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Research Article

Simulation Study on Opinion Evolution of Collaborative Shopping

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DW model is improved based on the unique characters of group consumption. At first, using social experiment, we determine the categories and attributes of agents, and then based on the DW model, participants' interaction rules are established. Finally, a mass of numerical simulation experiments show that in the form of collaborative online shopping, merchants can reverse opinions, who could persuade consumers with negative attitudes, changing opinions, and supporting collaborative online shopping, and the level of characteristics is closely related to the number of consumers changing opinions; opinion leaders can differentiate group opinions, neither accelerating effect nor destructive effect; the characteristics level of individual consumers has close relation with positive group polarization effect; when an individual consumer has high conformity or trust propensity, the opinions of some customers with supporting collaborative online shopping will be strengthened, they accept collaborative online shopping more. In addition, for group interaction of collaborative online shopping context, there is no negative group polarization effect.

1. Introduction

Online social groups can build a platform for instant communication, gather more users, improve users' good experience, and realize collaborative shopping [1]. Different from the traditional individual purchase decision, collaborative shopping is a group consumption behavior. Therefore, exploring the opinion evolution law of group collaborative shopping can provide a reference for merchants grasping group consumption behavior.

The literature about group opinion evolution of the public opinions mainly focuses on the developing tendency, government effect, the influence of communications media, and so on [2, 3]. In a collaborative shopping environment, participating agents, such as merchant, opinion leaders, and consumers, and their attributive characters are changing [4, 5], so in the process of collaborative consumption, the uniqueness of consumers' group opinion evolution, the role of each participant, and the effect of agent characteristics on the group opinion evolution of collaborative shopping are worth studying intensively. However, traditional statistical methods are difficult to reflect the evolution law of consumer group opinions from a macro level; therefore, along with the unceasing expansion of research content, especially group factors of collaborative shopping, other methods are needed to analyze the problems.

In the process of collaborative shopping, group members interact with each other, whose initial disordered opinions form obvious opinion tendency after the interaction, and the opinion dynamics model can explain how the disordered individual opinions in the system evolve into the group opinions with obvious tendencies through interaction rules, so opinion dynamics model is introduced to study the opinion evolution law of collaborative shopping [6–8]. With the development of computer simulation technology, the idea of multiagent simulation has also been gradually applied to the study of the group opinion evolution. The multiagent modeling and simulation method is particularly suitable for the uncertain occasion in which the behavior of each agent is relatively simple, follows certain interaction rules, has better suitability, and can learn and accumulate experience [9, 10]. While social groups are a decentralized platform where users can communicate freely, individual consumers choose whether to participate in the joint

purchase through interaction; moreover, the psychology and behavior of group members follow some regularity; therefore, multi-agent modeling and simulation method is used to simulate the group opinion evolution process of collaborative shopping.

The paper can be divided into three parts: the first step is to determine the categories and attributes of agent. Here, we adopt social experiment to confirm influences factors about individual member changing opinion; the second is to establish interaction rules on the base of the DW model, which includes rules of merchant-members, opinion leader-member, and member-member; and the last is to conduct numerical simulation experiments.

2. Confirmation of Categories and Attributes of Agent

According to the influence of participants on collaborative shopping, participants are divided into three categories: merchant, opinion leaders, and ordinary consumers. Merchant introduces the information of collaborative shopping to consumers, including detailed information of products, use, price, and time limit, answers consumers' questions, promotes the smooth development of collaborative shopping, and deals with after-sale matters; opinion leaders are special consumers who are highly active and have a lot of fans; the information released by them has high credibility; thus, opinion leaders have a certain influence on ordinary consumers; ordinary consumers usually passively accept the published information and are influenced by merchant and opinion leaders.

In the aspect of participants' characteristics, based on the classical documents and the interaction mechanism of group members, set the merchant characteristics to professionalism and execution, set the opinion leaders' characteristics to activity and attraction, set the consumers' characteristics to conformity, and trust tendency. This article takes the social group as a platform, three categories of participants as agents and participant characteristics as attributes of each agent. In addition, the participants interact through instant messenger; therefore, the information quality is also as the attributes of each agent. According to the above analysis, the settings of the agents and their attributes are as follows:

2.1. Merchant Agent. According to the above analysis, merchant professionalism, execution, and information quality released by them in collaborative shopping can all affect the individual consumers' opinions about participating in collaborative shopping. Therefore, the attributes of merchant are set to opinion, information quality, professionalism, and execution.

Merchant opinion A_k. As the organizer of collaborative shopping, merchant has a distinct standpoint and strongly supports collaborative shopping. Therefore, the opinion takes values in the continuous interval between 0.8 and 1.

Merchant information quality B_K. In order to promote the successful development of collaborative shopping, merchant vividly presents the products or services of collaborative shopping to consumers in various ways, such as text description, pictures, and videos, so as to attract consumers' attention and consultation. Therefore, information quality takes values in the continuous interval between 0.8 and 1.

Merchant professionalism C_K. Professionalism take values in the continuous interval between 0 and 1; 0 means that merchant doesn't organize collaborative shopping, lacking of relevant knowledge, and experience; 1 means that merchant carries out collaborative shopping many times, who is good at choosing better product for less money, is familiar with the process of collaborative shopping, and has rich experience in dealing with after-sales problems.

Merchant execution D_k. Execution take values in the continuous interval between 0 and 1; 0 means that merchant attempts and accomplishes nothing after releasing information, who does not communicate closely with consumers; 1 means that merchant interacts with consumers closely, answers consumers' questions promptly, tries his best to dispel consumers' doubts, and increases consumers' expectations for collaborative shopping.

2.2. Ordinary Consumer Agent. Ordinary consumers are the largest group of participants in collaborative shopping. This kind of groups often decides whether to participate in collaborative shopping by communicating and interacting with other consumers to obtain more information. In addition to the information received, according to the above analysis, the characteristics of consumers themselves, such as conformity, trust tendency, and so on, also play an important role in influencing consumers' participation in collaborative shopping. Therefore, the attributes of consumers are set to opinion, information quality, conformity, and trust tendency.

Consumer opinion $E_j(t)$: $E_j(t)$ represents the opinion of consumer j at time t, and takes values in the continuous interval between 0 and 1; 0 means that consumers don't accept collaborative shopping at all, and 1 means that consumers fully support and participate in collaborative shopping.

Consumer information quality F_j: F_j represents the information quality of consumer j and takes values in the continuous interval between 0 and 1; 0 indicates that consumers completely lack of information to support their opinions, and 1 indicates that consumers have enough convincing information to support their opinions.

Consumer conformity G_j: G_j represents the conformity of consumer j, which belongs to their own personality characteristics; therefore, it takes values in the continuous interval between 0 and 1, and does not change with time. 0 represents very stubborn consumer, and 1 represents totally undetermined consumer.

Consumer trust tendency H_j: H_j represents trust of individual in others and in common with conformity, belongs to their own personality characteristics; therefore, it takes values in the continuous interval between 0 and 1, and does not change with time. 0 represents consumers who never trust others, and 1 represents consumers who completely trust others.

2.3. Opinion Leader Agent. Opinion leaders are a distinct type of the few participants who are very active, have the power to attract fans, and influence consumers' psychology and behavior with high-quality opinions, so consumers are often influenced by opinion leaders to decide whether to participate in collaborative shopping. Based on the above analysis, opinion leaders' activeness, attraction, and information quality all affect consumers' opinions about participation in collaborative shopping. Therefore, the attributes of opinion leaders are set to opinion, information quality, activeness, and attraction.

Opinion leader opinion I_h. I_h represents the opinion of opinion leader h. As leading person of Hot Topic, opinion leaders usually have a distinct standpoint who make clear that they confirm or disprove collaborative shopping, therefore, the opinion take values in the continuous interval [0, 0.2] or [0.8, 1].

Opinion leader information quality $J_{h.}$ Opinion leaders play a special role in groups, who tend to be cautious, have a distinct standpoint, and possess enough argumentation when posting a comment, so opinion leaders' information quality take values in the continuous interval [0.8, 1].

Opinion leader activity K_h. K_h indicates the active degree of opinion leaders in the forum, which is a sufficient condition to become opinion leaders. They have been active in social groups for a long time, reach a suitably high level, often communicate zealously, and respond to others' comments timely. Therefore, it takes values in the continuous interval between [0.8, 1].

Opinion leader attraction L_h. L_h means that in social groups, opinion leaders can attract a lot of fans and influence other users within a certain range, mainly through replies, attitude, recommendations, the top content, and so on, that is also a sufficient condition to become opinion leaders, it takes values in the continuous interval [0.8, 1].

3. Construction of Influence Function

In the model, the convergence coefficient μ represents the acceptance degree of an individual to the others' opinions in their communication, which depends on the amount of information possessed by an individual, personality, information source, characteristics, and so on. In addition, the acceptance degree of an individual to the others' opinions is different; therefore, the convergence coefficient μ is improved to establish the influence function.

3.1. Influence Function of Merchant Impacting on Individual Consumer. In the process of collaborative shopping, the merchant can affect the individual consumers' opinions: the more professional the merchant is, the more positively individual consumers interact, the stronger information persuasion is. In addition, the change of individual consumers' opinions is also affected by their own characteristics: the stronger individual consumers conformity is, the more easily individual consumers trust others; the weaker the information quality individual consumers mastering is, the more easily individual consumers are influenced. Based on this, the influence function of merchant k on individual consumer j is defined as

$$r(k, j) = a_1 C_k + a_2 D_k + a_3 G_j + a_4 H_j + a_5\left(1 - F_j\right), \quad a_1 + a_2 + a_3 + a_4 + a_5 = 1. \tag{1}$$

3.2. Influence Function of Opinion Leaders Impacting on Individual Consumer. In the process of collaborative shopping, the more active opinion leaders are, the more positively they participate in group activities, the more fans they have, the wider the scope of influence is, the more convincing their opinions are, the greater the impact on individual consumers is. Similarly, the change of individual consumers' opinions is influenced by their own personality characteristics and the quality of information. Based on this, the influence function of opinion leader h on individual consumer j is defined as

$$s(h, j) = b_1 K_h + b_2 L_h + b_3 G_j + b_4 H_j + a_5\left(1 - F_j\right), \quad b_1 + b_2 + b_3 + b_4 + b_5 = 1. \tag{2}$$

3.3. Influence Function between Individual Consumers. In the process of collaborative shopping, when individual consumers interact with each other, they are affected by not only information quality but also individual personality tendency. The change of individual consumers' opinions is proportional to their own conformity, trust tendency, and the unreliability of the information quality. Based on this, the influence function of individual consumer i on individual consumer j is defined as

$$w(i, j) = c_1 G_j + c_2 H_j + c_3\left(1 - F_j\right), \quad c_1 + c_2 + c_3 = 1. \tag{3}$$

3.4. The Determination of Weight Coefficient. There are many methods to determine the indexes weight, but the AHP not only has the advantage of Delphi method, but also combines the scientific mathematical method. Because the method combines qualitative research and quantitative analysis, and has strong operability, so it is widely used. The steps of AHP determining the weight are as follows: firstly, the research problem is stratified; secondly, hierarchical optimization is carried out according to correspondence in pairs, and the judgment matrix is constructed; finally, the largest eigenvalue of each judgment matrix is calculated and the consistency check is carried out. In this paper, the weight coefficient computing the influence factors of opinion leaders to individual consumers are taken as an example to determine the weight coefficients of each influence function, the judgment matrix are show in Table 1. The specific results are as follows:

$$
\begin{aligned}
r(k,j) &= 0.187C_k + 0.326D_k + 0.215G_j + 0.163H_j \\
&\quad + 0.109\left(1 - F_j\right), \\
s(h,j) &= 0.256K_h + 0.350L_h + 0.166G_j + 0.110H_j \\
&\quad + 0.118\left(1 - F_j\right), \\
w(i,j) &= 0.349G_j + 0.484H_j + 0.167\left(1 - F_j\right).
\end{aligned} \tag{4}
$$

4. Interaction Rules

Based on the operation mechanism of collaborative shopping, the paper improves the original DW model and establishes individual interaction rules, mainly including merchant and individual consumers, opinion leaders, and individual consumers.

DW model, proposed by Deffaunt et al., defines individual opinion as a random number within a continuous interval, in which if the opinion difference between two individuals i and j selected randomly is less than a threshold that $|x_i - x_j| < \varepsilon$, they interact, otherwise they don't interact [11]. Opinion interaction rules are as follows:

$$
\begin{aligned}
X &= X + u\left(X' - X\right), \\
X &= X + u\left(X - X'\right).
\end{aligned} \tag{5}
$$

4.1. Interaction Rule between Merchant and Individual Consumers. As the organizers of collaborative shopping, merchant strongly supports collaborative shopping and releases information to influence individual users, then individual consumers compare mutual information of information quality, if the individual consumer information quality is higher than the merchant's, then he is not affected by merchant and his opinion remains constant, if the individual consumer information quality is below merchant's, namely, the information individual consumer grasping is less detailed than merchant, and then the individual consumer will refer to it and interact with merchant and, consequently, change his opinion. According to the improved DW model, the interaction rule between merchant and individual consumer is as follows:

$$
\begin{aligned}
&\text{If } B_k > F_j, \\
&r(k,j) = 0.187C_k + 0.326D_k + 0.215G_j + 0.163H_j \\
&\qquad + 0.109\left(1 - F_j\right), \\
&E_j(t+1) = E_J(t) + \left(A_k - E_j(t)\right) r(k,j), \\
&\text{If } B_k \le F_j, \\
&E_j(t+1) = E_j(t).
\end{aligned} \tag{6}
$$

4.2. Interaction Rule between Opinion Leader and Individual Consumer. Opinion leaders have a clear mind and attract some fans, so their opinions are thoughtful and play a key role in guiding individual consumers' comments. Opinion leader can make suggestion about collaborative shopping and individual consumer compare the opinions from both sides: if the opinion difference is too large, both sides do not communicate; if opinions are similar, individual consumer can compare the information quality, when his information quality is higher than opinion leader's, he is not affected by merchant and his opinion remains unchanged; when his information quality is lower, he can take into account the proposals of opinion leader and correct his own opinion. According to the improved DW model and the above analysis, the interaction rule between opinion leader and individual consumer is as follows:

$$
\begin{aligned}
&IF\left|I_h - E_j(T)\right| > \varepsilon, \\
&E_j(t+1) = E_J(t), \\
&IF\left|I_h - E_j(T)\right| < \varepsilon \cdot \text{and} \cdot J_h(t) < F_j, \\
&E_j(t+1) = E_j(t), \\
&IF\left|I_h - E_j(T)\right| < \varepsilon \cdot \text{and} \cdot J_h(t) > F_j, \\
&s(h,j) = 0.256K_h + 0.350L_h + 0,166G_j + 0.110H_j \\
&\quad + 0.118\left(1 - F_j\right), \\
&E_j(t+1) = E_j(t) + \left(I_h - E_j(t)\right) s(h,j).
\end{aligned} \tag{7}
$$

4.3. Interaction Rule between Individual Consumers. In collaborative shopping activities, individual consumer randomly selects other users to interact, according to the improved DW model, when opinion difference value is greater than ε, both do not interact; accordingly, their opinions remain unchanged. When opinion difference value is less than ε, both interact and compare information quality, individual consumer with high information quality is more convincing, accordingly, individual consumer with low information quality modifies his opinion. According to the improved DW model and the above analysis, the interaction rule among individual consumers is as follows:

$$
\begin{aligned}
&\text{If}\left|E_j(t) - E_j(t)\right| < \varepsilon, \text{ and } F_i > F_j, \\
&w(i,j) = 0.349G_j + 0.484H_j + 0.167\left(1 - F_j\right), \\
&E_j(t+1) = E_J(t) + \left(E_J(t) - E_J(t)\right) w(i,j), \\
&E_j(t+1) = E_j(t), \\
&\text{If}\left|E_j(t) - E_j(t)\right| < \varepsilon, \text{ and } F_j > F_i, \\
&w(i,j) = 0.349G_i + 0.484H_i + 0,167 + \left(1 - F_j\right), \\
&E_i(t+1) = E_i(t) + \left(E_j(t) - E_i(t)\right) w(j,i), \\
&E_j(t+1) = E_j(t).
\end{aligned} \tag{8}
$$

Table 1: Evaluation the relative importance of evaluative index.

	Attraction	Conformity	Trust tendency	Poor information quality
Activity				
Attraction				
Conformity				
Trust tendency				
Poor information quality				

5. Simulation Experiment and Analysis

5.1. Experimental Design

5.1.1. Group Size. According to the research of Dunbar [12], both human groups and individuals in the ape society have certain social relationship pattern. When the social relationship pattern remains unchanged, the group size (the quantity of individuals) can affect the harmonious coexistence or disintegration of the group. Based on a mass of observations and experiments, Dunbar points out that in human society, when the group size is between 100 and 150, the group can guarantee harmony.

Segmented mechanism of social groups can quickly gather together and form consumer groups of certain scale. In addition, based on the observation and the interview, merchant carries out collaborative shopping by WeChat groups, QQ groups, and so on, which often requires more than 100 consumers to open. In conclusion, the number of consumers involving in collaborating shopping is set to 150.

5.1.2. The Threshold. The threshold is set to a fixed value means the aggregation of similar users, and the threshold obeys certain distribution means that the difference of group members. Because segmented mechanism of social groups can gather a large number of homogeneous consumers, the paper sets the threshold to a fixed value and the determination of threshold is realized by simulation experiment as follows:

According to the simulation experiment analysis of DW model, when the threshold ε is greater than 0.5, the group opinions quickly build consensus; with the decrease of the threshold ε, the group opinions begin to differentiate and even two more opinion groups appear. In collaborative shopping environment, individuals possess unique attributes and interaction style, based on this, the following content through the simulation experiment of interaction between individual consumers explores the link between the threshold and group opinions. It is assumed that there are 150 consumers, the initial opinions obey the stochastic uniform among [0, 1], and the convergence coefficient $\mu = 0.25$. Simulation experiments are carried out according to the interaction rule between individual consumers, and the updating time of opinions is set as $T = 4000$. The simulation results are shown in Figure 1:

By the Figure 1 above, we can see that with the decrease of the threshold ε, group opinions of collaborative shopping reveal a trend of polarization even many opinion groups; however, compared with the DW original model simulations, consumer opinion evolution of collaborative shopping is unique: when the threshold inion evolution of collaborative emulations, consumer opinion evolution of collaborative among [0, 1], and the convergence coefficient $\mu = 0.25$. Simulation experiments are carried out according to the interaction rule BRGE on 0.2, and the system takes longer time to reach a stable status. When the threshold ε is smaller than 0.1, the differentiation rate of group opinions begins to accelerate. But in real life, there are similarities and differences in consumer feature, and extreme cases are rare, therefore, the individual differences are neither too big nor too small. According to the above simulation results, ruling out the extremes of $\varepsilon \geq 0.5$ and $\varepsilon \leq 0.1$, this article selects 0.25 as interact threshold of homogeneous consumers for simulation.

5.2. Comparative Study of Merchant and Opinion Leaders' Role. It is assumed that there are 150 consumers, of which 12 consumers are opinion leaders, and the initial opinions of 138 consumers obey stochastic uniform. The homogeneity threshold $\varepsilon = 0.25$, the ordinate represents the group opinions of the collaborative shopping, and the abscissa represents simulation steps. Firstly, the evolution trend of the group opinions after the generation of opinion leaders by consumer groups is simulated, and then the evolution trend of the group opinions after the integration of merchant is simulated. The simulation results are shown in Figures 2 and 3.

Contrast experiment shows that after opinion leaders are generated in the group, original opposite opinions change, the group opinions differentiate, and forming more opinion clusters; therefore, opinion leaders have a differentiation effect on the evolution of consumer group opinions. After merchant integrates into the consumer group, some consumers' opposing opinions are reversed to support the development of collaborative shopping activities. However, the differentiation is particularly more, and even in some interval opinion breakdown appears. In order to more intuitively determine the different roles of merchant and opinion leaders in collaborative shopping activities, the paper simulates the proportion of supporters before and after merchant's integration into the group, the simulation results are shown in Figures 4 and 5.

As seen in the figures above, in the evolution of group opinions which merchant does not participate in, the proportion of supporters is about 1/3, which always remains at this level, that further explains differentiation effect of opinion leaders who don't reverse consumers' opinions. However, after merchant joins the group, the proportion of supporters increase rapidly at the beginning and then fluctuates steadily

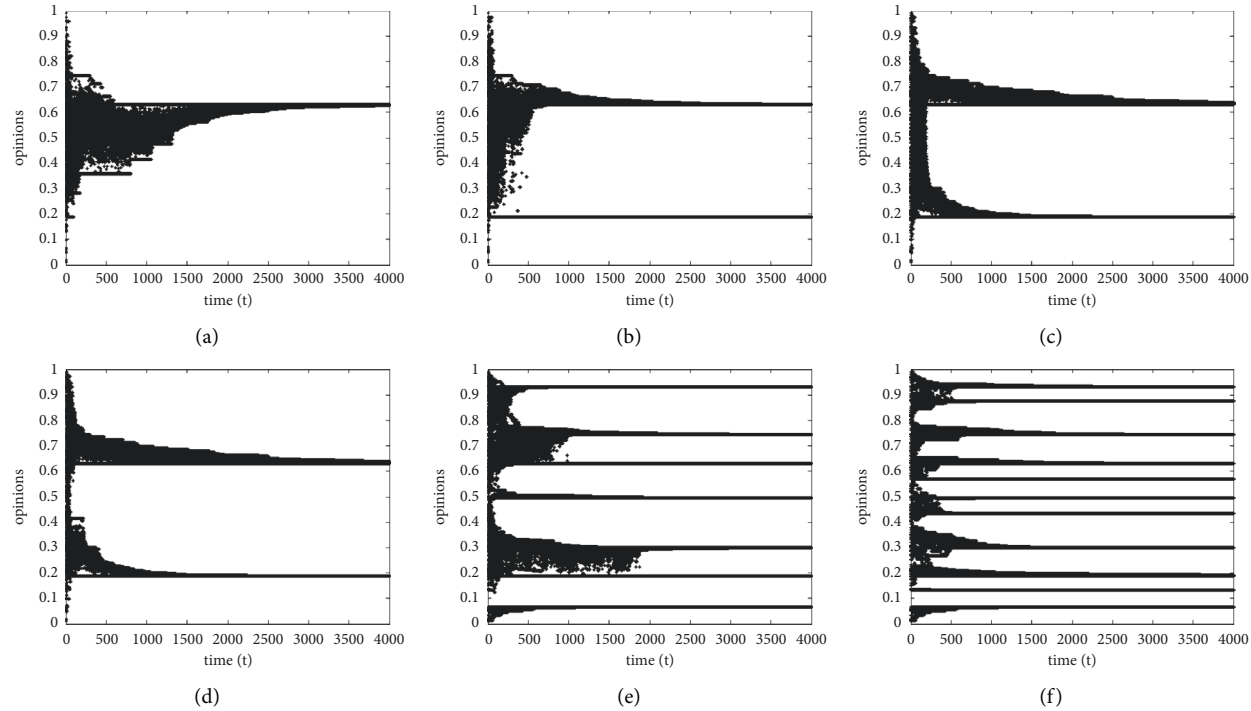

Figure 1: Plot of opinion evolution in the condition of $\varepsilon = 0.5$; $\varepsilon = 0.4$; $\varepsilon = 0.25$; $\varepsilon = 0.2$; $\varepsilon = 0.1$; $\varepsilon = 0.05$.

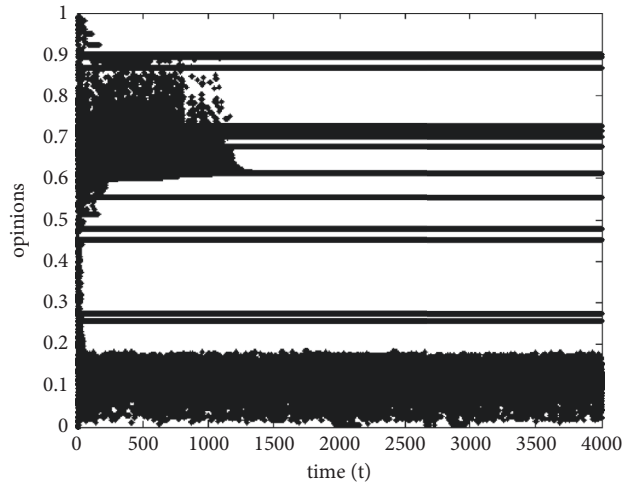

Figure 2: Plot of opinion evolution in the condition of no merchant.

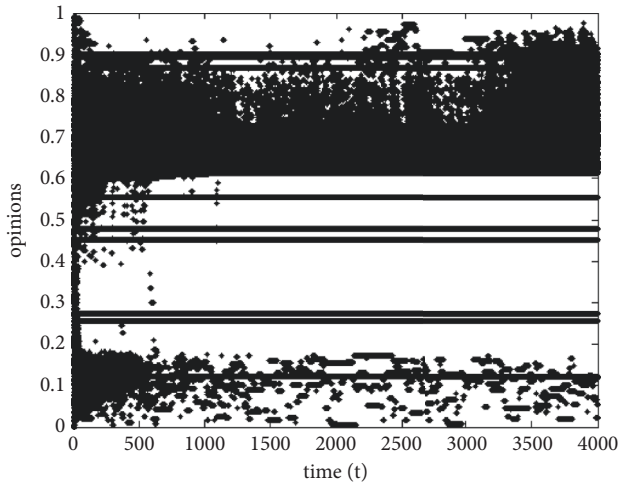

Figure 3: Plot of opinion evolution in the condition of join merchant's information.

and slightly. On the whole, the proportion gradually increases from about 1/3 to 2/3, the number of supporters has doubled, and that further explains that the merchant can reverse opinions of consumers who hold opposing attitudes.

5.3. The Influence of Merchant Characteristic on Opinion Evolution. In abovementioned experiments, promoting effect of the merchant is confirmed, in order to explore merchant's influence in-depth, the paper adjusts merchant's attribute value, firstly professionalism take values in the continuous interval [0, 0.2] and [0.8, 1], then execution take value in the continuous interval [0, 0.2] and [0.8, 1], in the end, both take values in the continuous interval [0, 0.2] and [0.8, 1], respectively. The numerical simulation experiments are carried out to compare the change of supporters' proportion, and the experimental results are shown in the Figure 6:

It can be found that when professionalism or execution is in low level, the merchant can also impact consumers to reverse opinions, but the range of impacts is limited, ultimately the proportion of supporters is roughly 60%. Even when professionalism and execution are in low level at the same time, the proportion of supporters and opponents is

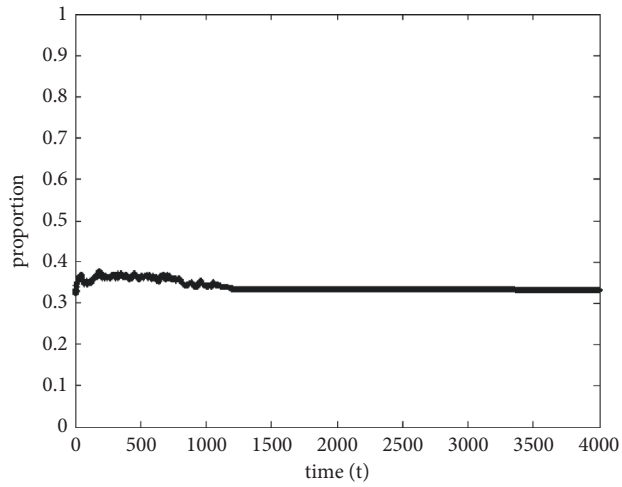

Figure 4: Plot of the proportion of supporters in the condition of no merchant.

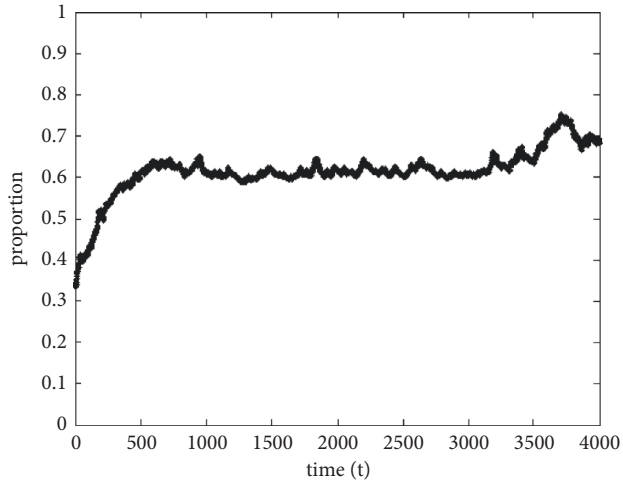

Figure 5: Plot of the proportion of supporters in the condition of join merchant's information.

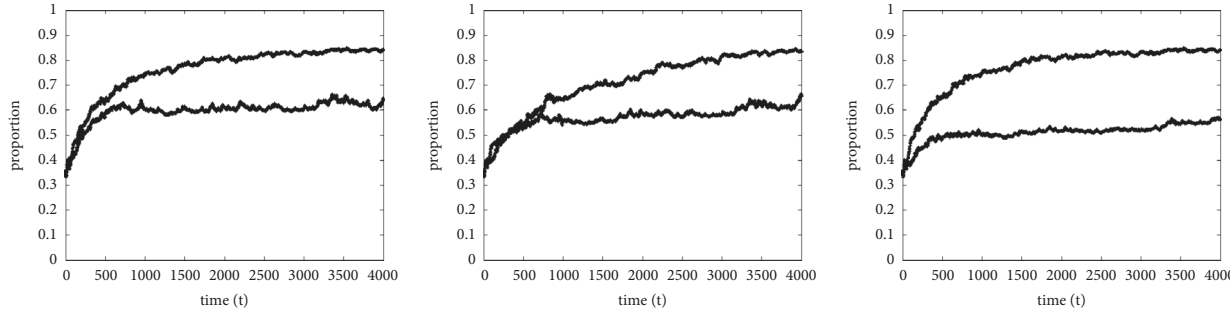

Figure 6: Plot of the proportion of supporters in different merchant characteristics: (a) professionalism; (b) execution; (c) professionalism; and execution.

almost equal. However, when professionalism or execution is in high level, or when both are in high level, the proportion of the supporters can exceed 80%. In addition, the influence of professionalism and execution on the evolution of group opinion is not significant.

This shows that although the merchant can persuade opponents to reverse opinions, however, when the merchant has high professionalism or execution, he can guide the vast majority of consumers to participate in collaborative shopping. If the merchant lacks professionalism of

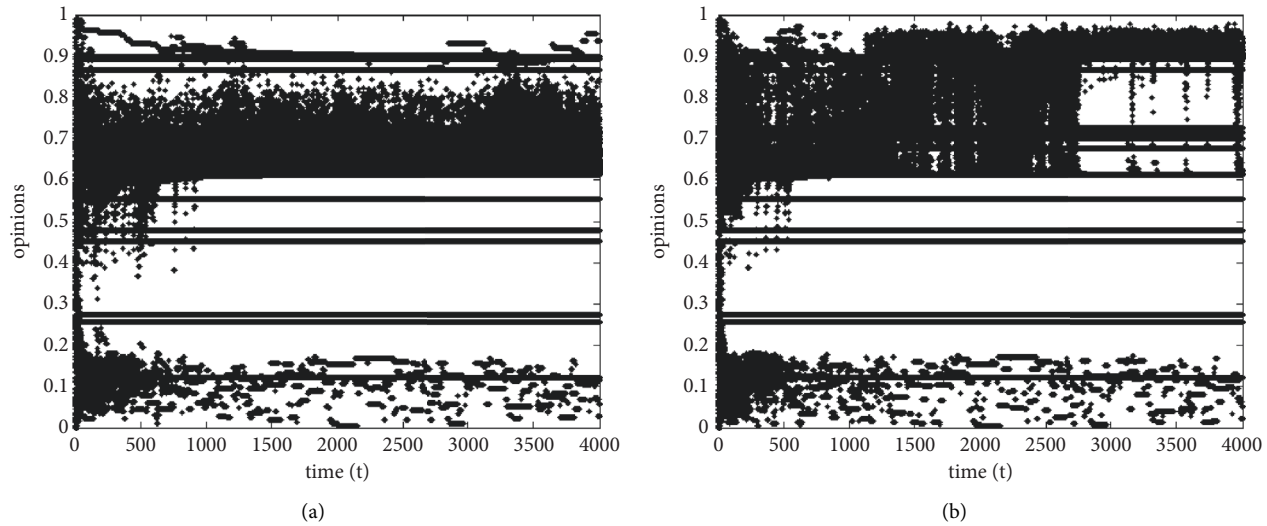

Figure 7: Plot of the evolutionary process of group opinions in different conformity: (a) conformity ∈ [0, 0.2]; (b) conformity ∈ [0.8, 1].

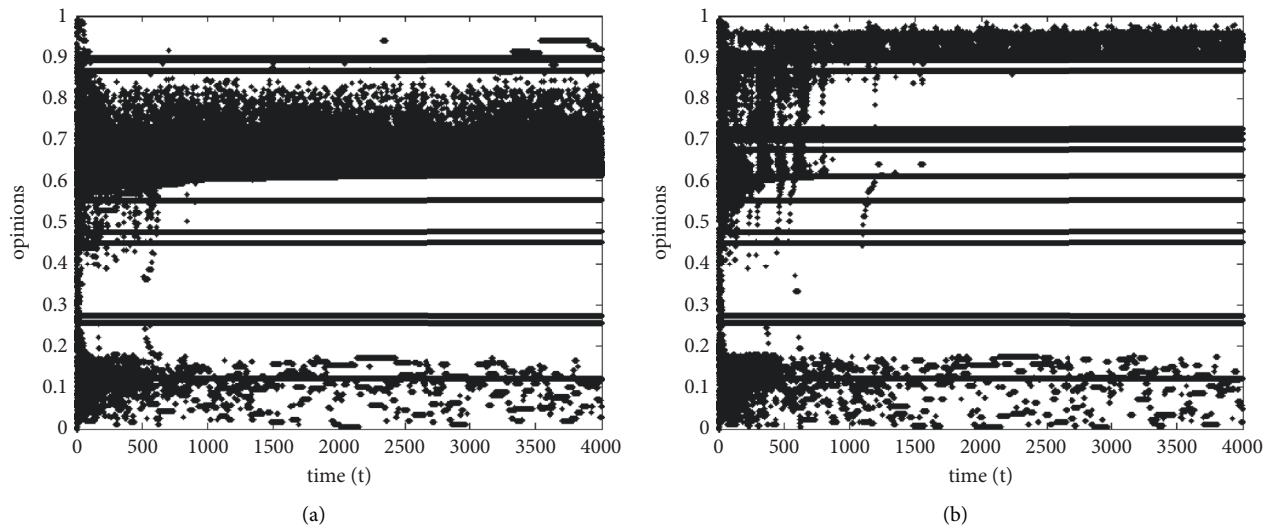

Figure 8: Plot of the evolutionary process of group opinions in different trust tendency: (a) trust tendency ∈ [0, 0.2]; (b) trust tendency ∈ [0.8, 1].

collaborative shopping process, product information, and so on, or does not fit into the consumer group actively and he only persuades very limited consumers.

5.4. The Influence of Consumer Characteristic on Opinion Evolution. This paper adjusts the characteristic variables of individual consumers to explore the impact on collaborative shopping activities. It is assumed that there are 12 opinion leaders in the group, and the initial opinions of 138 consumers obey stochastic uniform, the homogeneity threshold $\varepsilon = 0.25$, the ordinate represents the group opinions of the collaborative shopping group, and the abscissa represents simulation steps. The conformity and trust tendency of individual consumers are set as [0, 0.2] and [0.8, 1], respectively, The simulation results are shown in Figures 7 and 8:

The simulation results show that when the consumers' conformity is in low level, the majority of consumers support collaborative shopping, and their opinion values are distributed between 0.62 and 0.8. When the consumers' conformity is in high level, there are still a small number of consumers who hold negative opinions on collaborative shopping, but some supporters' opinions get reinforced, polarization phenomenon appears, and the opinion values rise to the interval [0.9, 1]. In common with conformity, when the consumers' trust tendency is in high level, the time of some supports polarizing is greatly shortened, so conformity and trust tendency cannot promote the development of collaborative shopping but can cause group polarization

of some supporters, and the trust tendency can cause group polarization in a shorter time.

6. Conclusions and Application

In this paper, the DW bounded trust model is taken as the original model, and based on the unique characteristics of group consumption, the DW model is improved, and the interaction rules of participants involved in collaborative shopping are established. A series of simulation experiments are carried out and the main conclusions are as follows:

Firstly, the reverse effect of the merchant. In the process of collaborative shopping, the main function of merchants is to persuade consumers having negative opinions to change their opinions, forming the situation that supporters far outweigh opponents and promote the smooth development of collaborative shopping activities. The characteristic level of merchant is closely related to the number of consumers changing their opinions, if the merchant has the high professionalism level and interacts with consumers positively; more consumers can be promoted to change their opinions for supporting collaborative shopping activities. In addition, there is no significant difference in the influence of professionalism and execution on the group opinions evolution. This shows that in the successful development of collaborative shopping, merchant plays a core promoting role, and consumers are more inclined to refer to the performance of merchant to decide whether to participate in it.

Secondly, the differentiation of opinion leaders. In the process of collaborative shopping, the main role of opinion leaders is to differentiate the opinions of consumer groups. In the course of group opinions evolution, opinion leaders disperse consumers' opinions which are divided into two clear-cut initially, forming different opinion clusters; however, the proportion of consumers having a favorable attitude has remained unchanged. The explanation is that opinion leaders do not promote or hinder collaborative shopping activities, only differentiate group opinions to form clusters. It may have happened because social networking services make consumers face more product selections and more efficient group communication, accordingly, consumers' online shopping experience are increasingly richer. Therefore, in the process of collaborative shopping, consumers can effectively identify normal users and opinion leaders and are no longer easily influenced by opinion leaders, which just consumers obtain product information from.

Thirdly, the polarization effect of consumers. In the process of collaborative shopping, the characteristic level of consumers is closely related to group polarization. When individual consumers' conformity or trust tendency is high, group polarization occurs, and some supporters' opinions are strengthened, but those who are having negative opinions do not change their attitudes. In addition, high-level trust tendency can quickly triggers group polarization of some supporters, while high-level conformity takes longer time to cause group polarization.

In the end, there is no negative group polarization. In a series of simulation experiments, the evolution trend of group opinions in different situation is simulated through adjusting the value range of parameters, and only under the condition of high-level consumers' characteristics, positive group polarization appears, under any circumstances negative group polarization is not apparent. Perhaps the most significant reason is that the negative group polarization is often related to the controversial and sensitive topic, while in the process of collaborative shopping, the theme which consumers discuss is relatively mild, in addition, the openness of the market and social impact of Internet make experienced consumers face diversified products to choose, they can choose other similar products to meet their needs if the product or service of collaborative shopping do not satisfy them.

Data Availability

The authors confirm that the data supporting the findings of this study are available within the article.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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