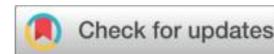# An Empirical Study on the Game and Equilibrium Relationship between Consumer Psychological Model and Enterprise Marketing Behavior Model in the New Period

Sanfeng Zhang [1,a] , Jin Shi [1,2,b*]

1.Zhejiang Polytechnic University of Mechanical and Electrical Engineering, Binjiang Campus, 528 Binwen Road, Binjiang District, Hangzhou 310053, Zhejiang, China

2.Université Grenoble Alpes, 621 Avenue Centrale, 38400 Saint-Martin-d'Hères, France

[a]yanxiexia@zime.edu.cn

[b]shijin@zime.edu.cn

Abstract: Corporate marketing activities as an important means to increase the share of products and services, and comprehensively promote the corporate service brand. Diversified marketing behavior will prompt changes in the psychology of the market consumer groups, leading to deviations in the enterprise's judgment of market development trends. According to the enterprise marketing behavior and consumer psychological changes to build the corresponding model, in-depth discussion of the interaction mechanism between the two, can accurately determine the existence of the game relationship and equilibrium relationship, accurately analyze the main reasons for the judgment of the deviation, and then to ensure that the practice of marketing strategy to obtain the maximum benefit. In this paper, after studying the consumer psychology model and enterprise marketing behavior model, according to the assumptions put forward by the research, based on the network platform using big data technology "kill acquaintance" phenomenon to carry out empirical research, and clarify the effective measures to solve the marketing problem.

Keywords: consumer; psychology; business; marketing behavior; game; equilibrium relationship

1. Consumer mental model

Combined with the existing research results, some scholars believe that cultural, social and personal factors directly affect the independent choice of consumer groups, of which cultural factors belong to the basic conditions, social factors play an important role, and personal factors are the key to determine the purchase of consumer groups. From the aspect of motivation, Freud believed that

there is no conscious motivation to drive behavior, while Maslow put forward the hierarchy of needs theory, and Herzberg's two-factor theory not only eliminates the dissatisfaction factor, but also stimulates the satisfaction factor. Combined with the structural diagram of the consumer behavior model shown in Figure 1 below, based on marketing stimuli and other stimuli to generate consumer psychology and consumer characteristics, which leads to the formation of the purchase decision and the corresponding process, which leads to the consumer group to generate consumer behavior is not determined by the price of the product, because the product is value for money.
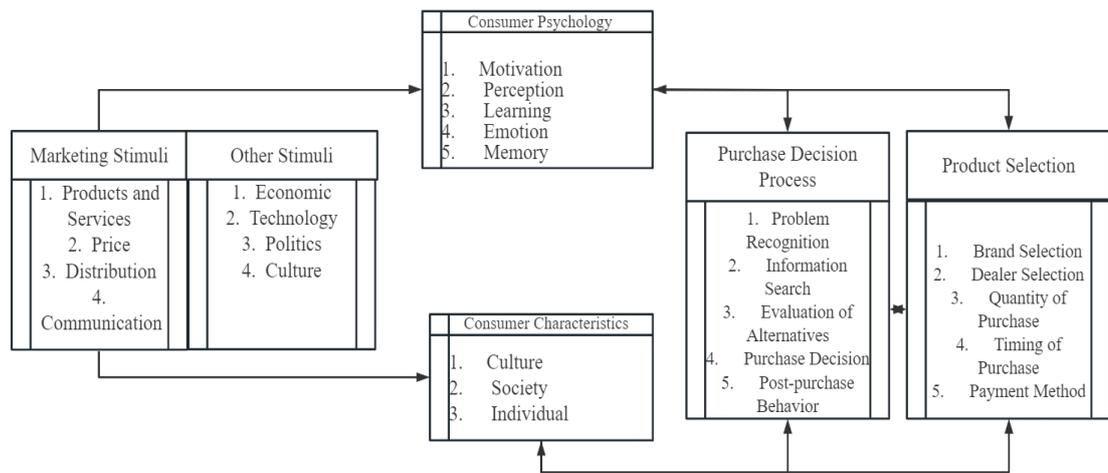

Figure 1 Structure of the consumer behavior model

Suppose the psychology of whether it is worth spending money to buy a certain product is regarded as consumer utility, which is represented as Y; the product has the value of use, which can bring real utility to the consumer group, which is called actual utility; due to the producer's marketing and promotion strategy, which leads to the consumer group's expectation of the value of the product's use, which is called expected utility. Consumer utility depends on the difference between the two, that is, consumer utility Y = actual utility - expected utility.

Actual utility and product use value into a positive proportional relationship, the use value as a measure of the main factors of product value, represented by Q; actual utility and product price into an inverse proportional relationship, that is, the actual utility $=\frac{Q}{P}$, which is also referred to as the product's cost-effective; expected utility and the consumer psychological index n into a positive proportional relationship, expected utility and the product price P into a positive proportional relationship, the expected utility and the enterprise marketing and publicity of the psychological effects f (x) into a proportional relationship, where x represents the enterprise marketing input, f (x)

represents the function of the effect of marketing on the psychological impact of consumption, from which we can get the user consumption psychological model shown below:

$$Y = \frac{Q}{P} - nPf(x)$$

Different values of consumer utility represent different meanings: firstly, Y> 0 means that the consumer group thinks that it is good value for money and the actual value of the goods is better than the publicity; secondly, Y< 0 means that the consumer group feels that it is not worthwhile and the publicity information does not match with the actual information and there is a false situation; and lastly, Y=0 means that it is good value for money. In the consumer utility in different value range, the psychological state of the consumer group also appeared to change, according to the practice of analysis can be obtained as shown in the following user consumption psychological model:

☐ $Y = \frac{Q}{P} - nPf(x)$, and Y tends to zero.

☐ $n'(Y) > 0$, and n increases for Y> 0 and decreases for Y< 0.

(iii) where. $Y \in (-\infty, \frac{Q}{P}], n = \frac{Q}{P^2 f(x)} \in (0,1]$

2. Enterprise marketing behavior model

Combined with the marketing framework shown in Figure 2 below, the essence of enterprise marketing is value creation, which includes value exploration, value creation and value delivery, and the basic line of marketing management includes demand management, resource management and network management. The STP idea is regarded as the dominant basis for accurately identifying customer groups, and the interests of customers are regarded as the basis for the development of practice, and the value creation premised on customer demand is realized through effective product analysis and service management, and then effective channels and methods are adopted for customer relationship management, which can realize effective value transfer. In resource management, based on the unique ability space of the enterprise to conduct environmental analysis, competitive analysis and vertical comparison, to clarify their own market elements, identify or cultivate their own core competencies, and select appropriate products and services and their marketing management, can effectively meet customer demand for value creation. In network management, improve the enterprise framework or build a new enterprise framework, and based on the development needs of modern enterprises, effectively integrate social resources, value creation based on a new approach,

and truly realize the value transfer. Without considering the conditions of other external influencing factors, the number of products sold is a function of marketing inputs and consumer psychology, i.e., the sales volume $F = F(x, n)$, introducing the simulation function $F(x, n) = kx^n$, where k represents the coefficients, and $k > 0$. Under the condition of $x = 0$, $F(0, n) = 0$. At this time, in the absence of any marketing inputs from the enterprise, the consumer group is unable to obtain the relevant information about the new product, and the The number of product sales is zero; under the condition of $n = 0$, $F(x, 0) = k$, when the consumer group is completely in a rational state, the enterprise's marketing activities have no effect on promoting transactions, only the natural sales amount k; under the condition of $n = 1$, $F(x, 1) = kx$, when the consumer group is completely emotional, the enterprise's marketing inputs and the amount of sales of the enterprise show a positive proportional linear relationship, from which we can get The enterprise marketing profit is as follows:

$L = (c_1 + c_2) - F(x, n) - c_1 F(x, n) - x$

In the above equation, c_1 represents the production cost per unit of product, c_2 represents the value of benefit per unit of product, and $c_1 + c_2 = P$. Simplification of the above model can be obtained:

$$L = c_2 F(x, n) - x = c_2 kx^n - x$$

Derivation of marketing profit can be obtained:

$$L'_x = nc_2 kx^{n-1} - 1 \quad {}_\omega$$

Let $L'_x = 0$, get $x^{n-1} = \frac{1}{nc_2 k}$, which is obtained by simplifying:

$x = 1 - n\sqrt{nc_2 k}$

Combining the above model can clarify the equilibrium equations of enterprise marketing behavior and user consumption psychology model as follows:

$$\begin{cases} x & = \sqrt[1-n]{nc_2 k} \\ n & = \dfrac{Q}{P^2 f(x)} \end{cases},$$

where $n = \frac{Q}{P^2 f(x)}$ represents the constraints and the solution to the system of equations is the final equilibrium state.

Assuming that x_0, n_0 is the unique solution of the above system of equations, then it can be concluded that: subject to the constraints, in the equilibrium state, the enterprise can't get more

profits by unlimitedly increasing the marketing input. If $x_0$increases, then the constraints get f (x_0)increases, then $n_0$decreases; by$x = \sqrt[1-n]{nc_2 k}$, promote $x_0$decreases, back to the equilibrium state value. And vice versa.
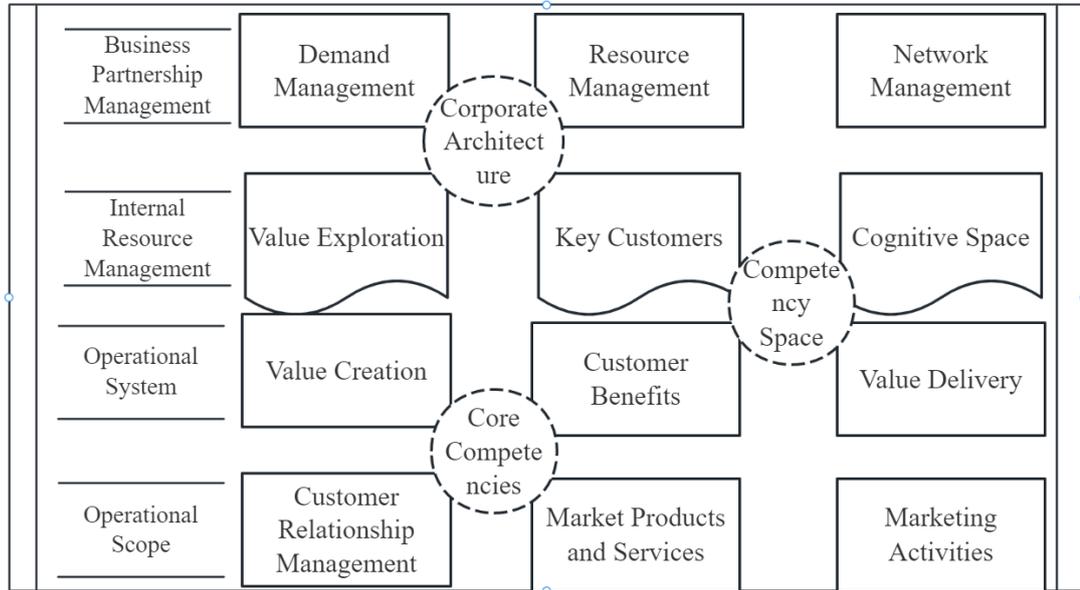

Fig. 2 Structure of the model of corporate marketing behavior

3. Analysis of the game relationship between consumer psychology model and enterprise marketing behavior model

Based on the relationship between consumer psychology and enterprise profitability, only by deeply studying the characteristics of consumer psychology can we clarify whether the consumer group is satisfied with the brand products. Brand satisfaction can generate positive consumer behavior, and positive consumer behavior is likely to bring benefits to enterprise marketing. Enterprise profitability can promote further research on consumer psychology. It can be seen from this that consumer psychology research is a basic condition for the profitability of enterprises, and consumer psychology research and the profitability of enterprises are mutually reinforcing.Before the empirical research, the corresponding hypothesis conditions are proposed: on the one hand, the consumption psychology is used to represent the consumption motivation of the consumer group, and the consumption psychology index is used to represent the relative strength degree of the emotional and rational emotions in the consumption psychology. When the emotional emotion increases, the consumption psychology index will also increase, and when the rational emotion increases, the consumption psychology index will decrease. Consumption psychology will be

affected by the consumption experience, in the case of the product physical and promotional inconsistency, rational emotions will increase, and vice versa. With the increasing consumer experience, the consumer psychology index will also change; on the other hand, the production capacity of any industry can not make the entire market demand for the industry's products to reach saturation. The production capacity of any one enterprise cannot saturate the demand of the industry in which the enterprise is located. That is, the utility generated by the marketing behavior of any enterprise exists in the law of diminishing editing, but does not have a limit value, so there is no possibility of empirical analysis of the possibility of the enterprise to stop its marketing behavior because the market or industry demand has reached saturation.

4. Empirical studies

4.1 Evolutionary game model

In the era of big data, e-commerce platforms may engage in speculative behaviors in product pricing in order to obtain more increased revenues, resulting in additional revenues known as gray excess profits. In light of the pricing practices of e-commerce platforms that "kill" regular customers, the relevant government departments need to comprehensively regulate such behaviors.

Assumption 1 game subject for the e-commerce platform and government departments of the two groups, and are limited rationality, in line with the prospect theory and the psychological account of the value function constructed, the corresponding model is as follows:

$$V(x) = \begin{cases} (x - U_0)^\theta, & x \geq U_0 \\ -\lambda(U_0 - x)^\beta, & x < U_0 \\ Z(x) = \begin{cases} \delta(x - U_1)^\varphi, & x \geq U_1 \\ -(U_1 - x)^\sigma, & x < U_1 \end{cases} \end{cases}$$

In the above model, V(x) represents the potency account i.e., the judgmental value function of obtaining returns, Z(x) represents the cost account and the judgmental value function of paying costs, U_0 represents the potency reference, U_1 represents the cost reference point, λ represents the sensitivity to aversion to the potency function, x represents the value variable, β represents the coefficient of risk appetite of the potency relative to the gain-loss, and $(x - U_1)$ represents the risk preference coefficient of cost relative to loss-gain, and σ represents the sensitivity to cost-loss aversion. The corresponding decision function is as follows:

$$\pi(\varepsilon) = \frac{\varepsilon^{\,\prime}}{\left[\varepsilon^{\,\prime} + (1 - \varepsilon)^{\,\prime}\right]^{\frac{1}{r}}}$$

In the above formula, $\pi(\varepsilon)$ represents the decision weight function, which refers to the subjective judgment of the decision-making group on the probability of the occurrence of the event or the degree of tendency to the choice of strategy, and r represents the influence decision coefficient, and the larger the value, the more curved the decision weight function proves to be, and the lower the rate of the individual's judgment on the objective probability.

Assumption 2 The game behavior of the e-commerce platform and the government department contains only a finite set of two decisions, in which the e-commerce platform will choose whether to adopt the strategy of killing the mature according to its own business strategy, the government department, as the regulator of the platform's behavior, the actual choice can be either to regulate or not to regulate, and the consumer group, as a third-party reporting group, will report the government department only in case of its failure to perform its duties.

Assumption 3 As the e-commerce platform kill pricing will bring losses, both sides of the game have to bear a certain security risk, and only when the simultaneous fulfillment of the non-killing and fulfillment of the regulatory duties can ensure that the whole reaches a safe state. During the game, the risk coefficient borne by both sides will change, and the risk will be transferred, and the risk transfer coefficient is not zero.

Hypothesis 4 When the government department chooses to regulate the behavior and the e-commerce platform chooses not to kill people, the risk is lowest at this time. For the convenience of empirical research, it is assumed that at this time both parties bear the cost of accident risk is zero.

The behavioral costs of the two sides of the game is refined into the e-commerce platform does not "kill maturity" and the government departments to perform the regulatory responsibilities of the fruits of labor and efforts to construct the e-commerce platform and the government departments of the traditional game matrix as shown in Table 1:

Table 1 Traditional matrix of the two sides of the game

E-commerce platform	supervise （y）	No supervision (1-y)
Non-exploitative pricing	$S_{P1} - C_{P1} - C_{P2}$	$S_{P1} - C_{P1} - C_{P2} - q_1 L h P_0$
Price gouging loyal users	$S_{G1} - C_{G1} - C_{G2}$	$S_{G1} - q_1 L P_0 - C_{G3} - \alpha L_{G1}$
(1-x)	$S_{P2} - W_0 - q_2 L P_0 - C_{P3}$	$S_{P2} - L P_0 - C_{P3} - \alpha L_{P1}$

E-commerce platform	supervise （y）	No supervision (1-y)
	$S_{G1} + q_3W_0 -$	$S_{G1} + P_CS_{G2} - LP_0 -$
	$C_{G1} - C_{G2} - q_2LhP_0$	$C_{G3} - \alpha(L_{G1} + L_{G2})$

Based on the above matrices, the utility account function V (x) and the cost account function Z (x) are brought in, and the evolutionary game matrices of prospect theory and mental accounts are utilized to obtain what is shown in Table 2 below:

Table 2 Improved game matrix

E-commerce platform	supervise （y）	No supervision (1-y)
Non-exploitative pricing	$V(S_n) - Z(C_n + C_n)$	$V(S_n) - Z(C_n + C_n + C_n)$
Price gouging loyal users	$V(S_n) - Z(L\pi(P_0) + C_nl\pi(P_0))$	$V(S_n + q_1)\Psi_0) - Z(C_n + C_n + q_2lh\pi(P_0))$
(1-x)	$S_{P2} - W_0 - q_2LP_0 - C_{P3}$	$S_{P2} - LP_0 - C_{P3} - \alpha L_{P1}$
	$S_{G1} + q_3W_0 -$	$V(S_n) - Z(q_1l\pi(P_0) + C_nl\pi(P_0))$
	$V(S_n + S_n\pi(P_0)) - Z(L\pi(P_0) + C_n + L_nl\pi(P_0))$	$V(S_n) - Z(L\pi(P_0) + C_nl\pi(P_0))$

The replicated dynamic equations of the government sector and the e-commerce platform are established, from which the two-dimensional dynamical system formed by the two is obtained as follows:

$$G = \begin{cases} \dfrac{dx}{dt} = x(U_{PY} - U_P) = x(1 - x)[\pi(y)A + \pi(1 - y)B] \\ \dfrac{dy}{dt} = y(U_{GY} - U_G) = y(1 - y)[\pi(x)C + \pi(1 - x)D] \end{cases}$$

In the system of equations G, assuming $\dfrac{dx}{dt} = 0, \dfrac{dy}{dt} = 0$, it is possible to obtain five local equilibria of the system evolution, which fulfill the following conditions:

$$J = \begin{bmatrix} \dfrac{\partial F(x)}{\partial x} & \dfrac{\partial F(x)}{\partial y} \\ \dfrac{\partial F(y)}{\partial x} & \dfrac{\partial F(y)}{\partial y} \end{bmatrix} = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}$$

Because of the unpredictability and secrecy of consumption, if e-commerce platforms choose to "kill familiar" pricing in order to obtain greater profits, the consumer group is often more

psychologically than economically vulnerable when they realize that they have been "killed familiar". In order to improve the loyalty of consumer groups to online consumption and promote the stable development of the platform, both e-commerce platforms and government departments need to fulfill their responsibilities and try to control the occurrence of "kill familiar" pricing behavior. Because the equilibrium point obtained by the dynamic equation system is not necessarily the evolutionary equilibrium strategy of the system, according to the local stability of the following matrix, we can obtain the analysis results shown in Table 3:

Table 3 Equilibrium stability analysis results

Inflection Point	dσ/dx	Sign	σ/J	Sign	Stability
(0,0)	BD	+	B+D	+	Unstable
(0,1)	−AD	-	A−D	Indeterminate	Saddle Point
(1,0)	−CB	-	C−B	Indeterminate	Saddle Point
(1,1)	AC	+	−(A+C)	-	ESs
(2n,2n)	2D(1,1)	+	2n2D(1,1)	+	Unstable

This paper studies the use of software to simulate the evolutionary state between e-commerce platforms and government departments, which can more intuitively analyze the impact of different reference factors, on the behavioral choices of e-commerce platforms and government departments. By changing different reporting values of consumer groups, we observe the changes in their group behavioral choices towards e-commerce platforms and government departments. The actual results show that increasing the reporting probability of consumer groups can influence the behavior of e-commerce platforms and government departments, prompting them to actively perform their own regulatory responsibilities; after the discovery of e-commerce platforms' "kill familiar" pricing behaviors, changing the degree of punishment and increasing the regulatory efforts of the government departments, and the corresponding fines can promote their behavioral choices towards the "no kill familiar" pricing behavior. The corresponding fines can promote the evolution of the strategy of "not killing familiar", and increasing the commission coefficient of the government department can effectively motivate the government department to fulfill its supervisory duties. It can be seen that, according to the status quo of the e-commerce platform's kill familiarization, combined with the prospect theory and psychological construction of the game model to clarify the game between the e-commerce platform and the government departments in the kill familiarization

regulatory behavior, the use of the consumer group's reporting behavior, prompting the e-commerce platform and the government departments to choose an effective regulatory strategy, which can show the fairness and effectiveness of the online consumption and marketing activities.

Conclusion

To sum up, because of the lag in market development and information asymmetry , so the enterprise's judgment of the market development trend has certain bias, combined with the consumer psychology comprehensive analysis of the enterprise marketing behavior and activities of innovation, can make clear the interaction between each other, to improve the quality of the enterprise's products and services to provide an effective basis for the realization of the development of social and economic virtuous circle.

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