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Impact Analysis Between the Individual and Group Based on Dynamic System Simulation

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Abstract: Complex human behavior is very interesting and important, we should continue to explore and research, but the process itself is able to attract the interest of many scholars. In this study, from the perspective of economics and psychology, by using of computer modeling and simulation with the theory of the complex systems, the mutual influence between individual and group behavior in the limit environment were researched and analyzed. The experimental results emerged a real impact mode between individual and group behavior in the real world and a more reasonable explanation of the mutual influence between individual and group is made by this experimental results.

Key words: Behavior modeling, simulation, individual, groups

INTRODUCTION

From the middle of last century, the issues about group organizational and individuals were studied and analyzed from different aspects by many scholars (Wang, 2002; Robbins, 2005; Maslow, 1998; Fehr and Rockenbach, 2003). The individual behavior motivation, the behavior motivation of individuals in organizational groups, the problems about formation, development and result of group were elaborated based on different aspects. These results greatly promoted the group's research and dissemination of knowledge, accumulation and innovation.

German social psychologist lewin said: People's behavior trend depends on the interaction of the internal force and scenario force field (Wang, 2002). It = s can be expressed by the formula as B = F (P.E), where B is the direction and intensity of individual behavior, P is the internal dynamics and internal features of individual, E is the group environment of the individual. Any behavior, that is to say, is the interaction of personal and environmental factors; for a person with sanie motivation, different environment will lead to different behaviors. Therefore, the psychodynamic of individual behavior in the organization primarily driven by the individual's needs, motivations and the group environment.

This work originated in the observation of daily life. The student associations, as a ubiquitous group organization in university, are generally agreed with the positive impact on students. What factors influence a student to join the organization and what factors have relations with the group's influence on the individual? This study attempts to find out the answers to these questions by establishing the mathematical models of individual behavior and then simulating in complex system environment.

ASSUMPTIONS ON THE INDIVIDUAL

Psychologists generally believe that human behavior is controlled and restricted by their conscious trend, such as needs, motives, values, beliefs, attitudes and so on; the needs and motives play a key role in individual behavior (Robbins, 2005). Motivation determines the individual's behavior and the needs dominate the motivation; so the needs and motivation are two most basic elements of the power of behavior. Need as a driving force, is the source of all power of behavior, turns into behavioral motive leaded by incentives (external conditions) or goals to play its function of power. Meanwhile, people's behavior is also the result of the interaction between the environment and the individual.

This study makes the following assumptions on the individual and the environment: First, assuming that laziness (Zhang, 1990; Ellis and Knaus, 1977) is human nature; secondly, assuming that the individual except the laziness but has the sense of belonging to a organization and the enthusiasm stimulated by some demands (i.e., individual active force) and individual self-satisfaction. In addition, the group itself has a boundary but its influence covers the entire world environment; And, except the group and individual self-satisfaction have influence on motivation but also affected by the other adjacent individuals.

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BEHAVIORAL MODEL

Characteristics of the individual and the environment: According to Maslow's hierarchy of needs theory (Maslow, 1998) and assumptions above, the i-th individual has following attributes: inertia λ_i, individual active force N_i, the probability p_i and the strength k_i affected by other individuals, groups impact factor $\dot{e}_i$, the target satisfaction m_i; moreover, the i-th individual also has the velocity v_i and position r_i in environment.

The environment is an unbounded two-dimensional coordinate system, but the group has a range of radius R. Individuals were randomly distributed into the region outside the group range in the initialization time. Unbounded environment means that when the individual reaches the boundary of the world W can wrap around to the other side of the coordinate system and not out of the boundaries of the world environment.

Individual motion model: Assuming that any individual can move uncontrolled in the environment of the world, namely it can be free to enter or leave the group; Whether an individual has joined the group or not identified by the distance between them and each individual are subject to the following equation of motion which references to the literatures (Fehr and Rockenbach, 2003; Zhang *et al*.,2005):

$$r_i (t+\Delta t) = r_i (t)+v_i (t)\,\Delta t \quad (1)$$

$$v_i = F_i/(m_i+\lambda_i) \quad (2)$$

Equation 1 is used to calculate the location of the individual and Eq. 2 to calculate the speed of the individual. Fi is a vector, representing the individual self-excitation force, can be understood as the individual factors affecting the change of state; which is mainly affected by Ni in the model, the individual active force. Mi is the quality of the i-th individual, the value is 1; and the time scale $\Delta t = 1$. If all of the individuals return to the initial state of motion at any end time of Δt, so it is easily to obtain the displacement formula in unit time Δt from the Eq. 1 and 2 as shown in Eq. 3:

$$\Delta r_i = F_i/(1+\lambda_i) \quad (3)$$

Definition of self-excitation force: The self-excitation force is a vector, which can be understood as the individual drive force and other influential power force in the action direction. The individual self-excitation force at time t can be represented by Eq. 4 and the Eq. 5 is used to calculate the individual drive force at time t+1.

$$F_{(i,j)} = \left[N_{(i,t)} + (1-\lambda_i)P_{(i,t)} + \left| N_{(i,t)} + (1-\lambda_i)P_{(i,t)} \right| \times \left(\delta_{(i,t)} - m_i \right) \right] \vec{\theta}_{(i,t)}, (|\theta|=1) \quad (4)$$

$$N_{(i,t+1)} = \left| F_{(i,t)} \right| \quad (5)$$

$N_{(i,t)}$ is the drive force of the i-th individual at time t; $P_{(i,t)}$ is the power of influence acting on the i-th individual at time t by the group and other adjacent individuals; $\delta_{(i,t)}$ is the degree of satisfaction of the i-th individual at time t; m_i is the feedback coefficient of behavior satisfaction of the i-th individual at the end of action; $\theta_{(i,t)}$ is the direction vector of the motion of the i-th individual at time t and the angle is a random quantity as a reference to the origin of coordinates but the offset is less than $\pi/2$. The resultant force impact on a single individual can be expressed by Eq. 6:

$$P_{(i,t)} = F_{(i,t),G}+F_{(i,t),B} \quad (6)$$

where, $F_{(i,t),G}$ and $F_{(i,t),B}$ were group influence and other adjacent individual It should be emphasized that the choice of force is not the only way in this model; other options can also produce similar behavior. The main purpose of this study is to propose a relatively simple model to validate parameters.

Simulation results: Most people do not want to change their established habits of behavior or way of thinking for many years to develop, you can think that this is inertia and most people think that inertia is the nature of human being. The inertia and some other similar characteristics have great influence on people's behavior. By using the Netlogo simulation platform based on Agent and on the basis of individual behavior model established above, the individual behavior is simulated and analyzed in this study. According to the simulation results, from the following aspects, the factors which influence the behaviors between the individuals and group are also discussed in this study. Influence acting on the i-th individual respectively at time t. $F_{(i,t),G}$ and $F_{(i,t),B}$ can be expressed by Eq. 7:

$$\begin{aligned} F_{(i,t),G} &= qlN_{(i,t)} \\ F_{(i,t),B} &= \sum_{j\neq i, j\in\beta} pk(N_{(j,t)} - N_{(i,t)}) \end{aligned} \quad (7)$$

The parameter q is the probability of the individual affected by the group and the parameter l (l?(0,1)) is the impact factor; the parameter p is the probability affected by other individual within a distance β and k (k?(0,1)) is

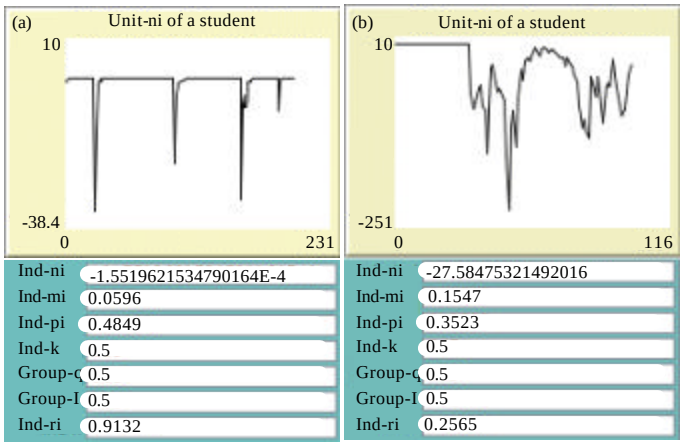

Fig. 1(a-b): Inertia (ind-ri) impact on individual, (a) ind-ri = 0.9123 and (b) ind-ri = 0.2565

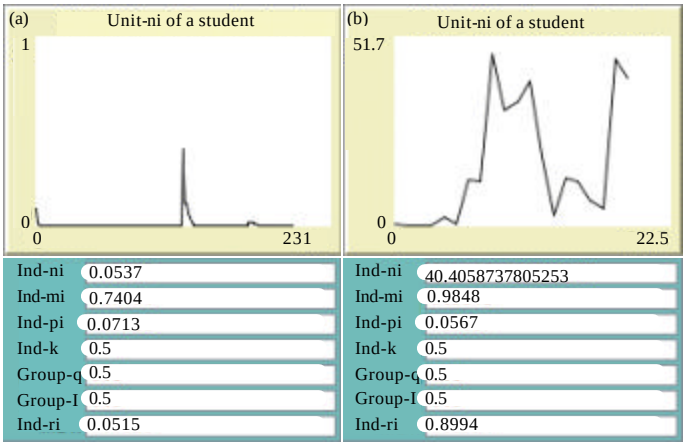

Fig. 2(a-b): visibility range (β) impact on individual, (a) β = 0.6 and (b) β = 2

the impact strength. So the Eq. 6 can be further expressed as below Eq. 8 and the Eq. 4, for calculating the individual self-excitation force, can be further expressed as Eq. 9:

$$P_{(i,t)} = qlN_{(i,t)} + \sum_{j\neq i,\, j\in\beta} pk(N_{(j,t)} - N_{(i,t)}) \tag{8}$$

$$F_{(i,t)} = \begin{Bmatrix} N_{(i,t)} + (1-\lambda_i)\left[qlN_{(i,t)} + \sum_{j\neq i,\, j\in\beta} pk(N_{(j,t)} - N_{(i,t)}) \right] + \left| N_{(i,t)} + (1-\lambda_i) \right| \\ \left[qlN_{(i,t)} + \sum_{j\neq i,\, j\in\beta} pk(N_{(j,t)} - N_{(i,t)}) \right] \times \left(\delta_{(i,t)} - m_i \right) \end{Bmatrix} \dot{\Theta}_{(i,t)}, (|\Theta|=1) \tag{9}$$

The first one, Inertia impact on individual: As shown in Fig. 1, the individual which inertia value is smaller (ind-ri = 0.2565) have more stronger activity than the individual which inertia value is larger (ind-ri = 0.9132), when the probability q affected by group (i.e., group-q in Fig. 1), influence factor l (i.e., group-l in Fig. 1), the individual satisfaction mi (i.e., ind-mi in Fig. 1), individual mutual influence k (i.e., ind-k in Fig. 1) are similar. So we can see, inertia offers obvious resistance to the activities of the individual.

Second, visibility range impact on individual: The visibility range impact on individual's activity is shown in Fig. 2. The individual activity diagram (visibility range β = 0.6) is shown in Fig. 2a and the other one (β = 2) is shown in Fig. 2b. The larger visibility range of individual means the greater mutual influence probability with other individuals. It can be seen from Fig. 2: Increasing the individual's horizon has obvious effect on increasing the individual influence probability affected by other individuals; the visibility range is positively related to the mutual influence between individuals, even individuals with high Inertia (ind-ri = 0.8994) and satisfaction (ind-mi = 0.9848), it will also play a significant influence.

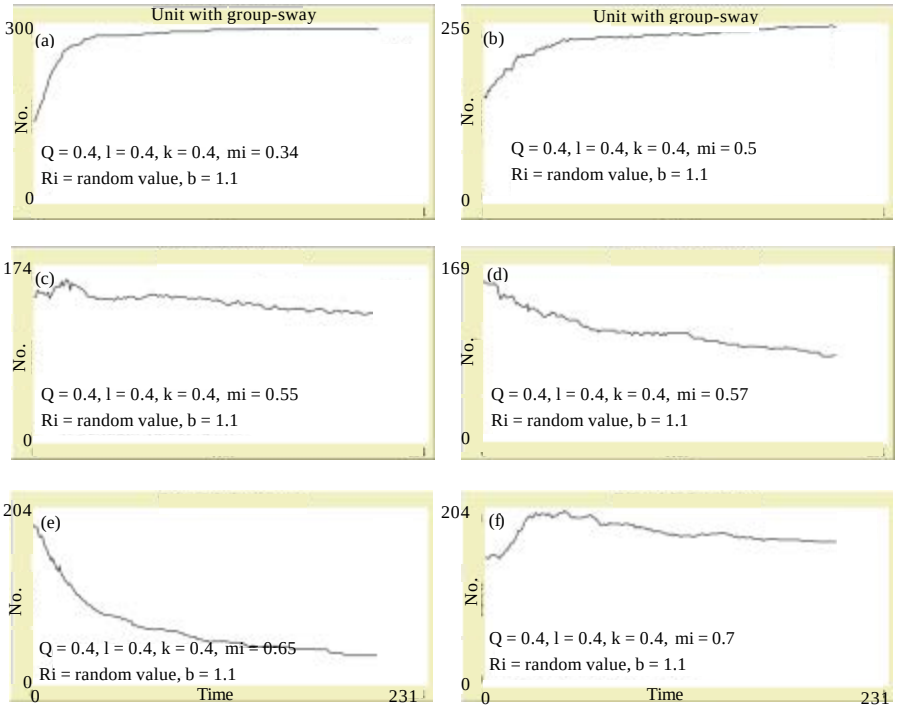

Fig. 3(a-e): Influence of individual satisfaction on group

The third, self-satisfaction impact on the organizational community: For any individual, the individual satisfaction plays the role of evaluation and feedback on their behavior outcomes and further strengthens the behavior. This enhancement is bidirectional, when individual behavior expected reaches or exceeds expectation, a positive feedback, play a positive role in strengthening; otherwise a negative feedback, a negative role in strengthening. Self-satisfaction impact on the organization is shown in Fig. 3.

From the comparative analysis in Fig. 3 can be seen: when the individual's other factors remain unchanged (q = 0.4, l = 0.4, k = 0.4, ri is random value, b = 1.1; where b is the individual horizon β, b denotes variables used in the procedure), the individual with lower satisfaction (mi) is more conducive for organizations to stimulate its initiative. When the individual satisfaction value is small, as shown in Fig. 3a (mi = 0.34) and Fig. 3b (mi = 0.5), groups activating effect on the individual initiative present upward trend over time tick. Increasing individual satisfaction value, when its value is 0.55, as shown in Fig. 3c, the ascension of the individual initiative begin slowing down and gradually decrease. The change indicates the individual's expectations began to be less than its expected value, at the same time the stimulating effect on the individual by groups begins to become weak. With the further increase of individual satisfaction, as shown in Fig. 3d and e, the group hardly have any effect to drive the individual. When the value of individual satisfaction (mi) is 0.7, as shown in Fig. 3f, even if the influence probability parameter (q) and impact strength parameter (l) of the group were added to 0.9, the excitation effect can not stop the downward trend; that means the individual expectations is difficult to achieve the desired values, the behavior of reverse strengthening effect was further enhanced.

Finally, community organizations impact on the individual: From the comparative analysis of the organization's influence on the individual as shown in Fig. 4, it is not difficult to see that: In the case of the other influence factors of the individual remain unchanged, only to strengthen the organization's influence probability q (as shown in Fig. 4a, q = 0.8, l = 0.14) or just enhance the influence strength l (as shown in Fig. 4b, q = 0.16, l = 0.72), can enhance the individual incentive effect to some extent; but compare to properly enhancing the effect probability and influence degree (as shown in Fig. 4c, q = 0.47, l = 0.55), the latter effect is better than the former.

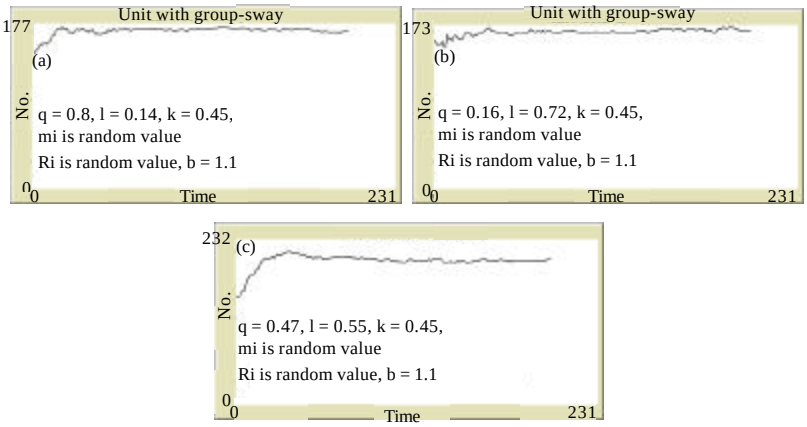

Fig. 4(a-c): Community organizations impact on the individual

CONCLUSION

Through the above analysis about the simulation results can be drawn that, the main factors influencing the organizational trend of individual is the strength of their tissue tropism and the factors affecting the excitation force include the individual initiative, inertia, influence of other individuals and groups organizing exciting force (charisma). Individual drive force is the source power of the individual and the inertia with blocking effect on individual behavior; the individual affected by other individual is uncertain, it depends on its own characteristics (the probability of being affected) and its surroundings (the features of other individuals in the visibility range).

For a rational economic individual, in order to improve the vitality effectively of its own, the first important thing is to reduce the influence of inertia, then need to expand the horizon to enhance the mutual influence and activity among individuals within the group. For the group, in order to enhance organizational influence on individuals, it is not only need to organize collective activities with appropriate frequency to increase the influence probability on individuals, but also need to enhance each activity's influence on individuals; and it is also need to strengthen the organization's guiding force, to guide the individual to establish correct self-satisfaction on the basis of in-depth knowledge and understanding of the organization (objective expectations, namely the group values).

Of course, the model is only to student organizations as the simulation object for analysis, only considering the main influence factors between individuals and the group; and it is a basic model with some other factors not considered, such as the relationship between individuals (lovers, friends, gender, etc.). The next step of the model also needs to make further corrections and extensions.

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