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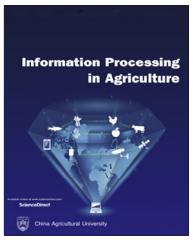

Simulation research on online marketing strategies of branded agricultural products based on the difference in opinion leader attitudes

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ABSTRACT

By virtue of the low-cost and high-efficiency internet traffic monetizing ability, key opinion leaders (KOL) have achieved great success on social media platforms in terms of agricultural brand e-commerce marketing. However, opinion leaders tend to adopt different promotion strategies according to their preference to brands. How to optimize online marketing strategies based on the difference in opinion leaders' attitudes remains a problem demanding prompt solution for agricultural product brand enterprises. This study takes agricultural product brand enterprises and opinion leaders with limited rationality as the research subjects. On the premise of considering the difference in opinion leaders' attitudes towards brands, the paper combines the evolutionary game theory to construct agricultural product brands' online promotion strategy evolutionary model, adopts visualization system to simulate the evolutionary process of brand online promotion strategies, verifies model validity and explores the influencing mechanism of punishment on opinion leaders' negative promotion. Results of multi-agent-based simulation demonstrate that investment in brand promotion, irrelevant to opinion leaders' attitudes towards brands, pertains to the absolute advantage strategy of agricultural product brand enterprises. Reinforced intensity of punishment against opinion leaders following negative promotion may change opinion leaders' promotion strategies for agricultural product brands. Moreover, the present study provides an idea and reference to the management decisions of agricultural product brand enterprises' online brand promotion strategies.

1. Introduction

Agriculture branding development in China begins to take shape under the strong leadership of government brand strategies favoring the peasants. As indicated by the statistics of RPC (Trademark office of national intellectual property administration), the number of registered trademarks of agri-

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cultural products increased from 600,000 in 2008 to 2.8513 million in 2017, with annual average growth rate totaling 21.5%. Till June 2019, 2,594 geographical indication agricultural products and approximately 40,000 green organic agricultural products registered in Ministry of Agricultural and Rural Affairs. Branding spurs agricultural production standardization. For five consecutive years, the quality safety monitoring pass rate had been maintained above 96%. In addition, agricultural product e-commerce market also sought quick expansion. In 2018, agricultural products' network sales volume reached 340 billion RMB, including 230.5 billion RMB contributed by agricultural products' network retail sales [1]. Thus, it can be seen that green and quality agricultural product brands in China have gained high popularity among consumers both at home and abroad.

According to *Opinions of Ministry of Agricultural and Rural Affairs on Facilitating Brand Strategies Favoring the Peasants*, the government should resort mobile internet technologies to innovate brand marketing mode, realize precision marketing of agricultural brands and expand agricultural brands' market shares [2]. However, as stated by Minister of Ministry of Agricultural and Rural Affairs of China at China Agricultural Brand Building Summit Forum, agricultural brand building of China remains in the start-up stage [10] in need of further improvement in marketing and circulation efficiency. The low promotion efficiency of traditional marketing philosophy and mode aggravates the severity of agricultural products' unsalable problems and undermines the awareness of Chinese agricultural product brands [11]. Consequently, it cannot give full play to the advantages of internet economy era in low communication cost, wide information communication channel and strong service logic. As the emerging business mode in social media era, "live-streaming + agriculture + e-commerce" replaces traditional marketing by online celebrities, gains extensive and quality agricultural product brand promotion effects at low marketing cost, which can thus increase brand awareness and sales volume. Until now, internet influencers created many extraordinary sales performances via live-streaming. Weiya, a famous internet influencer in Chinese live-streaming filed, sold 75,000 kg Dangshan nectarine and created 1.5 million RMB sales simply within ten minutes [9].

The essence of internet influencer marketing refers to that opinion leaders directly convey brand or product electronic word-of-mouth (eWOM) to consumers via social media or live-streaming platforms. As a key factor affecting consumer attitudes and buying behaviors, word-of-mouth (WOM) directly affects sales conversion behaviors and attitudes [3]. Electronic word-of-mouth (eWOM) is defined as the dynamic and ongoing information exchange process between consumers regarding a product, service, brand, or company via the Internet [13], which turns out to be an influential factor affecting the way consumers make purchase decisions [12,14-16,18,21]. eWOM is characterized by long retention, wide coverage, fast speed of communication and extensive influence [28]. When agricultural product brands' WOM comments present a mix of praise and criticism, consumer opinion leaders can significantly steer others' consumption attitudes, beliefs and behaviors [5,6,20].

Different preferences of opinion leaders to agricultural product brands decide their different attitudes towards WOM marketing. In turn, the difference in opinion leaders' attitudes towards brands directly affects the effects of brand online marketing. When opinion leaders show high passion for certain brand, their comments will be more influential [12,14,21,25,27]. When enterprises choose proper opinion leaders for brand promotion, they can only make decisions according to quantitative indexes such as number of fans and sales transfer ability, yet cannot measure their attitudes towards brands [26]. On this basis, taking the attitude of opinion leaders in brand promotion as a variable factor, optimizing the network marketing strategy of agricultural products brands is the key problem to be solved by this research.

The existing theoretical research on general brands, such as opinion leaders' WOM share will and motivation [26,29], consumers' brand perception and behavior [23,24,30,33], provides the research foundation and enlightening insight for solving the optimization problem of online brand promotion strategies for agricultural products. Though Chinese agricultural brand building is currently entering the fast lane, entire development of agricultural branding remains in the start-up stage [8]. Agricultural product brand online marketing belongs to an emerging marketing business mode in recent years, which received increasing consideration. Though in terms of actual production operations, agricultural enterprises gradually increase the proportion of investment in social media marketing [7]. While in research field, relevant studies more concentrate on descriptive research but overlook targeted and reliable theoretical research yet. In the field of agricultural product brand online marketing, there still exists a research question received little attention about online promotion decisions considering promoter marketing positivity differentiation factors.

Evolutionary game theory, originated in the field of biology, believes that players do not have the ability to make optimal decisions and can only update their strategies through trial and error and imitation. If, after a finite number of games, the strategies of the two sides finally become stable, it can be said that players of the game have chosen their respective advantage strategies. Evolutionary game theory is generally used to explain the relationship between parameter changes and evolutionary results [19], and it has been extensively employed in strategic choice issues [4].

Therefore, with the purpose of promoting the online brand marketing of agricultural products, this paper, regarded opinion leaders (OL) as the main body of eWOM communication, builds an evolutionary game model of online promotion strategy of agricultural products brands. Meantime, by reference to the results of the dynamic visualization multi-agent-based simulation experiment, the paper aims to answer the following two questions: 1. What is the condition for opinion leaders to proactively promote agricultural product brands? 2. Is punishment conducive to changing negative brand promotion strategies of opinion leaders?.

2. Modeling and analysis

Taking agricultural product brand enterprises and opinion leaders with limited rationality in social media as the research subjects, we intend to analyze the choice mecha-

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nism of agricultural product brand enterprises for online promotion strategies on the premise of opinion leaders' stand differentiation under evolutionary game perspective.

Although agricultural product brand enterprises attempt to promote brand awareness via online brand eWOM marketing, it should be noted that online marketing requests investment in promotion and it possibly fails in some cases. Under such circumstances, it may result in divergence in enterprise internal marketing strategies during decision-making process. Those managers who prefer investment in online marketing are probably assimilated to change their mind, while those who prefer investment in brand online marketing probably gain more support, generate scale effects on groups and even reverse the decision of whole agricultural product brand enterprise. This decision-making process is in consistence with the evolutionary game theory in biological terms.

Hypothesis 1.. *The strategy space of agricultural product brand enterprise is defined as B = (Investment, No investment). Supposing* α *is the proportion of individuals favoring investment in brand online promotion strategies in agricultural product brand enterprise groups, then the proportion of individuals against investment in brand online promotion strategies is* $1-\alpha$*, and the cost of brand online promotion is* $C(C>0)$.

As a result of the difference between opinion leaders in attitudes towards brands in social media, opinion leaders also take different promotion strategies in agricultural product brands' online promotion. Fans of opinion leaders usually have similar preferences, indicating that opinion leaders and their fans tend to hold identical attitudes towards brands [17]. If agricultural product brand enterprises simply measure opinion leaders' influence according to number of fans, and literacy of posts, and accordingly judge effects of brand promotion, mistakes are bound to occur. To be specific, if opinion leaders who dislike the brand are chosen for brand promotion, they possibly take negative promotion strategies and cause negative influences on the brand. Therefore, to better improve the effect of online brand promotion, it is necessary to take opinion leaders' brand promotion attitude as a key index into consideration, and choose opinion leaders holding high brand recognition and preference as well as active promotion attitudes as brand promoters.

Hypothesis 2. *The strategy space of opinion leader is defined as L = (Active Promotion, Negative promotion). Supposing* β *is the proportion of opinion leaders taking active brand promotion strategies in social media, then the proportion of opinion leaders taking negative brand promotion strategies is* $1-\beta$ *and brand promotion earnings gained by opinion leaders is* $C(C>0)$.

When opinion leaders hold positive attitudes towards a brand, they will not arouse their loyal fans' aversion even if they undertake the promotion business of the brand. If fans can gain a discount from the brand enterprise, they possibly generate favorable views with the brand and expedite public debate over brand-related topics. On the contrary, opinion leaders may also incur defamation, slander and other negative influences through brand promotion business. When opinion leaders hold negative attitudes towards a brand but still undertake brand promotion business for the sake of profits, they easily arouse the aversion of fans. To make matters worse, such practice may undermine opinion leaders' WOM among fans which ends with the loss of fans or expose opinion leaders to other negative outcomes. Simultaneously, it may also hold the attention of consumers keen on the brand, enable the enterprise to harvest new fans and reinforce brand awareness.

Hypothesis 3. P_1*is defined as the recessive earnings gained by opinion leaders from positive brand promotion business, and* P_2 *is defined as the recessive earnings gained by opinion leaders from negative brand promotion business.*

When agricultural product brand enterprises choose opinion leaders who positively make brand promotion, these opinion leaders usually gain optimistic WOM effects among original fans and simultaneously trigger the aversion of opponents towards the brand. The reason is that opinion leaders basically have the same brand preference with fans. When brand enterprises choose opinion leaders who negatively make brand promotion, it often leads to the aversion of fans towards the brand, and worsens brand awareness. However, the complaints or WOM communication of fans probably cause a sensation and allow enterprises to gain positive brand promotion effects. Therefore, it is supposed that brand enterprises inevitably gain both positive and negative influences no matter what opinion the leaders take in brand promotion.

Hypothesis 4. V_1 *is defined as the gross earnings gained by brand enterprises from brand promotion undertaken by positive opinion leaders, and* V_2 *is defined as the gross earnings gained by brand enterprises from brand promotion undertaken by negative opinion leaders.*

When opinion leaders choose negative promotion strategies in agricultural product brand promotion, brand enterprises will miss the chance of raising brand awareness brought about by positive promotion, and pay a bill of opportunity cost. In consequence, to reduce loss arising from opinion leaders' negative promotion, brand enterprises need to punish opinion leaders engaged in negative marketing with fine F.

Hypothesis 5. *F is defined as the fine imposed by agricultural product brand enterprises on opinion leaders for negative brand promotion. T is defined as the opportunity cost missed by agricultural product brand companies because they not invest in positive brand promotion.*

To clarify the parameter settings, combined with the dependency of actual costs, benefits and losses of opinion leader and brand enterprise under different strategic combinations, relevant parameters and the corresponding meanings are set in Table 1.

Based on the above assumptions, an evolutionary game payoff matrix of brand enterprises and opinion leaders' brand promotion strategy is shown in Table 2.

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Table 1 – Parameter and explanation.

Symbol	Meaning and explanation	Hypothesis
α	The proportion of individuals favoring investment in brand online promotion strategies in agricultural product brand enterprise groups; $1-\alpha$ means the proportion of individuals against investment in brand online promotion strategies	1
β	The proportion of opinion leaders taking active brand promotion strategies in social media; $1-\beta$ means the proportion of opinion leaders taking negative brand promotion strategies	2
C	Investment cost of agricultural product brand enterprises in opinion leaders' brand promotion (explicit earnings gained by opinion leaders from brand promotion) ($C>0$)	1&2
V_1	Earnings gained by agricultural product brand enterprises from opinion leaders' active brand promotion	3
V_2	Earnings gained by agricultural product brand enterprises from opinion leaders' negative brand promotion ($V_1>V_2$)	3
F	Fine imposed by agricultural product brand enterprises on opinion leaders for negative brand promotion ($F>0$)	5
P_1	Recessive earnings gained by opinion leaders from active brand promotion	4
P_2	Recessive earnings gained by opinion leaders from negative brand promotion	4
T	Opportunity cost missed by agricultural product brand companies because they do not invest in active brand promotion ($T<0$)	5

Table 2 – - Payoff matrix.

		L (Opinion Leader)	
	Strategy/Proportion	Active Promotion/β	Negative Promotion /$1-\beta$
B (Brand Enterprise)	Investment/α	$-C+V_1, C+P_1$	$-C+V_2+F, C+P_2-F$
	No Investment /$1-\alpha$	$T, 0$	$0, 0$

The expected return of brand enterprises' investment or non-investment are U_{C1} and U_{C2}. The Average group return is $\bar{U_C}$.

$$U_{C1}=\beta(-C+V_1)+(1-\beta)(-C+V_2+F) \quad (1)$$

$$U_{C2}=\beta T \quad (2)$$

$$\bar{U_C}=\alpha U_{C1}+(1-\alpha)U_{C2} \quad (3)$$

The expected returns of opinion leader active or negative promotion are U_{V1} and U_{V2}. The Average group return is $\bar{U_V}$.

$$U_{V1}=\alpha(C+P_1) \quad (4)$$

$$U_{V2}=\alpha(C+P_2-F) \quad (5)$$

$$\bar{U_V}=\beta U_{V1}+(1-\beta)U_{V2} \quad (6)$$

According to the evolutionary game theory, the replicator dynamic equation of the brand promotion strategy game of opinion leaders and brand enterprises is presented as below:

$$F_U(\alpha,\beta)=\frac{d\alpha}{dt}=\alpha\left(U_{C1}-\bar{U_C}\right)=\alpha(1-\alpha)(\beta V_1-C+V_2+F-\beta V_2-\beta F-\beta T) \quad (7)$$

$$F_V(\alpha,\beta)=\frac{d\beta}{dt}=\beta\left(U_{V1}-\bar{U_V}\right)=\alpha\beta(1-\beta)(P_1-P_2+F) \quad (8)$$

Make $\frac{d\alpha}{dt}=0$ and $\frac{d\beta}{dt}=0$, and solve the replicator dynamic equation to get three equilibrium points $(0,\beta),(1,0)$ and $(1,1)$.

If $\alpha\neq0,\ \beta\in(0,1)$ and $P_1+F=P_2,(\alpha,\beta^*)$ is an equilibrium point, where

$$\beta^*=\frac{C-V_2-F}{V_1-V_2-T-F} \quad (9)$$

Local stability analysis method is sued to analyze and determine whether the above equilibrium points are the evolutionary stability strategy of the system.

$$J=\begin{pmatrix}\frac{\partial F_U}{\partial\alpha} & \frac{\partial F_U}{\partial\beta}\\ \frac{\partial F_V}{\partial\alpha} & \frac{\partial F_V}{\partial\beta}\end{pmatrix}=\begin{pmatrix}f_{11} & f_{12}\\ f_{21} & f_{22}\end{pmatrix} \quad (10)$$

where

$$f_{11}=(1-2\alpha)(\beta V_1-C+V_2+F-\beta V_2-\beta F-\beta T) \quad (11)$$

$$f_{12}=\alpha(1-\alpha)(V_1-V_2-F-T) \quad (12)$$

$$f_{21}=\beta(1-\beta)(P_1-P_2+F) \quad (13)$$

$$f_{22}=\alpha(1-2\beta)(P_1-P_2+F) \quad (14)$$

The specific values of local equilibrium pointsf_{11}, f_{12}, f_{21} and f_{22} are listed in Table 3.

When the determinant of Jacobian matrix corresponding to local equilibrium points is $DetJ=f_{11}\cdot f_{22}-f_{12}\cdot f_{21}>0$ and the trace $TrJ=f_{11}+f_{22}<0$, the system converges to this point, and the corresponding strategy is evolution stable strategy (ESS).

For point$(0,\beta)$and point(α,β^*), since $DetJ=0$ is always true, these points are not ESSs.

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Table 3 – Local equilibrium point matrix element parameter expression.

Points	f_{11}	f_{12}	f_{21}	f_{22}
$(1,0)$	$C-V_2-F$	0	0	P_1-P_2+F
$(1,1)$	$C+T-V_1$	0	0	P_2-P_1-F
$(0,\beta)$	$\beta V_1-C+V_2+F-\beta V_2-\beta F-\beta T$	0	$\beta(1-\beta)(P_1-P_2+F)$	0
(α,β^*)	0	$\alpha(1-\alpha)(V_1-V_2-F-T)$	0	0

For point$(1,0)$, if and if only

$$DetJ=(C-V_2-F)(P_1-P_2+F)>0 \tag{15}$$

$$TrJ=(C-V_2-F)+(P_1-P_2+F)<0 \tag{16}$$

Namely,

$$C-V_2<F<P_2-P_1 \tag{17}$$

The point $(1,0)$ is ESS.

For point$(1,1)$, if and if only

$$DetJ=(C-V_1+T)(P_2-P_1-F)>0 \tag{18}$$

$$TrJ=(C-V_1+T)+(P_2-P_1-F)<0 \tag{19}$$

Namely,

$$\begin{cases} F>P_2-P_1 \\ T<V_2-C \end{cases} \tag{20}$$

The point $(1,1)$ is ESS.

Based on the above discussion, the following conclusions can be drawn:

Conclusion 1. Whether the local equilibrium point is the global equilibrium point is not directly affected by α, β or V_1.

Conclusion 2. When there is local equilibrium point$(0,\beta)$or (α,β^*), $TrJ(0,\beta)=0$ or $TrJ(\alpha,\beta^*)=0$ is constantly established. Therefore, neither $(0,\beta)$ nor (α,β^*) is not the evolutionary stable point of the system.

Conclusion 3. When $C-V_2<F<P_2-P_1$,$(1,0)$ is the evolutionary stable point of the system.

Conclusion 4. When $F>P_2-P_1$ and $T<V_2-C$, $(1,1)$ is the evolutionary stable point of the system.

3. Simulation and analysis

In accordance with evolutionary game theory, individuals with limited rationality lack due ability to compute personal payoff earnings and make best decisions, and they can only make best decisions throughout constant trials and learning [22]. Aiming at two game groups (brand enterprises and opinion leaders) with limited rationality, the research divides two groups with different strategic choices in simulation experiment. Now that individuals with limited liability are unable to compute personal payoff earnings, they can only continually learn from and keep pace with other individual's adept in high-earnings strategies. Meanwhile, there are proportional mutants in the group too. When mutants' earnings payoff exceeds group earnings payoff, they cannot disturb system decisions and would be quickly eliminated in system iteration. Otherwise, they gradually proliferate and spread in the group until completely invading the group, changing group strategic choices and reaching final evolution stable state. Please refer to Fig. 1 for specific system evolutionary game flow.

To verify the validity of agricultural product brands' online promotion strategy evolutionary game model, and explore the influence of key parameters on group strategic choices, Netlogo simulation tool is taken to perform multi-subject simulation experiment. First of all, it randomly generates and scatters 500 heterogeneous individuals in system space, in which brand enterprises and opinion leaders make up 50% respectively. Secondly, it follows random walk hypothesis to set up multi-subject movement process. Heterogeneous individuals play game to each other during the encounter, while homogeneous individuals simulate upgrade strategy for optimal rules under limited rationality conditions in Fermi dynamic process [31,32]. Please refer to Fig. 2 for the initial state and stable state of simulation system. In order to eliminate randomness, the simulation under each parameter set is repeated 10 times. The result when the strategy evolution trend is the same should prevail.

3.1. *Verification and analysis of model conclusions*

In order to eliminate the possible influence of parameter variation in the simulation process, the number of changing parameters in each simulation experiment should be minimized. According to the actual situation and the restriction of parameters by conditions in model Conclusion 3 and Conclusion 4, the parameters are set according to Table 4 in the simulation experiment.

As shown by system simulation results in Fig. 3, the initial strategies of agricultural product brand enterprises and opinion leaders would not affect system evolution stable strategies. This attests the validity of Hypothesis 1 throughout 300 Ticks system evolution, two game groups' strategies turn stable. Due to the limited rationality of group individuals, heterogeneous individuals resulting from disturbance are quickly assimilated by mainstream groups, and therefore, the system is stabilized at the equilibrium point (1,0) (Fig. 3a) and point (1,1) (Fig. 3b) under different parameter hypotheses. Hypothesis 3 and 4 are attested. Additionally, it also implies the validity of agricultural product brands' online promotion strategy evolutionary game model.

3.2. *Evolution of system ESS under the dynamic condition of punishment intensity(F)*

In order to go into the influence of agricultural product brand enterprises' reinforced punishment intensity (F) on opinion

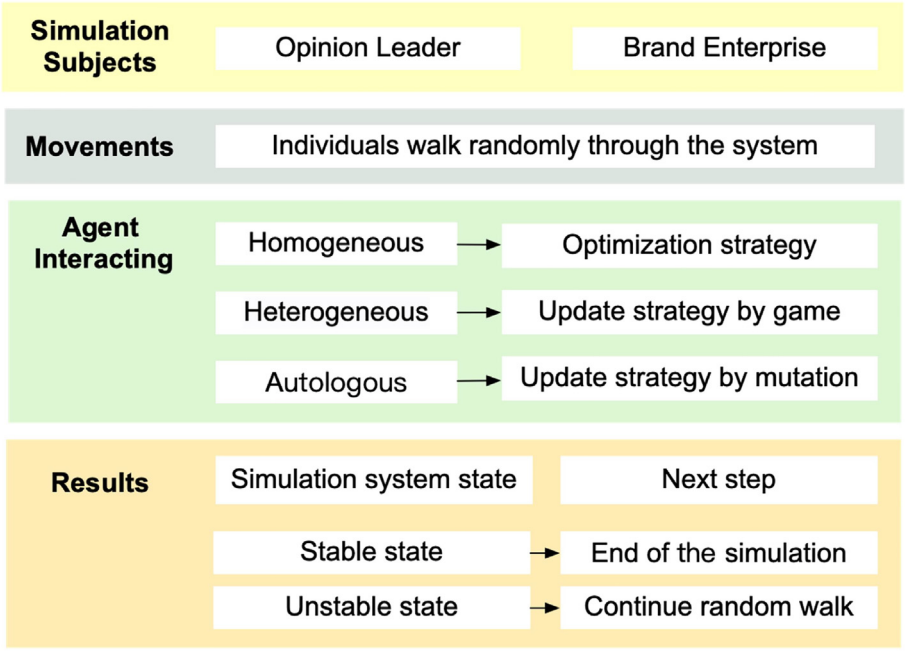

Fig. 1 – The evolutionary game process of the system.

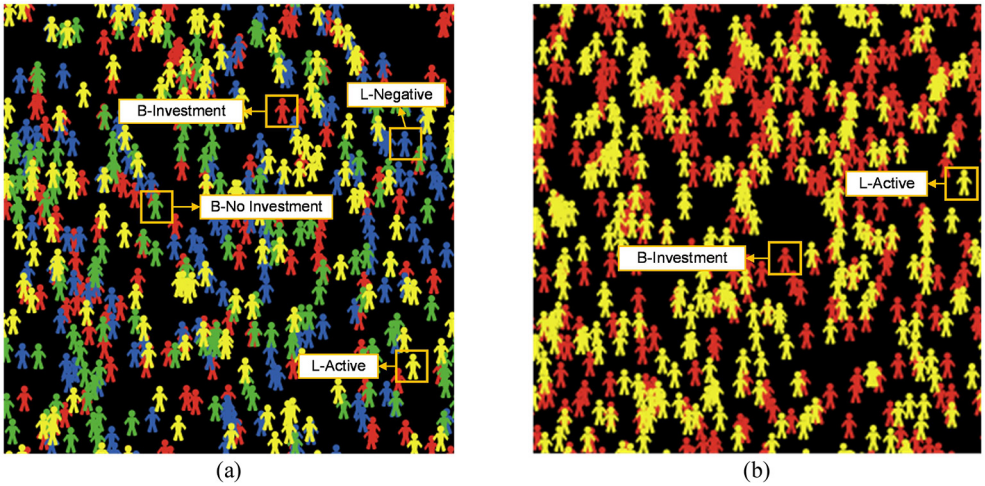

Fig. 2 – System simulation experiment space (take ESS = (1, 1) as an example); (a) the initial state of the evolutionary game; (b) the stable state of the evolutionary game.

Table 4 – The variable values in simulation.

ESS	V_1	V_2	P_1	P_2	C	F	T
(1, 0)	20	10	10	20	5	5	−5
(1, 1)	20	10	20	10	5	5	−5

leaders who have made negative promotion on opinion leaders' brand promotion strategies, the research sets up parameters as per Table 5. With other parameters remaining unchanged, the research just modifies the value of parameter F, and utilizes visualization system to simulate the variation trend of model evolution stable solution.

As shown by system simulation results in Fig. 4, when the value of F approaches the critical value $(P_2 - P_1)$ of stable strategy changes, the system has most stable training times as 680 ticks. When the value of F deviates from the critical value $(P_2 - P_1)$, the system reaches the stable state after around 300 Ticks. With the continuous rise of parameter F,

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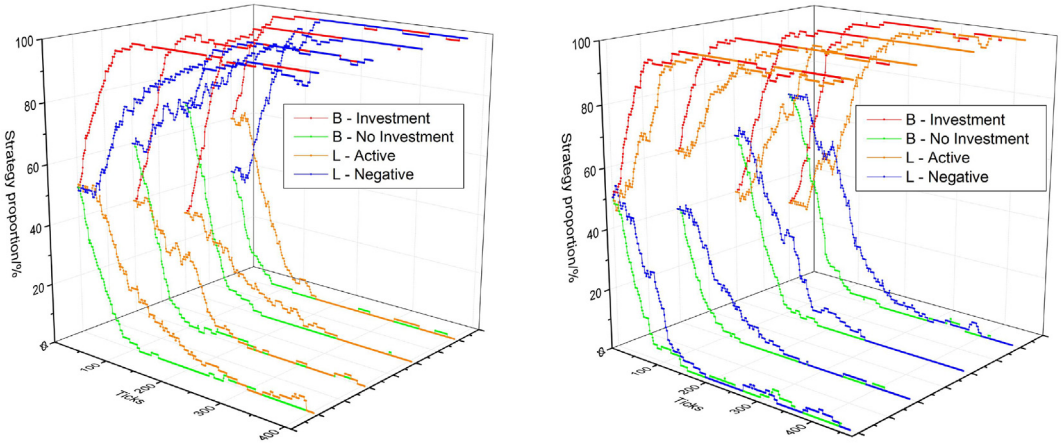

$(a)\ C - V_2 < F < P_2 - P_1$ $(b)\ F > P_2 - P_1\ \ and\ \ T < V_2 - C$

Fig. 3 – System simulation experiment results. (a) ESS $= (1, 0)$; (b) ESS $= (1, 1)$.

Table 5 – The variable values in simulation.

	α	β	V_1	V_2	P_1	P_2	C	F	T
1	50%	50%	20	10	10	20	5	0	−5
2	50%	50%	20	10	10	20	5	4	−5
3	50%	50%	20	10	10	20	5	8	−5
4	50%	50%	20	10	10	20	5	12	−5
5	50%	50%	20	10	10	20	5	16	−5

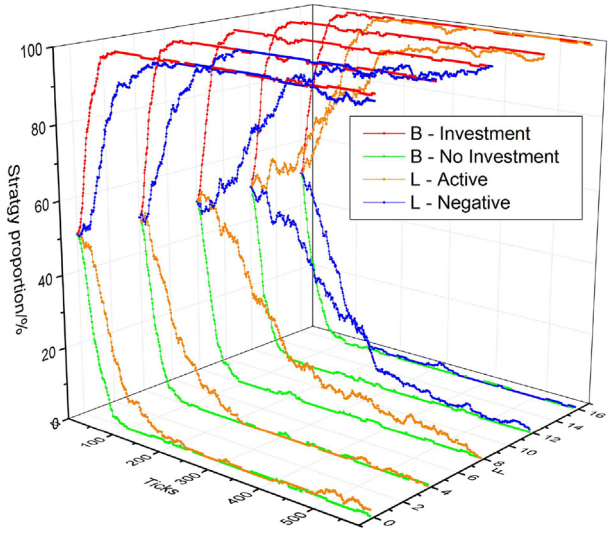

Fig. 4 – Simulation experiment results under the dynamic condition of punishment intensity.

system evolution stable strategy gradually changes from (1,0) to (1,1). Experiment demonstrates that growing intensity of punishment may change opinion leaders' promotion strategies for agricultural product brands.

4. Conclusions and implications

On the premise of preference difference between online opinion leaders, the research assumes that opinion leaders hold different motivation and attitudes in agricultural product brand promotion. Subsequently, it combines with evolutionary game theory to construct a game model for online marketing strategies of branded agricultural products, examines brand enterprises' brand promotion advantage strategies for different opinion leaders, and consults dynamic visualization simulation to verify model validity. Additionally, throughout multi-subject simulation experiment, the research further investigates the influence of varying punishment intensity on opinion leaders' negative marketing.

Analysis and dynamic simulation test for theoretical model reveal that agricultural product brand enterprises' advantage strategy always invests in brand promotion despite opinion leaders' attitudes towards brand promotion, and growing punishment intensity for opinion leaders' negative promotion may force opinion leaders to take active promotion strategies for agricultural product brands. To be specific,

(1) In condition that punishment intensity for opinion leaders' negative promotion is $F \in (C - V_2, P_2 - P_1)$, then agricultural product brand enterprises choose opinion leaders who hold negative attitudes for brand promotion. In this case, for opinion leaders, choosing a brand contradictory to their own preference will expand the fan base, and take advantage of brand promotion

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opportunity to gain more audiences. In this way, they not only gain direct earnings from brand marketing, but also indirect earnings from fans and WOM. For brand enterprises, in comparison with opinion leaders favoring the brand, though the decision of choosing opinion leaders who hold negative attitudes for brand promotion is seemingly risky, it actually widens the range of audiences, creates more topics, and even possibly reverses the stereotype of opinion leaders and their fans about the brand via brand marketing. Besides that, as agricultural product brand enterprises gain extra earnings from punishment, the comprehensive earnings gained by agricultural product brand enterprises is far out of expectation.

(2) In condition of $F > P_2 - P_1$ and $T < V_2 - C$, agricultural product brand enterprises choose opinion leaders who hold active attitudes for brand promotion. In this case, for opinion leaders, choosing a brand consistent with their own preference will provide new discount and brand dynamics information for like-minded fans, and therefore improve popularity and customer stickiness. Moreover, brand promotion brings about fewer negative effects to opinion leaders. Generally, promoting brands that cater to their own taste creates higher recessive earnings for opinion leaders. For brand enterprises, they may directly consider the fan group of active opinion leaders as the target user group. As this group of consumers have favorable impression with the brand, they more easily accept brand information, and brand promotion strategies easily lift brand values. Under such condition, agricultural product brand enterprises should prefer investment in brand promotion strategy to non-investment strategy.

The above conclusion shows that, opinion leaders' WOM marketing has certain influence [3,28], but the attitude of sharing WOM will affect the effect of WOM marketing [12,14,21,25,27], which is consistent with the previous literature conclusion. Additionally, this study shows that when agricultural product brand enterprises select opinion leaders for its brands' WOM marketing, if they can reasonably formulate the penalty rules for negative publicity, it may effectively inhibit the negative marketing behavior of opinion leaders.

Adhering to the new mode and thinking of agricultural product brand marketing presented by "internet + agricul tural product brand" in China, the research offers evidence and reference to the management decisions of agricultural product brand enterprises' online brand promotion strategies. Meanwhile, it can also enlighten opinion leaders on how to make rational decision for agricultural product brand promotion. This study theoretically enriches the research on the subject selection strategy of agricultural product brand WOM Internet marketing and provides theoretical support for the follow-up research on the optimization of agricultural product brand Internet marketing strategy.

However, the current research still has several limitations that merit discussion. The research simply takes brand enterprises and opinion leaders as the research subjects in the game model for agricultural product brand enterprises' online promotion strategies. Further research is suggested to construct multi-subject evolutionary game model covering internet platforms and government so as to more comprehensively and profoundly understand the real dynamic decision-making process of brand online promotion strategies. Besides, due to the particularity of the evolutionary game method, the strategy set held by players can only contain two extremely opposite. In addition, future research could also consider more actual attitude of opinion leader, such as generally active, neutral or generally negative.

Declaration of Competing Interest

The authors declared that there is no conflict of interest.

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