. It's very easy for social computing to implement state backtracking. But state backtracking is difficult to implement for traditional social science research methods. Evolution and related analysis are shown in Figure 4 after 1000 iterations, in which the 300th iterations as the starting point for a more powerful implementation of UPVs mainstream values shaping strategy.

From Figure 4 (a), (b1), (b2), the researchers can see that the number of the components of the "family" formed in the artificial system is reduced to 1 after UPVs implementing a more powerful mainstream value shaping strategy. At this point, there is only VM6 left in the "family". None of the neighboring values in the ring-resembled



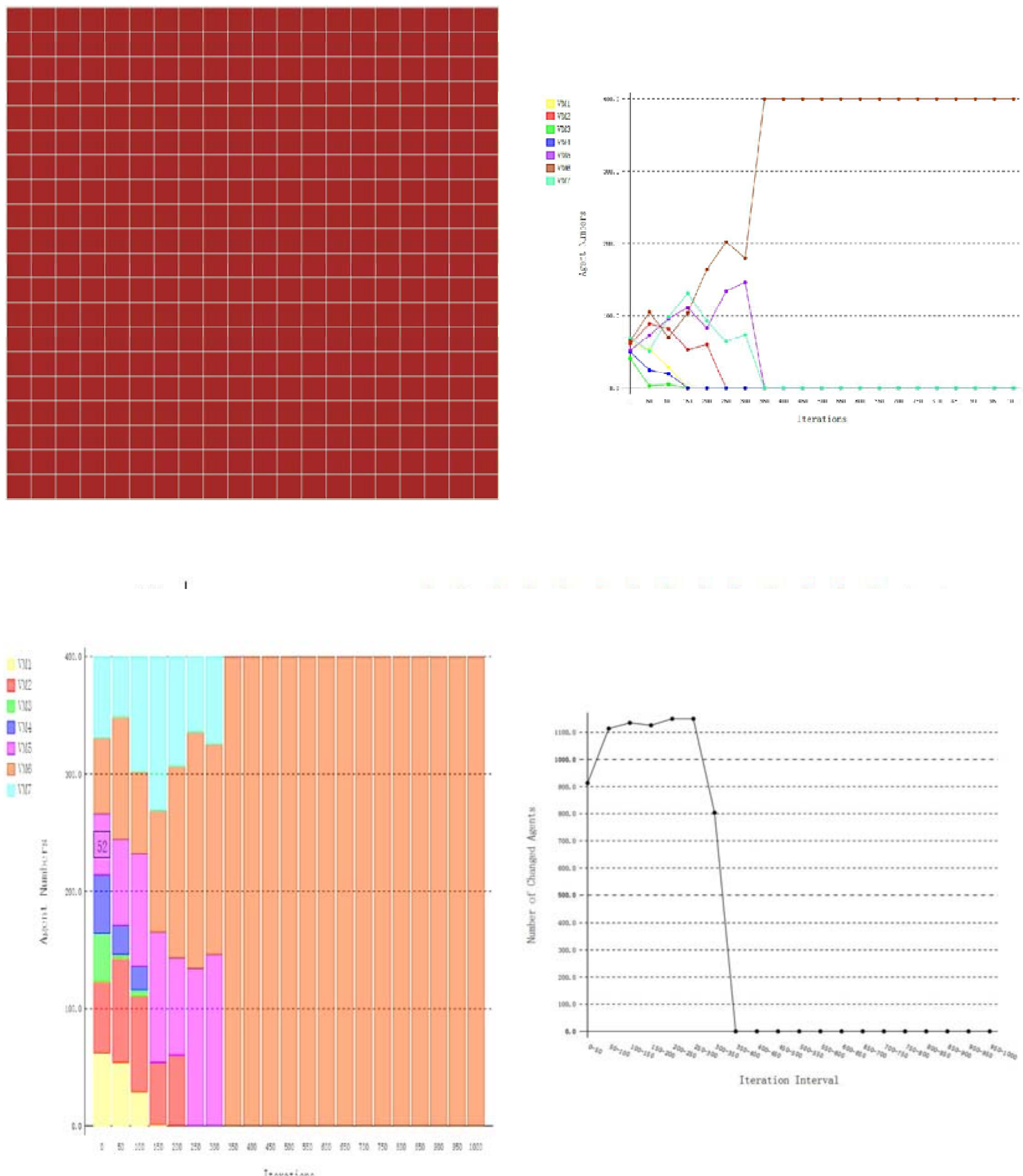
(a1) Initial situation (a2) 300 iterations (a3) 1000 iterations
(b1) Trends in the number of agents holding different values in populations
(b2) Trends in the proportion of agents holding different values in populations
(b3) The number of agents changing their values after 50 iterations

Fig. 2. Independent evolution and data analysis of the cultivated "value shaping" artificial system



(a) 1000 iterations
(b1) Trends in the number of agents holding different values in population
(b2) Trends in the proportion of agents holding different values in populations
(b3) Number of agents changing their values in each 50 iterations

Fig. 3. Evolution and data analysis of artificial system after UPVs implementing effective mainstream value shaping strategy



(a) 1000 iterations
(b1) Trends in the number of agents holding different values in populations
(b2) Trends in the proportion of agents holding different values in populations
(b3) Number of agents changing their values in each 50 iterations

Fig. 4. Evolution and data analysis of artificial system after UPVs implementing a more powerful mainstream value shaping strategy

structure appears in the "family". Obviously, the intention of UPVs is to make VM6 optimize its advantages to a maximum extent. Such a result is called "homogeneity value optimal family". In addition, it can be seen that there are marked differences between Figure 4 (b3) and Figure 3 (b3), Figure 2 (b3). From Figure 4 (b3), the researchers can see that the number of agents changing their values in each 50 iterations quickly decreases to 0 after UPVs implementing a more powerful mainstream value shaping strategy. The dynamic characteristics are lost and the static characteristics become significant.

In order to implement mainstream values shaping, except for modifying the value of the three important properties of values meme, UPVs can also choose some agents agreeing with mainstream values (Obviously, VM6 is chosen as the mainstream value of the population by UPVs in this calculation experiment) from population as model and expect the appearance of the "model demonstration effect". The evolution based on model demonstration effect and related analyses are shown in Figure 5 after 1000 iterations, in which the 300th iterations as the starting point of "demonstration model effect" implemented by UPVs.

Figure 5 (a1), (a2) show the process of UPVs sorting model candidates and choosing models respectively. From the changes and trends shown in Figure 5 (a3), (b1), (b2), (b3), it can be seen that the shaping effect of "model demonstration" strategy of UPVs is similar to the effect of increasing the value of the 3 important characteristics of ethnic core value.

Comparative Experiments on the Immunity of Homogeneity Value Optimal Family and Heterogeneity Value Adaptive Family at the Level of Population

Considering the two values of family homogeneity value optimal family and heterogeneity value adaptive family in the previous section, the researchers will conduct comparative computing experiments on their immunity at population level in this section.

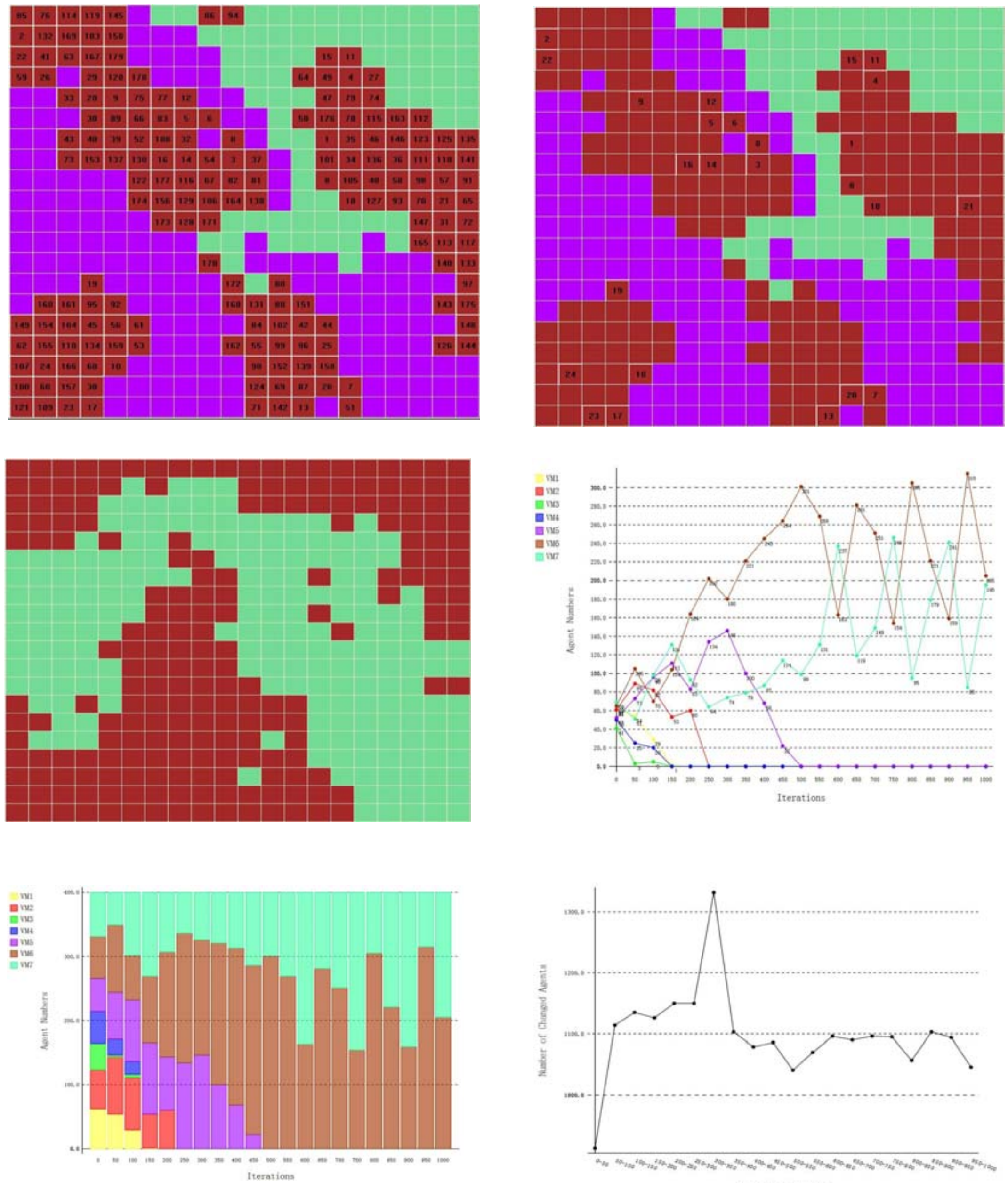
First, the researchers conducted state backtracking to the state in Figure 4 (a). There is only VM6 in the family of the artificial system. No value close to VM6 in ring-resembled is in the "family". The family is homogeneity value optimal family. At this point, the following extreme cases are introduced to the parallel execution system. The value orientation of an agent in homogeneity value optimal family changes suddenly. The researchers studied the immunity of homogeneity value optimal family. First, assume that the value orientation change of the agent in "family" is that it bursts into VM2 not close neighboring to VM6. The evolution results of artificial system are shown in Figure 6.

From Figure 6 (b), it can be seen that VM2 has become the dissimilar value difficult to digest outside the family. However, if the agent suddenly changing its value is smarter and chooses to be circuitous, it will choose VM5 at first. Now the worst chain induction happens. According to the chain of "VM6' VM5', VM4', VM3', VM2", the value is completely flipped. Of course, the agent is too smart. Intelligent counter is intelligently harmed. There is no difference between the immunity itself of this state and the starting point state. They are both not robust. "Progressive chain induction" is shown in Figure 7.

Next, the researchers analyzed the immunity of heterogeneity values adaptive family. First, the researchers conducted state backtracking to the state in Figure 3 (a). Now, the following extreme cases are still introduced into the parallel execution of system. In the heterogeneity values adaptive family, an agent changes its value orientation suddenly. The researchers will study the immunity of the adaptive family. First, assume that the change of value orientation in the family is to change the value orientation to the VM2 not close to VM6 and VM7. And another change is to change its value to VM5 close to VM6. The evolution phenomenon the researchers observed of the artificial system is shown in Figure 8.

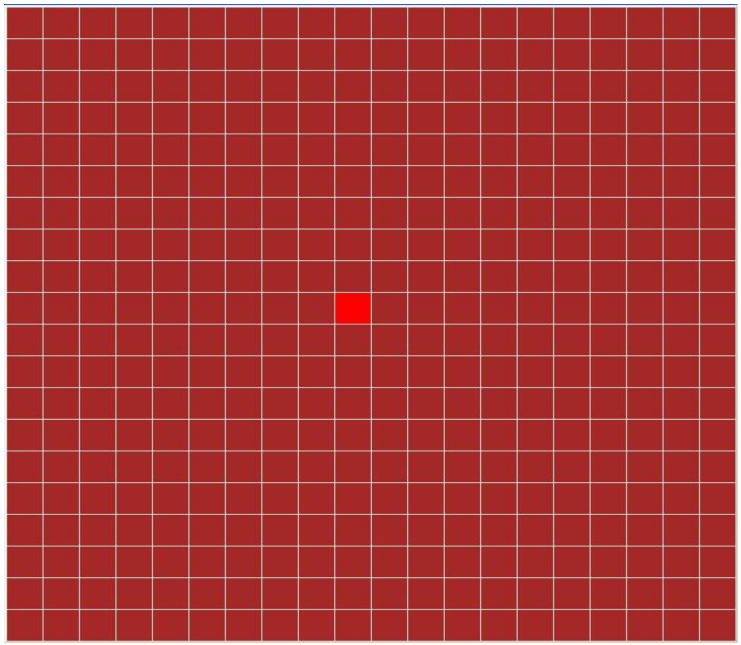
As can be seen from Figure 8, the immunity of heterogeneity values adaptive family is more superior to that of homogeneity value optimal family when facing the induction from neighboring and non-neighboring values.

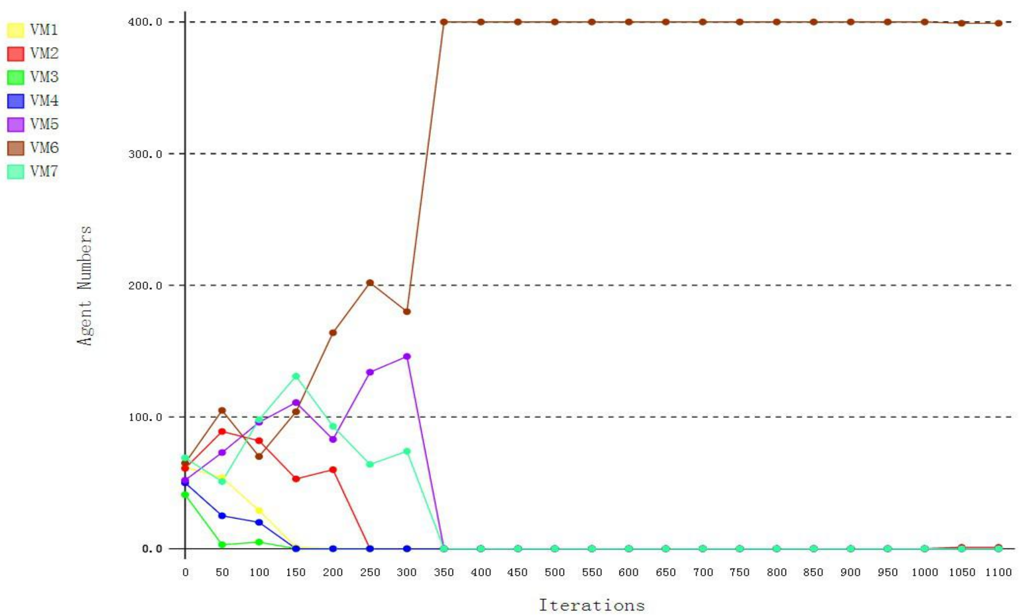
However, there is a fact that needs to be discussed. The researchers make the artificial system back to the state in Figure 3(a). In this case, they got the result shown in Figure 9(a) if they let the artificial system continue evolving 5000 iterations. The conclusion is that the originally modest strategy becomes a too powerful strategy after 1000 iterations, with the increasing of the number of iterations, making the system fall into "homogeneity value optimal family" again.



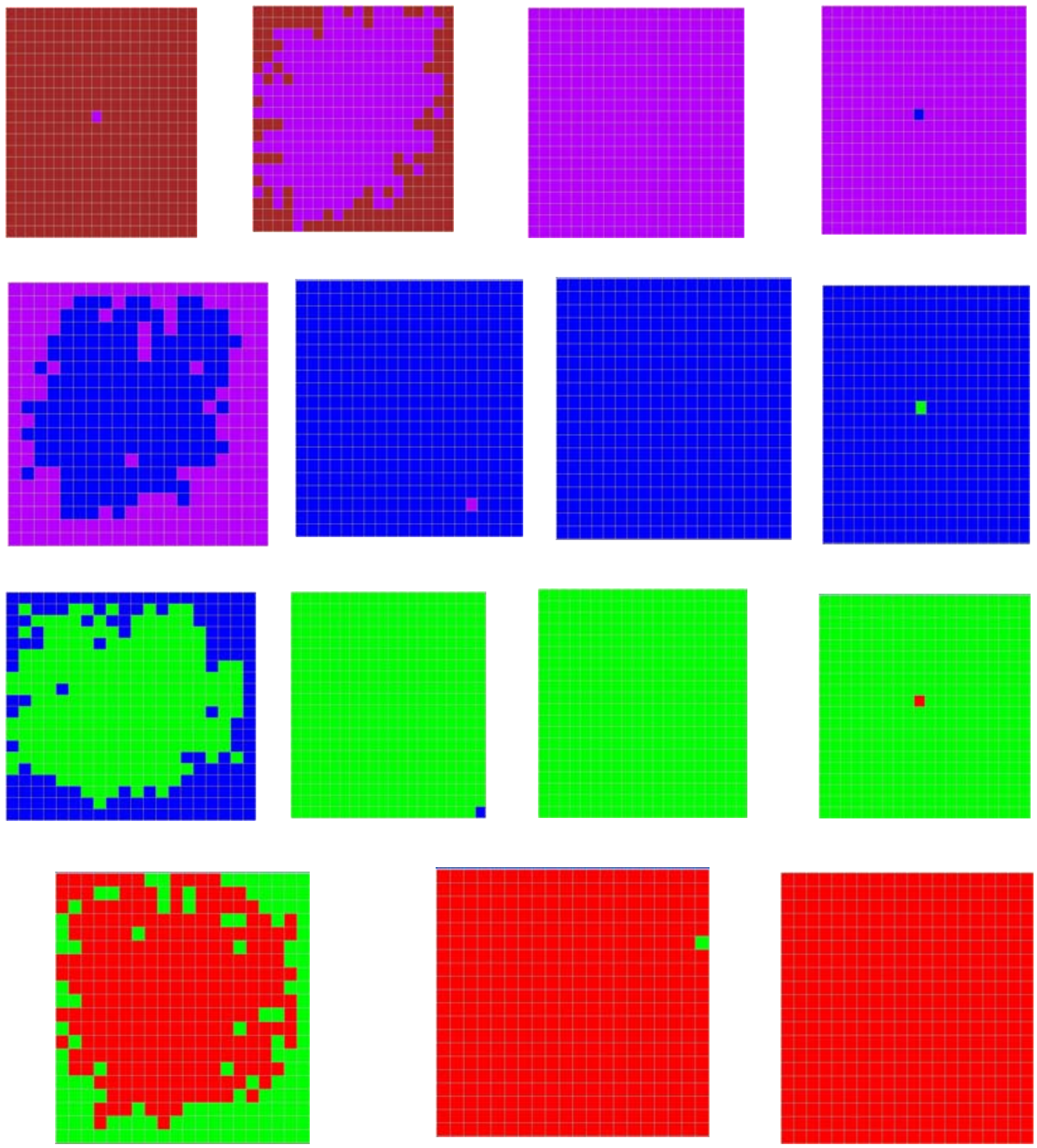
(a1) Model candidates sorting
(a2) Model choosing
(a3) Result of model demonstration effect
(b1) Trends in the number of agents holding different values in populations
(b2) Trends in the proportion of agents holding different values in populations
(b3) Number of agents changing their values in each 50 iterations

Fig. 5. Evolution and data analysis of artificial system of model demonstration effect (1)



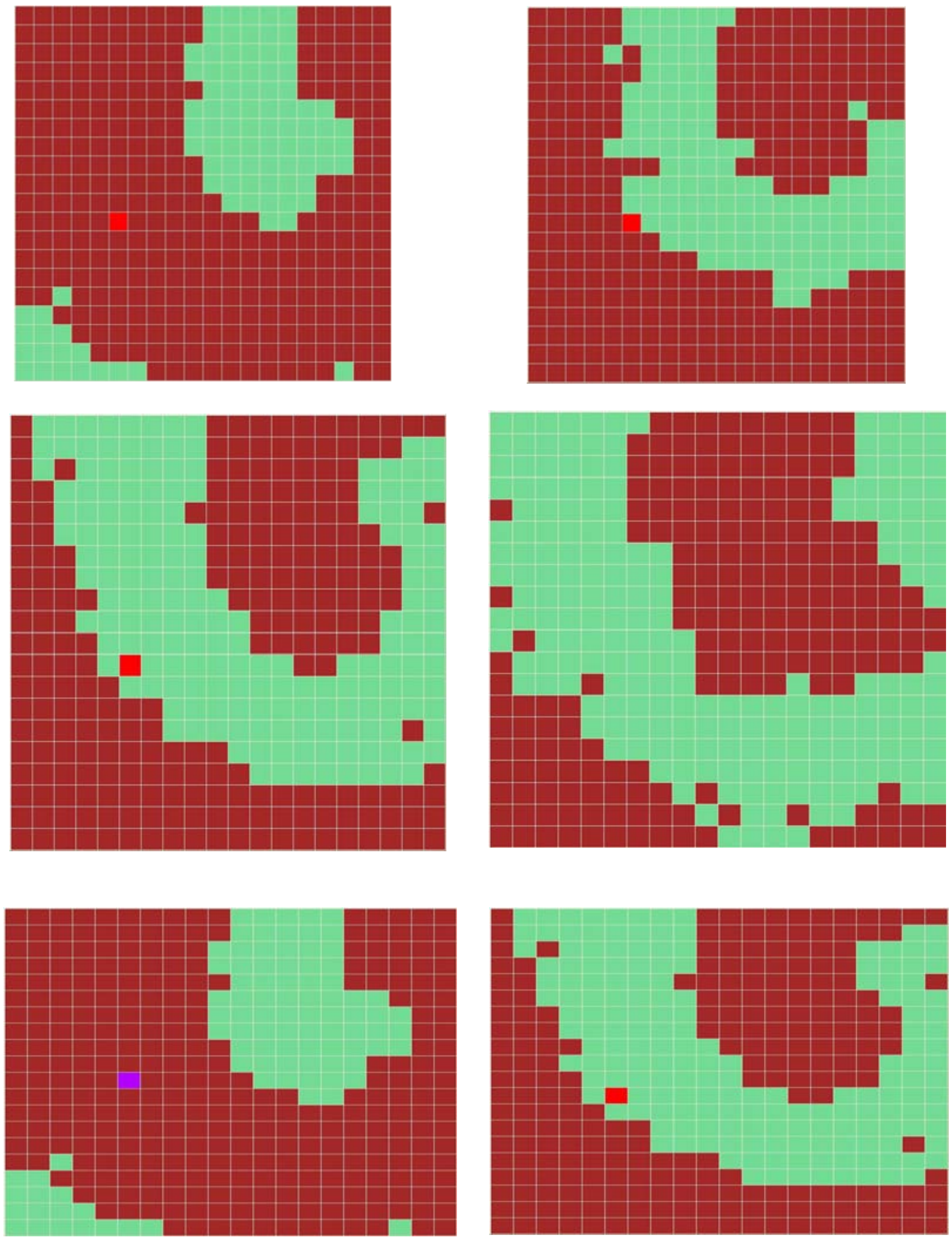


(a)
(b)
Fig. 6. Immunity analysis of homogeneity value optimal family (1)



(a) induction(from neighboring values) (b) after 10 iterations
(c) after 20 iterations (d) induction
(e) after 10 iterations (f) after 20 iterations
(g) after 23 iterations (h) induction
(i) after 10 iterations (j) after 20 iterations
(k) after 22 iterations (l) induction
(m) after 10 iterations (n) after 20 iterations
(o) after 21 iterations

Fig. 7. Immunity analysis of homogeneity value optimal family (2)



(a1) induction (a2) after 10 iterations (from non-neighboring values)
(a3) after 15 iterations (a4) after 20 iterations
(b1) induction (from neighboring values) (b2) after 3 iterations
Fig. 8. Immunity analysis of heterogeneity values adaptive family

To prevent this from happening, UPVs should adopt a special strategy. The strategy is that choosing some agents agreeing with another value close to the population mainstream values in "heterogeneity values adaptive family" as models. So, the immunity and robustness of "heterogeneity values adaptive family" are maintained. This strategy avoids the "heterogeneity values adaptive family" transforming into "homogeneity value optimal family". Strategy implementation process and results are shown in Figure 9 (b).

Validity Experiments of the Strategy UPVs Take When Shaping Population Values Under a Special Circumstance

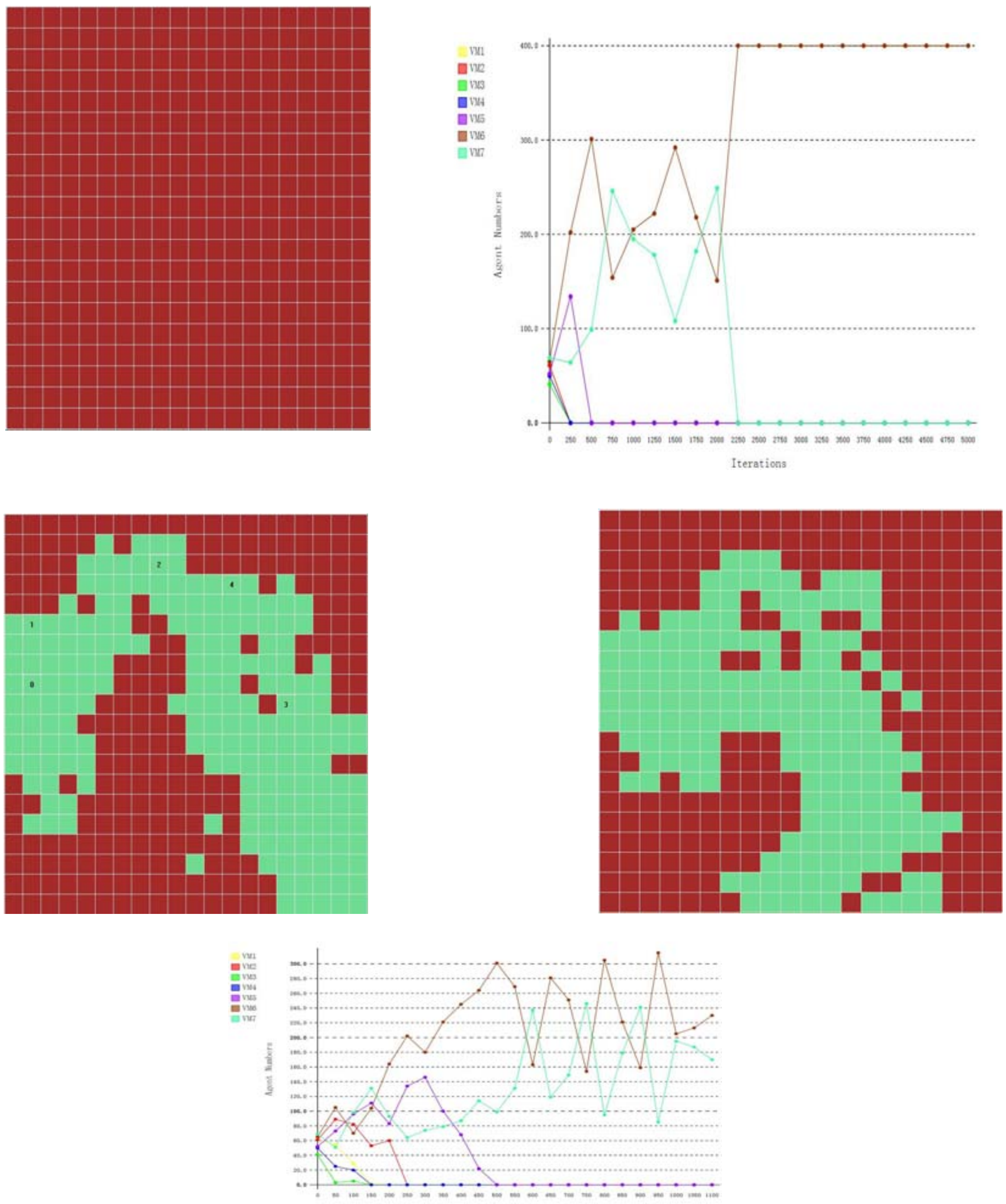
The researchers also found a phenomenon appearing in a large number of computing experiments. At the beginning of artificial system running, if the space distribution of the 7 values is not random but of apparent regional characteristics, it's easier for artificial system to form a small amount of outside family non-neighboring values difficult to digest compared to the artificial system in which the values are randomly distributed at the beginning, even though UPVs take population mainstream values shaping strategy. Taking "7 values, 1000 parallel executions and 1000 iterations in every parallel execution" for example, the number of the state of "2 neighboring values and a value non-similar to any of the 2 values left" is 1 (according to Table 1) when the artificial system independently evolves and initial values are randomly distributed in the artificial system. When the values have obvious regional characteristics, the number of the appearance of the state is up to 3 even though UPVs take population mainstream values shaping strategy. With the values having obvious regional characteristics as the starting point of observation, the shaping strategy UPVS can take in such special situations is shown in Figure 10.

One values distribution with regional characteristics is shown in Figure 10 (a1). Figure 10 (a2) shows the appearance of family outside non-neighboring VM3 (green, 2 points) in artificial system evolution. Figure 10 (a3) shows that the independent evolution iterations of artificial system cannot digest the few remaining family outside non-neighboring VM3 in a relatively short period, here it is 400 iterations. The implementation of "progressive remodeling chain" strategy is shown in Figure 10 (a4), (a5),(a6) and (a7). Taking the value (VM3, red) close to the family outside values as the starting point, what UPVs need to do is to disguise the Agent which is close to the two agents agreeing with VM3 and originally agreeing with the mainstream values as Agent agreeing with VM2 and color it red. Figure 10 (a8), (b1) and (b2) indicate that there is no "family outside" non-neighboring reproduced values in the subsequent evolution after implementing "progressive chain reshaping" strategy. So, the strategy is valid.

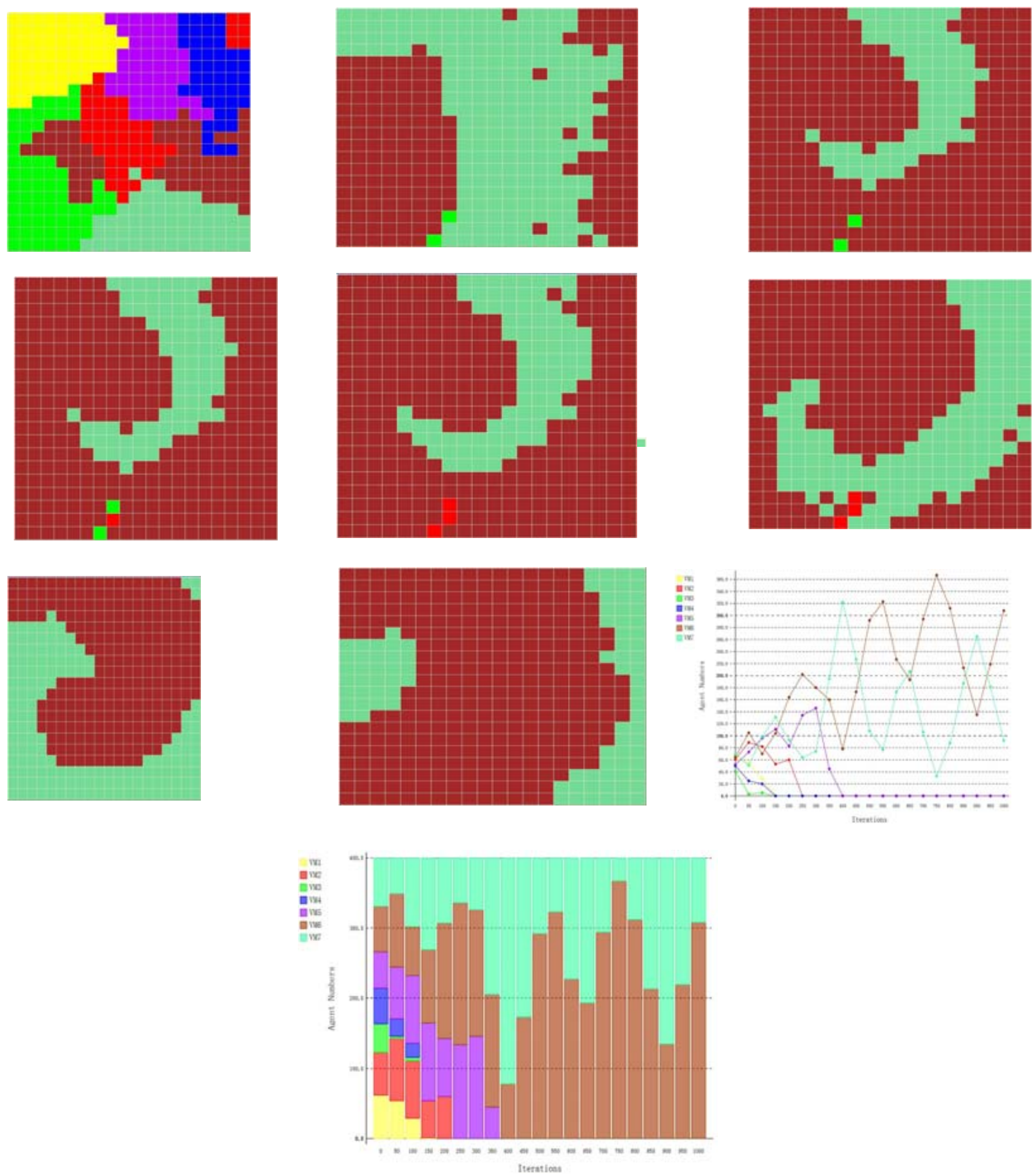
CONCLUSION

The researchers' main work in this paper is to build a computation model of population values shaping process in a bottom-up way and furthermore foster an population values shaping complex adaptive system with obvious "in between" characteristics through computing experiments, based on social science computing experimental thinking, complex adaptive thinking, culture gene social delivery theory (Meme theory) and agent modeling method. The researchers didn't simply borrow the concept of Meme, nor build the culture genetic algorithm itself. But through the parallel execution of complex adaptive systems, they proved that meme and its 3 essential characteristics are important and exists objectively in the artificial system. This is a critical problem in the field of social science. Such natural science research problems as building culture genetic algorithms should be based on this issue logically. Moreover, the researchers proposed the series concepts of "values family" verified in the artificial system.

For UPVs, how to shape population mainstream values effectively is a problem. Regarding the social problem, there are still many interesting problems to be discussed through the computing focusing artificial system. The complex adaptive system in this paper can describe the process of population values shaping. And this system has the potential of providing new ideas and policy guidance for the related social science problems. This is one of the core objectives of social computing. The researchers' future work will focus on making the artificial system cultivated more powerful on the analysis of social behavior, providing more valuable suggestions for related social science issues and evaluating social decision-making.



(a1) Intuitive results under too powerful strategy
(a2) Data analysis under too powerful strategy
(b1) model candidates sorting (b2)model choosing
(b3) data analysis
Fig. 9. Evolution and data analysis of "model demonstration effects"(2)



(a1) values distribution with regional characteristics
(a2) appearance of non-neighboring values outside family
(a3) after 400 iterations (a4)re-shaping (from neighboring values)
(a5) reshaping (a6)reshaping
(a7) successful reshaping (a8) successful reshaping
(b1) Trends in the number of agents holding different values in populations
(b2) Trends in the proportion of agents holding different values in populations

Fig. 10. Evolution and data analysis of digesting outside family values

RECOMMENDATIONS

Based on the artificial population values shaping complex adaptive system and its parallel execution results, this paper proposes the following insights into the social science issue called population values shaping and gives the corresponding recommendations.

1.) Traditional social science theory, especially the theory based on political science prospective, tends to emphasize too much on shaping population values through the homogeneity of values when discussing values shaping. However, if the same problem from the perspective of complex adaptive system, the immunity and robustness of heterogeneity values adaptive family are superior to homogeneity values optimal family. In fact, the two values consisting of heterogeneity values adaptive family are already close neighboring in ring-resemble structure. In addition, the advantages of mainstream values in the family are obvious compared to others. The characteristics of heterogeneity value adaptive family are mainstream clear, inclusive and vibrant. This is a perfect example of the best state of population values. Therefore, UPVs should take the best state as the goal to set and implement population values shaping strategy approximately. For example, the intensity of shaping strategy should be moderate and choose models from the agents agreeing with the mainstream values.

2.) What should be cared for particularly is that UPVs require to pay full attention to the values close to population mainstream values in heterogeneity values adaptive family. Then, it set models for the agents agreeing with the values timely to maintain the immunity and robustness of heterogeneity values adaptive family and avoid heterogeneity values adaptive family transforming into homogeneity value optimal family.

3.) Taking the values close to the family outside non-neighboring value as starting point and using progressive chain reshaping strategy, the reshaping result will be better when there is family outside non-neighboring value which is difficult to digest in the population. Conversely, we should take measures to prevent "progressive chain induction" from occurring.

ACKNOWLEDGEMENTS

This work was supported by the Fundamental Research Funds for the Central Universities of China: Prediction research on execution effects of national culture security policies in China from perspective of computational social science(No. DC201502030401).

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