Driving Factors for Opinion Diffusion Behavior in Consumers on Online Social Networks: A Study of Network Characteristics

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ABSTRACT Online consumer social networks have become an important marketing channel for product-related information diffusion in the technological landscape. This paper aims to identify the factors that drive opinion diffusion behavior in consumers on online social networks. To empirically test the theoretically driven hypotheses, the study uses firsthand survey responses from 614 respondents based in two major cities in China: Shenzhen, an eastern city, and Xi'an, a western city. A survey of online shopping consumers shows that both network heterogeneity and network influence have a positive impact on consumers' level of online opinion leadership and online opinion seeking behavior. However, network acquaintance has an insignificant impact on the level of opinion diffusion. Furthermore, online opinion diffusion has a positive impact on behavioral consequence, which has two dimensions: online forwarding and online communication. An online opinion leader is more likely to forward and communicate information than an online opinion seeker. Multiple-group analysis indicates that gender and city moderate the effect of opinion diffusion. Theoretically, this paper makes several contributions to marketing literature, particularly from a social networking perspective. The results from this study can help online retailers and social network service providers utilize consumer networks to improve online opinion diffusion. Within social networking literature, this is a unique attempt to explore the factors driving opinion diffusion behavior in consumers' online social networks.

INDEX TERMS Social network services, diffusion processes, consumer behavior, communication networks.

I. INTRODUCTION

Facing the disadvantage of high listing fees and long payback periods, manufacturers have extended their marketing channels to online platforms. Previously, when consumers needed product-related information, they had no choice but to turn to manufacturer-generated advertisements published by traditional media. However, information released by manufacturers may exaggerate the quality of a product or service, and consumers are unwilling to trust and accept the information generated by firms. Internet technology has transformed the way we search for information, interact with each other, and shop [1]. Therefore, traditional word-of-mouth behavior has become electronic word-of-mouth, and consumers are connected by online social networks [2]. Facebook, Twitter, Pinterest, LivingSocial, and Kickstarter are examples

of social commerce and social networking platforms that have largely shaped our current understanding and practice [3]. Consumers are increasingly using social networks to gather information to make their online buying decisions. Online social networks facilitate consumers' social interaction with each other and help them exchange product-related information. E-commerce companies are increasingly focusing on product information diffusion in consumer social networks. Several opinion leaders have emerged as influential members of online communities and as a source of advice for other consumers [4].

In the past two decades, a significant amount of social media applications, such as Facebook, Twitter, Microblog, and WeChat, have emerged from all over the world. These applications constitute the online social networks that play an important role in our daily lives. Social networks often carry large amounts of information-rich data [5]. Due to the substantial changes that social commerce has brought to both

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businesses and consumers, understanding consumer behavior in the context of social commerce has become critical for companies that aim to better influence consumers and harness the power of their social ties [6]. Marketing managers and researchers generally agree that analyzing social networks and using them to influence consumers' purchase decisions are useful strategies [7]. Do social network characteristics provide sufficient information to identify customers who have the ability to influence opinion diffusion in social networks?

Previous studies on antecedent variables of opinion leaders have paid more attention to information content, such as perceived originality, perceived uniqueness, perceived quantity, and innovativeness [4], [8], while some existing studies have considered network centrality to be the most important network characteristic for information diffusion [7]. However, only a limited number of studies have incorporated influence, heterogeneity, and acquaintance into the research model. Existing research mostly focuses on the information sender; however, opinion seekers may also exhibit high opinion leadership because they want to gain more knowledge and information. Moreover, product-related information dissemination and seeking are not the end of opinion diffusion, and the influencing factors of behavioral consequences deserve further study. This study examines the effect of consumer social network characteristics on online opinion diffusion and investigates its outcomes, which include online forwarding and online communication.

To understand product-related opinion diffusion behavior in China, respondents representing two different types of cities were chosen from the survey location of Shenzhen (in the Pearl River Delta Economic Zone) and Xi'an (in the West Triangle Economic Zone). The two cities are in the eastern and western parts of China, respectively, and have different levels of economic development and consumption. Considering the above details, this article focuses on the consumer social network heterogeneity, network influence, and network acquaintance, etc., related to opinion diffusion behavior. Regression analysis and path analysis are conducted on the parameters, such as gender, age, etc.

This article (1) presents a market investigation of consumers' product-related opinion diffusion behavior for online retailers to identify consumers with high opinion leadership in online social networks from the three dimensions of network characteristics, (2) aids online retailers in identifying the behavioral consequences of opinion leadership and opinion seeking in online social networks and the effect of opinion seeking on diffusion behavior, and (3) offers suggestions to social network platforms and online retailers for distinguishing product-related opinion diffusion behavior of consumers by gender and region.

The remainder of the article is organized as follows. Firstly, we provide an overview of the literature on network characteristics and online opinion diffusion behavior. Then, we develop the hypotheses, followed by the methodology and results. The paper ends with a conclusion, theoretical and managerial implications, limitations, and suggestions for further research.

II. LITERATURE REVIEW
A. NETWORK CHARACTERISTICS
In traditional economics and management research, the agent is regarded as a rational and independent decision-making individual. In this perspective, the market is composed of a large number of consumers with no links, and these consumers' decisions are independent. As information diffuses in consumer social networks, consumer decision-making becomes more and more interdependent. A consumer social network is formed by individuals through formal or informal ties around a purchasing period [2], [9]. In this study, a consumer network refers to an online social network relationship between consumers within the context of Web 2.0 technologies, through which product-related information is spread. With the formation of consumer networks, consumers are no longer passive information receivers, but instead some of them become information disseminators [10]. The characteristics of the source of information are one of the main factors that determine information diffusion [11]; online recommendations generated by product/service users are not considered motivated by economic incentives, so their credibility is usually not questioned by information seekers [12]. In general, network characteristics that influence online consumer behavior include network heterogeneity, network influence, and network acquaintance.

1) NETWORK HETEROGENEITY (NH)
It is generally believed that a social network that consists of heterogeneous members can generate a lot of information and form an information resource pool [13]. Heterogeneity facilitates product-related information diffusion, and consumer social networks can be used by retailers to spread information and for consumers to obtain information.

2) NETWORK INFLUENCE (NI)
Often, a small number of users with high network centrality have a large number of social connections. These individuals are called hub nodes, and hub nodes with a large number of social links can significantly affect product adoption and market share [14]. The ability to affect other consumers' decision-making process is called network influence [15]. Node degrees in online social networks usually have power-law distribution [16], which has been studied and confirmed in many networks [17]. In the field of shopping behavior, research suggests that analyzing network structure, such as the impact of network centrality on consumer behavior, can provide economic value [18].

3) NETWORK ACQUAINTANCE (NA)
Opinion acceptance and relationship establishment are based on certain psychological mechanisms in online social networks. Familiarity and trust play a major role in mediating

the exchange between sellers and buyers, and they positively affect buyers' perceived usefulness of social commerce platforms [19]. Therefore, trust has a subtle influence on the evolution of opinion and social links. In the product diffusion process, individuals' opinions are more accepted and trusted by familiar users. Consumers are willing to participate in community activities and make recommendations to people who are familiar [20]. Source credibility refers to the extent to which a source is perceived to be trustworthy and credible [21]. Individuals are more likely to consult with other users with high credibility during consumption decisions.

B. OPINION DIFFUSION AND BEHAVIORAL CONSEQUENCES

Opinion diffusion is driven by opinion leadership and opinion seeking [22]. Opinion leadership (OL) is the process by which people (the opinion leaders) influence the attitudes or behaviors of others (the opinion seekers). Opinion seeking (OS) facilitates information diffusion in the interpersonal communication process [23]. Opinion leaders are defined as individuals who transmit information about a topic to other people, in terms of the extent to which information is sought by those people [24]. Opinion leaders are important sources that can advise other consumers, and opinion leadership influences consumer interaction and recommendation intentions [4]. Opinion seekers seek information or advice from others when making an informed decision or taking an action. Opinion leaders cannot exist without opinion seekers, and vice versa. Posts from influential users with influential friends are acknowledged and shared at a very high rate by their followers, and spread rapidly in the network through information dissemination [25]. Zhang *et al.* [26] studied the relationship between opinion leadership and susceptibility to social influence in new product adoption and found that opinion leaders are less sensitive to informational influence than non-leaders. The internet not only provides opinion leaders with efficient ways to disseminate information, but also greatly facilitates information search for opinion seekers. The development of information technology has broken down the barrier between opinion leaders and normal users and has provided online social network platforms for normal users to post their own opinions. Additionally, online opinion diffusion is not the end of online behavior; existing research indicates that behavioral consequences are affected by opinion diffusion [8].

In this study, behavioral consequences are defined as the level of individual online forwarding of product information to others (online forwarding, OF) and the level of individual online communication with other members about product-related information (online communication, OC). Online forwarding and online communication greatly promote new product adoption [27]. Opinion formation is the result of information dissemination among online social network users through communication and discussion of opinions, views, and beliefs about products [25]. Forwarding of information through online consumer social networks may be led by

opinion leaders or opinion seekers, if the comment they received is beneficial to them. Consumers who spread product-related information through online forwarding may also be interested in communicating in online environments [8]. Online communicators tend to be more willing to disclose personal information and be honest and forthcoming with their opinions [28].

III. CONCEPTUAL FRAMEWORK AND HYPOTHESES

This study presumes that the network characteristics of online social network participants play a key role in influencing online opinion leadership and online opinion seeking, which in turn can influence their behaviors in diffusing information to other members in their online community. Thus, in this conceptual model (Fig. 1), network characteristics have positive effects on online opinion diffusion, and online opinion diffusion has positive effects on behavioral consequences.
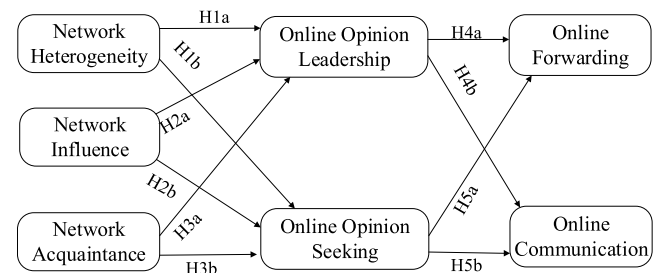

FIGURE 1. Conceptual model.

A. IMPACT OF NETWORK STRUCTURE ON OPINION DIFFUSION

The presence of diverse consumers in social networks increases the diversity of ideas, opinions, and experiences, and heterogeneous information has a positive effect on performance [29]. Heterogeneous social networks may widen users' scope of cognitive resources and vision, and promote problem-solving ability [30]. A community with more diverse participants will be better able to deliver knowledge by leveraging the wider collective experiences and perspectives of its members [31]. Individuals who have a high heterogeneous network may obtain useful information and secure a dominant position in social networks [32]. Before making decisions, consumers like to communicate with others in online social networks. Therefore, heterogeneity between the sender and seeker will contribute to promoting the flow of product-related information. Thus, we hypothesize that consumers who have a high level of network heterogeneity will have a high level of online opinion leadership and online opinion seeking. Thus, we hypothesize the following:

H1a: Consumer network heterogeneity will be positively related to the level of online opinion leadership.

H1b: Consumer network heterogeneity will be positively related to the level of online opinion seeking.

Opinion diffusion is based on interpersonal relationships in which product information is spread. Researchers have

suggested that the influence of peers, society, and others significantly affects consumers during their opinion formation about any brand [33]. In general, influential users are always located in the hub of a network, and information sent by them can spread quickly and affect other users' decision-making process. Influential individuals tend to have a wide audience [34], follow the expectations of others, and seek information from others [33]. Influential users of online social networks can spread positive or negative posts or opinions on services or products to other online social network users. This process can significantly affect the reputation of an organization because a post on an online social network can spread to numerous users [25]. Thus, we hypothesize that in consumer networks, highly influential people—whether opinion leaders or seekers—can more easily obtain or transfer product-related information.

H2a: Consumer network influence will be positively related to the level of online opinion leadership.

H2b: Consumer network influence will be positively related to the level of online opinion seeking.

Relationships between consumers (e.g. relatives, friends, classmates, and colleagues) are diverse. The familiarity of relationships will impact the degree of trust and information sharing frequency between consumers. The network connections among users help in spreading information and influencing other users. The strength of the link between the two nodes of a network depends on the overlap of their neighborhoods [13]. Interpersonal similarity, social interaction, and common identity attachment are the primary drivers of user behavior in online communities [35]. Related studies in marketing have shown that consumers prefer to obtain information through strong ties [36], [37]. If users are familiar with each other, there will be more interpersonal interaction and trust among them. In addition, with an increase of interaction between users, users learn more about each other, and the sense of community belonging also increases. Word of mouth plays a vital role in building trust and assists in increasing buyer propensity and intention to search for products on social commerce platforms [19]. Users' feelings of uncertainty will decrease as familiarity increases, and they will build more mutual trust and emotional cognition, which in turn allows users to become comfortable interacting and communicating with others. Accordingly, once consumers become familiar with others in a social network, they will transform from information visitors into information creators. Thus, we hypothesize the following:

H3a: Consumer network acquaintance will be positively related to the level of online opinion leadership.

H3b: Consumer network acquaintance will be positively related to the level of online opinion seeking.

B. IMPACT OF OPINION DIFFUSION ON BEHAVIORAL CONSEQUENCES

Opinion leaders play an important role in consumers' decision-making process on social commerce platforms, and opinion leaders can disseminate information to many consumers in a short time period. With social commerce platforms, customers usually comment, endorse, and rate products or services based on interests and experiences [38]. These opinions are then diffused by the behavior of individuals online, such as online forwarding and online communication. Along with the development of information technology, online forwarding and online communication have become common behaviors of opinion leaders [39]. Thus, we hypothesize the following:

H4a: The consumer's level of online opinion leadership will be positively related to online forwarding.

H4b: The consumer's level of online opinion leadership will be positively related to online communication.

Online forwarding and online communication can greatly promote new product adoption [27]. Opinion seeking is also a common characteristic of opinion leaders. New customers usually look for others' opinions about a product or service before deciding to use a product or a service. Opinion sharing facilitates information gathering by potential customers before product or service adoption [38]. If an opinion leader cannot obtain the information from others, they cannot collect enough information to become an information source. Opinion seekers usually actively communicate with other people, and many opinion seekers become opinion leaders. In online communities, opinion seekers tend to find information from others through a mutually beneficial exchange. At the same time, online forwarding and communicating are convenient tools for opinion seekers to exchange information with friends or other unfamiliar people [8]. In light of this, we hypothesize the following:

H5a: The consumer's level of online opinion seeking will be positively related to online forwarding.

H5b: The consumer's level of online opinion seeking will be positively related to online communication.

IV. METHODOLOGY
A. CONSTRUCT MEASURES
Previous studies have employed a number of research methods to provide empirical evidence of consumer behavior in social commerce. According to Zhang and Benyoucef [6], over 70% (n = 54) of these studies adopted the quantitative survey method, which indicates that the survey method dominates empirical research in social commerce studies. This study adopts the survey method and uses multi-item measures from the existing literature; some of these were modified to suit the context. The survey instrument included a variety of measures that assess the following concepts: (1) network heterogeneity; (2) network influence; (3) network acquaintance; (4) opinion diffusion (online opinion leadership and online opinion seeking); and (5) behavioral consequences (online forwarding and online communication).

This study measures network characteristics in terms of network heterogeneity, network influence, and network acquaintance. The items on network heterogeneity were revised from measures used by Sweeney *et al.* [40];

three items were measured using a 5-point Likert scale ranging from 1 (strongly agree) to 5 (strongly disagree). Network influence was measured by one item ("Compared with my friends, I am usually consulted more about online shopping."), and network acquaintance was measured by one question ("What percentage of people are you familiar with in your online social network?").

The measure of opinion diffusion consisted of online opinion leadership [41] and online opinion seeking [42]. Six items were measured using a 5-point Likert scale. To examine the consequences of opinion diffusion, the measures of behavioral consequences focused on online forwarding and online communication [8]. Eight items were measured using a 5-point Likert scale. Zhang and Benyoucef [6] suggest that antecedent factors may vary the impacts under different contingency conditions, such as consumers' demographics. Thus, to eliminate alternative explanations, this study also included age, gender, education level, and average living expenses per month as control variables.

In the questionnaire preparation process, we invited six doctoral, master, and undergraduate students majoring in management, to raise substantive and stylistic issues regarding the questionnaire; based on their feedback, the questionnaire was improved. Because the questionnaire items are derived from English papers and the survey context is China, the questionnaire is written in Chinese. To ensure consistency between the English source items and the Chinese questionnaire, a colleague who has studied in the United States and is fluent in Chinese and English reviewed the questionnaire prior to administration.

To ensure the reliability and validity of the survey questionnaire, we preliminarily administered the questionnaire to students enrolled in a university in western China. A total of 466 students in different grades and majors were surveyed, and we received 456 valid responses. After conducting reliability and validity analysis, we further revised the questionnaire.

B. SAMPLING AND DATA COLLECTION

Emerging markets contain more than half of the world's population and have become the growth engines of the world economy [43]. E-commerce is an important industry in emerging economies. China ranks first in the world in terms of people who use social networking sites, making China an ideal market for investigating consumer online behavior. This study was conducted in Shenzhen (an eastern city in China) and Xi'an (a western city in China); both cities are relatively well developed compared to the rest of their regions. Our survey sample consisted of employees of the information service industry. With the assistance of local government, we selected 30-40 companies in different areas of both cities. We asked the human resources managers of those companies to distribute questionnaires to their employees. Of the 1310 emails containing a link to the survey sent by human resources managers in both cities, 663 people responded to the survey online. After deleting 49 questionnaires because

respondents did not answer important questions, our sample consisted of 614 valid questionnaires, indicating a response rate of 46.9%. Most respondents are between 22 and 34 years old, and 57.2% of the respondents are women, which is consistent with the characteristics of the population of online shoppers in China.

V. DATA ANALYSIS AND RESULTS
A. MEASUREMENT MODEL

SPSS 22.0 and AMOS 22.0 were used to test the reliability and validity of the questionnaire. First, internal reliability was assessed (see results in Table 1). Internal consistency is a measure of the correlations between different items on the same test (or the same subscale on a larger test) and is usually measured with Cronbach's alpha, a statistic calculated from the pairwise correlations between items. The Cronbach's scores of each sub-construct were above 0.7, indicating that the scale of this study has good internal reliability. Second, convergent validity and construct validity were assessed measuring the degree to which two measures of constructs that theoretically should be related are in fact related. This is based on the criterion that the indicator's estimated coefficient was significant on its posited underlying construct factor. As shown in Table 1, all items' loadings on corresponding constructs are greater than 0.50, which indicates that the sample data is suitable for factor analysis. As shown in Table 1, the results of the Kaiser-Meyer-Olkin (KMO) test for network heterogeneity, opinion diffusion, and behavioral consequences are 0.63, 0.81 and 0.91, respectively, which indicate that the questionnaire has good construct validity. The study also employed confirmatory factor analysis to test convergent validity. The model fit indexes of network heterogeneity, opinion diffusion, and behavioral consequences are all satisfactory. Overall, these results show that there is good compatibility between the data and the model.

Principal components and varimax rotation were used to obtain the factor loading after rotation, and five factors were extracted. We assessed unidimensionality by conducting exploratory factor analysis (EFA) using varimax rotation. The EFA results indicate that all the measurement scales are well loaded on their supposed constructs. Network heterogeneity items extract one effective factor, and the total variance explained is 61.50%. Opinion diffusion items extract two effective factors—online opinion leadership and online opinion seeking—and the total variance explained is 77.98%. Behavioral consequences items also extract two effective factors—online forwarding and online communication—and the total variance explained is 77.58%.

This study applies Fornell and Larcker's measure of the average variance extracted (AVE) to access the discriminative validity of the measurement [44]. We assessed discriminant validity by comparing the square root of AVEs and construct correlations. The AVE measures the amount of variance captured by a construct through its items relative to the amount of variance caused by measurement errors. To satisfy

TABLE 1. Summary of constructs and confirmatory factor analysis.

Items	FL 1	FL 2
Network Heterogeneity NFI=0.97,RFI=0.93,ILI=0.98,TFI=0.95,CFI=0.98,RMSEA=0.07,RMR=0.02,Total Variance Explained=61.50%		
I like to communicate with and contact people who I have never met before offline on online social networks.	0.79	
I feel that the information diffused by unfamiliar people is useful to me.	0.85	
I like to follow the social media accounts of retailers, institutions, and influential people.	0.71	
Opinion Diffusion (Online Opinion Leadership, Online Opinion Seeker) NFI=0.98, RFI=0.97,ILI=0.99, TFI=0.98,CFI=0.99,RMSEA=0.07,RMR=0.03,Total Variance Explained=77.98%		
Compared with my friends, I am usually consulted more about online shopping.	0.89	0.22
I feel that my friends deem me as the channel to access online shopping advice.	0.88	0.21
I like to provide advice on online products to my friends through my online social network.	0.81	0.24
I like to seek others' advice through Weibo, WeChat, QQ, and other online social network tools when I want to shop online.	0.21	0.87
I feel very happy when I obtain advice from others when I am shopping online.	0.15	0.84
I tend to consult others in my online social network to help with my shopping decisions.	0.33	0.82
Behavioral Consequence (Online Forwarding, Online Communication) NFI=0.95,RFI=0.92,ILI=0.95,TFI=0.93,CFI=0.95,RMSEA=0.12,RMR=0.03,Total Variance Explained=77.58%		
I like to use the button "forward to friend" when I find a good product.	0.83	0.32
I like to forward information on products I prefer to my friends.	0.81	0.36
I like to forward product information that I receive from others if I think it will be useful to my friends.	0.77	0.37
I like to forward product information that I receive from one circle of friends to another circle of friends if the product is interesting.	0.77	0.43
I like to share information on products I have bought when I communicate with members of my online social network.	0.50	0.73
I like to share the brand of product that I am interested in when I communicate with members of my online social network.	0.39	0.79
My friends tend to consult me for product advice by communicating with members of my online social network.	0.34	0.85
I tend to persuade others to buy products that I like by communicating with members of my online social network.	0.31	0.80

the requirement of discriminative validity, the square root of a construct's AVE must be greater than the correlations between the construct and other constructs in the model. For example, the square roots of the AVEs of the two constructs, NH and OL, are 0.78 and 0.89, respectively; this is greater than the correlation, 0.53, between them as seen in Table 2. It demonstrates adequate discriminative validity between NH and OL. Results indicate that all square roots of AVEs (diagonal entries in Table 2) exceed corresponding construct correlations. The square roots of all constructs' AVEs are all greater than the correlations among all constructs in Table 2. Therefore, the discriminative validity of the measurement is acceptable.

TABLE 2. Correlations and square root of the AVE value.

	1	2	3	4	5	6	7
1 NI	/						
2 NA	-0.04	/					
3 NH	0.58***	-0.09**	0.78				
4 OL	0.54***	-0.01	0.53***	0.89			
5 OS	0.34***	0.01	0.38***	0.00	0.87		
6 OF	0.38***	-0.02	0.38***	0.32***	0.26***	0.88	
7 OC	0.39***	-0.02	0.42***	0.46***	0.33***	0.00	0.88

Note: ***.Significant at p<0.01, **.Significant at p<0.05, and the diagonal elements presented in italics are the square roots of AVE

Table 2 also presents the correlations for major variables. A majority of the correlation coefficients between two variables are positive and significant. However, network acquaintance has a significant negative correlation with network heterogeneity, and network acquaintance has no significant correlation with any other variable.

B. REGRESSION ANALYSIS

To test the impact of consumers' network characteristics on opinion diffusion, this study constructed four models hierarchically (see Table 3). In Model 1, the regression coefficients for gender and living expenses are significant, indicating that men are more likely to be online opinion leaders than women, as well as people with high consumption ability. In Model 3, the control variables have no significant impact on online opinion seeking. Age and education have no significant relationship with either online opinion leadership or online opinion seeking, which corroborates existing evidence that online opinion diffusion is not limited to people with high levels of education or varied experiences due to age. Turning to consumer network characteristics (Model 2 and Model 4), the independent variables of network heterogeneity and network influence have significant positive effects on online opinion leadership and online opinion seeking. Thus, the results support H1a, H1b, H2a, and H2b. However, network acquaintance has no significant relationship with online

TABLE 3. Regression analysis results of online opinion diffusion.

Dependent	Online Opinion Leadership		Online Opinion Seeking	
Variable	Model 1	Model 2	Model 3	Model 4
Gen	-0.168**	-0.266***	-0.055	
Age	-0.007		0.001	
Edu	0.078		-0.012	
Exp	0.183***	0.104**	-0.067	
NH		0.343***		0.289***
NI		0.369***		0.185***
NA		0.015		0.047
F	4.238***	75.106***	0.516	41.004***
R^2	0.027	0.382	0.003	0.168
ΔR^2	0.021	0.377	-0.003	0.164

Note: ***.Significant at p<0.01, **.Significant at p<0.05

opinion leadership and online opinion seeking, indicating that H3a and H3b are not supported.

Table 4 and Table 5 present the empirical results of the impact of online opinion diffusion on behavioral consequences. Model 5 and Model 9 tested the effects of control variables on online forwarding and online communication, and only the regression coefficient of gender is significant, which indicates that men are more likely to participate in online forwarding than women. However, in Model 9, the control variables have no significant effect on online communication. Online opinion leadership is incorporated in Model 6 and Model 10; the regression coefficient of online opinion leadership on online forwarding and online communication is 0.32 and 0.46, respectively, at the 0.01 significance level. The regression coefficient of online opinion seeking on online forwarding and online communication is 0.26 and 0.33, respectively, at the 0.01 significance level. Model 8 tested the effects of online opinion leadership and online opinion seeking on online forwarding, and the regression coefficient of online opinion leadership on online forwarding is higher than online opinion seeking. Model 12 tested the effects of online opinion leadership and online opinion seeking on online communication, and the regression

TABLE 4. Regression analysis results of online forwarding.

Variable	Model 5	Model 6	Model 7	Model 8
Gen	-0.197**	-0.144*	-0.184**	-0.129*
Age	0.010			
Edu	0.076			
Exp	0.065			
OL		0.318***		0.319***
OS			0.261***	0.262***
F	3.016**	37.771***	25.748***	44.178***
R^2	0.019	0.110	0.078	0.178
ΔR^2	0.013	0.107	0.075	0.174

Note: ***.Significant at p<0.01, **.Significant at p<0.05, *.Significant at p<0.1

TABLE 5. Regression analysis results of online communication.

Variable	Model 9	Model 10	Model 11	Model 12
Gen	-0.069			
Age	0.005			
Edu	0.018			
Exp	0.016			
OL		0.461***		0.461***
OS			0.327***	0.327***
F	0.364	165.202***	73.117***	143.291***
R^2	0.002	0.213	0.107	0.319
ΔR^2	-0.004	0.211	0.105	0.317

Note: ***.Significant at p<0.01

coefficient of online opinion leadership on online communication is higher than online opinion seeking. Thus, the results support H4a, H4b, H5a, and H5b.

C. STRUCTURAL EQUATION MODEL AND MULTIPLE-GROUP ANALYSIS

Finally, we used structural equation modeling (SEM) to test the measurement model and explore the relationship between variables. SEM is a powerful statistical technique for testing and estimating causal relationships. The SEM includes two levels of analysis: the measurement model and the structural model. Results show that the chi-square = 673.93, degrees of freedom = 140, and the four fit indexes of CFI, NFI, TLI, and IFI are 0.93, 0.91, 0.91, and 0.93, respectively. The root mean square error of approximation (RMSEA) for the model is less than 0.08, which indicates that the model fits well. The regression analysis and path analysis provide consistent results for our hypotheses: H3a and H3b are rejected and other hypotheses are supported.

To further analyze our hypotheses, we divided the sample into groups and performed multiple-group analysis. Based on our regression analysis, gender is one of the control variables that had a significant effect on opinion diffusion and behavioral consequences. Moreover, in related studies of online shopping and social networking, findings reveal that men and women usually exhibit different behaviors. Therefore, we divided the sample into groups by gender and explored whether gender impacts the formation of online opinion diffusion and behavioral consequences. In addition, because the respondents were from two cities, the sample was divided into groups by city for conducting multi-group analysis.

The results of multiple-group analysis by gender, using standardized regression weights and significance level, are shown in Table 6. For consumers with high network heterogeneity, female consumers have a higher level of online opinion leadership ($\beta = 0.64$, $p < 0.01$) and online opinion seeking ($\beta = 0.55$, $p < 0.01$) than men. For consumers with high network influence, men are more likely to have a slightly higher level of online opinion leadership ($\beta = 0.50$, $p < 0.01$), and women have a higher level of online opinion seeking ($\beta = 0.36$, $p < 0.01$). For consumers with high network acquaintance, men are more likely to have a higher level of

TABLE 6. Multiple-group analysis and hypotheses summary.

Hypothesis	Male	Female	Western	Eastern
H1a:NH→OL	0.456***	0.639***	0.541***	0.607***
H1b:NH→OS	0.429***	0.554***	0.464***	0.574***
H2a:NI→OL	0.497***	0.469***	0.489***	0.478***
H2b:NI→OS	0.317***	0.356***	0.336***	0.343***
H3a:NA→OL	0.061	0.033	0.045	0.052
H3b:NA→OS	0.171***	-0.008	0.040	0.081
H4a:OL→OF	0.212***	0.610***	0.488***	0.406***
H4b:OL→OC	0.337***	0.598***	0.517***	0.493***
H5a:OS→OF	0.349***	0.248***	0.253***	0.375***
H5b:OS→OC	0.303***	0.276***	0.209***	0.379***

Note: ***.Significant at p<0.01

online opinion seeking ($\beta = 0.17$, p $<$ 0.01). For consumers with high levels of online opinion leadership, women are more likely to engage in online forwarding ($\beta = 0.61$, p $<$ 0.01) and online communication ($\beta = 0.50$, p $<$ 0.01). For consumers with high levels of online opinion seeking, men are more likely to engage in online forwarding ($\beta = 0.35$, p $<$ 0.01) and online communication ($\beta = 0.30$, p $<$ 0.01).

From the perspective of a city, wherein consumers have (1) high network heterogeneity, those from the eastern city have a higher level of online opinion leadership ($\beta = 0.607$, p $<$ 0.01) and online opinion seeking ($\beta = 0.574$, p $<$ 0.01) than those from the western city; (2) high network influence, those from the western city were found more likely to have a slightly higher level of online opinion leadership ($\beta = 0.489$, p $<$ 0.01) while those from the eastern city were relatively higher in online opinion seeking ($\beta = 0.343$, p $<$ 0.01); (3) high network acquaintance, consumers from neither city showed a high level of online opinion leadership and online opinion seeking; (4) high level of online opinion leadership, those from the western city were more likely to exhibit online forwarding ($\beta = 0.488$, p $<$ 0.01) and online communication ($\beta = 0.517$, p $<$ 0.01) than consumers from the eastern city; and (5) high level of online opinion seeking, those from the eastern city were more likely to exhibit online forwarding ($\beta = 0.375$, p $<$ 0.01) and online communication ($\beta = 0.379$, p $<$ 0.01) than consumers from the western city.

VI. CONCLUSIONS

A. THEORETICAL IMPLICATIONS

Recognizing the need to understand opinion diffusion in the context of consumer-to-consumer (C2C) interactions is one of the key developments of customer management in recent years, and investigating these developments presents both new opportunities and challenges for firms and researchers. Consistent with that need, this study investigates the impact of network characteristics on opinion leadership and seeking in online social settings. These findings provide several theoretical contributions to the existing literature. The main theoretical contribution comes from the application of network characteristics to explain how high levels of opinion diffusion

behavior are formed. The study examined three dimensions of network characteristics: network heterogeneity, network influence, and network acquaintance.

This study identified a positive relationship between network heterogeneity and online diffusion, suggesting that an individual's network heterogeneity is a reliable indicator of opinion leadership and opinion seeking. Network influence was found to have a positive relationship with online diffusion. The results demonstrate that an individual's network influence is a determinant of both online opinion leadership and opinion seeking. Additionally, men are likely to have different levels of opinion diffusion behavior to women. This finding highlights the role of gender in the online opinion diffusion process. Gender-related findings may be useful in understanding the different capabilities of male and female consumers in opinion leadership, opinion seeking, online forwarding, and online communication. Furthermore, consumers from the eastern city showed a higher level of online opinion diffusion than those from the western city.

Hypotheses H3a and H3b were not validated by the regression analysis and path analysis; that is, network acquaintance showed no significant relationship with online opinion leadership and online opinion seeking. This finding indicates that if individuals are familiar with most of their contacts in their online social network, they are less likely to become an opinion leader or opinion seeker. However, prior research indicates that social ties are positively related to opinion leadership across a variety of contexts, and strong ties between people are perceived to be more influential than weak ties in shaping the word-of-mouth communication process [8]. Thus, this finding is in conflict with prior research on traditional opinion diffusion, which may be explained by two aspects. Firstly, network acquaintance in this study is different from strong ties; an individual's network acquaintance is defined as the level of the individual's familiarity with the members of his or her online network. Secondly, this study was conducted in an online environment; although familiar and strong ties build trust in such an environment, weak ties can also promote information diffusion faster in an online environment.

B. MANAGERIAL IMPLICATIONS

Beyond theoretical significance, this study has practical implications for online participants, such as online retailers and social network platforms.

Online retailers should not only identify online opinion leaders from consumer networks, but also aim to meet the needs of opinion seekers. Product web pages should have a button with a clear design to allow consumers to easily share a product link, and users' accounts on e-commerce websites should interconnect with online social network services, which may save time and reduce the complexity in product-related information sharing. Moreover, online retailers should set up an incentive mechanism to stimulate individuals with influential or heterogeneous network characteristics to diffuse positive product-related information in their online

social network. Specifically, online retailers should provide good service for female consumers with high levels of network heterogeneity, network influence, and online opinion leadership. In particular, online retailers who want to enter the Chinese market should pay more attention to the opinion diffusion differences in different cities.

To facilitate opinion diffusion, social network platforms need to recommend knowledgeable users to opinion seekers and develop a search engine for opinion seekers to find information. Social network platforms should empower users to create chat groups with other people to share similar interests and needs. In this way, product information can be accumulated and created by users in these groups. In particular, social network platforms should inspire and promote opinion diffusion activity in consumers with high levels of network heterogeneity and network influence. To increase the level of online forwarding and online communication, social network platforms should stimulate consumers with high levels of online opinion leadership from the western city and consumers with high level of online opinion seeking from the eastern city.

C. LIMITATIONS AND FURTHER RESEARCH

This study has several limitations, which can provide a direction for future research. Firstly, although the research data in this study came from two representative cities in China, the study's findings may be restricted to the Chinese context. Further research should extend the model to other areas and countries and compare the effects of consumer network characteristics on online opinion diffusion. Secondly, from the perspective of information forwarding behavior, information content and form of expression may influence information diffusion. Interesting information may be more easily and quickly passed between users in online consumer networks. Thus, future research should consider the interestingness of information content and form of expression. Third, some personality traits were not considered in this study. Although demographic characteristics of consumers such as age, education, and other background information were considered, personality traits from consumer psychology were not considered, such as altruistic motives, self-improvement, and extraversion. Therefore, it is necessary to analyze the effects of personality traits on opinion diffusion.

REFERENCES

[1] R. A. King, P. Racherla, and V. D. Bush, "What we know and don't know about online word-of-mouth: A review and synthesis of the literature," *J. Interact. Marketing*, vol. 28, no. 3, pp. 167–183, Aug. 2014. doi: 10.1016/j.intmar.2014.02.001.

[2] A. Madi, "Using values to segment virtual consumers on social networking sites," *Marketing Intell. Planning*, vol. 34, no. 5, pp. 623–645, 2016. doi: 10.1108/MIP-11-2015-0223.

[3] A. Doha, N. Elnahla, and L. McShane, "Social commerce as social networking," *J. Retailing Consum. Services*, vol. 47, pp. 307–321, Mar. 2019. doi: 10.1016/j.jretconser.2018.11.008.

[4] L. V. Casaló, C. Flavián, and S. Ibáñez-Sánchez, "Influencers on instagram: Antecedents and consequences of opinion leadership," *J. Bus. Res.*, to be published. doi: 10.1016/j.jbusres.2018.07.005.

[5] J. Lin, L. Zhang, M. He, H. Zhang, G. Liu, X. Chen, and Z. Chen, "Multi-path relationship preserved social network embedding," *IEEE Access*, vol. 7, pp. 26507–26518, 2019. doi: 10.1109/ACCESS.2019.2900920.

[6] K. Z. K. Zhang and M. Benyoucef, "Consumer behavior in social commerce: A literature review," *Decis. Support Syst.*, vol. 86, pp. 95–108, Jun. 2016. doi: 10.1016/j.dss.2016.04.001.

[7] O. Hinz, C. Schulze, and C. Takac, "New product adoption in social networks: Why direction matters," *J. Bus. Res.*, vol. 67, no. 1, pp. 2836–2844, Jan. 2014. doi: 10.1016/j.jbusres.2012.07.005.

[8] T. Sun, S. Youn, G. Wu, and M. Kuntaraporn, "Online word-of-mouth (or mouse): An exploration of its antecedents and consequences," *J. Comput.-Mediated Commun.*, vol. 11, no. 4, pp. 1104–1127, Jul. 2006.

[9] R. S. Achrol and P. Kotler, "Marketing in the network economy," *J. Marketing*, vol. 63, no. 1, pp. 146–163, 1999.

[10] P. S. Fader and R. S. Winer, "Introduction to the special issue on the emergence and impact of user-generated content," *Marketing Sci.*, vol. 31, no. 3, pp. 369–371, 2012.

[11] P. W. Ballantine and C. A. Yeung, "The effects of review valence in organic versus sponsored blog sites on perceived credibility, brand attitude, and behavioural intentions," *Marketing Intell. Planning*, vol. 33, no. 4, pp. 508–521, 2015. doi: 10.1108/MIP-03-2014-0044.

[12] S. Mahapatra and A. Mishra, "Acceptance and forwarding of electronic word of mouth," *Marketing Intell. Planning*, vol. 35, no. 5, pp. 594–610, 2017. doi: 10.1108/MIP-01-2017-0007.

[13] M. Granovetter, "The strength of weak ties," *Amer. J. Sociol.*, vol. 78, no. 6, pp. 1360–1380, 1973.

[14] J. Goldenberg, S. Han, D. R. Lehmann, and J. W. Hong, "The role of hubs in the adoption process," *J. Marketing*, vol. 73, no. 2, pp. 1–13, 2009.

[15] J. Lammers, J. I. Stoker, and D. A. Stapel, "Differentiating social and personal power: Opposite effects on stereotyping, but parallel effects on behavioral approach tendencies," *Psychol. Sci.*, vol. 20, no. 12, pp. 1543–1549, 2009.

[16] M. M. Wasko and S. Faraj, "Why should I share? Examining social capital and knowledge contribution in electronic networks of practice," *MIS Quart.*, vol. 29, no. 1, pp. 35–57, 2005.

[17] A. L. Barabási and R. Albert, "Emergence of scaling in random networks," *Science*, vol. 286, no. 5439, pp. 509–512, Oct. 1999.

[18] E. Gentina and S. K. Bonsu, "Peer network position and shopping behavior among adolescents," *J. Retailing Consum. Services*, vol. 20, no. 1, pp. 87–93, Jan. 2013.

[19] O. Gibreel, D. A. AlOtaibi, and J. Altmann, "Social commerce development in emerging markets," *Electron. Commerce Res. Appl.*, vol. 27, pp. 152–162, Jan./Feb. 2018. doi: 10.1016/j.elerap.2017.12.008.

[20] R. Algesheimer, S. Borle, U. M. Dholakia, and S. S. Singh, "The impact of customer community participation on customer behaviors: An empirical investigation," *Marketing Sci.*, vol. 29, no. 4, pp. 756–769, Jul./Aug. 2010.

[21] B. Lawrence, S. Fournier, and F. Brunel, "When companies don't make the ad: A multimethod inquiry into the differential effectiveness of consumer-generated advertising," *J. Advertising*, vol. 42, no. 4, pp. 292–307, Oct. 2013. doi: 10.1080/00913367.2013.795120.

[22] L. R. Flynn, R. E. Goldsmith, and J. K. Eastman, "Opinion leaders and opinion seekers: Two new measurement scales," *J. Acad. Marketing Sci.*, vol. 24, no. 2, p. 137, 1996. doi: 10.1177/0092070396242004.

[23] F. D. Reynolds and W. R. Darden, "Mutually adaptive effects of interpersonal communication," *J. Marketing Res.*, vol. 8, no. 4, pp. 449–454, Nov. 1971.

[24] C. W. King and J. O. Summers, "Overlap of opinion leadership across consumer product categories," *J. Marketing Res.*, vol. 7, no. 1, pp. 43–50, Feb. 1970.

[25] M. A. Al-Garadi, K. D. Varathan, S. D. Ravana, E. Ahmed, G. Mujtaba, M. U. S. Khan, and S. U. Khan, "Analysis of online social network connections for identification of influential users: Survey and open research issues," *ACM Comput. Surv.*, vol. 51, no. 1, Apr. 2018, Art. no. 16. doi: 10.1145/3155897.

[26] H. Zhang, K. Fam, T. Goh, and X. Dai, "When are influentials equally influenceable? The strength of strong ties in new product adoption," *J. Bus. Res.*, vol. 82, pp. 160–170, Jan. 2018. doi: 10.1016/j.jbusres.2017.09.013.

[27] D. Godes and D. Mayzlin, "Using online conversations to study word-of-mouth communication," *Marketing Sci.*, vol. 23, no. 4, pp. 545–560, 2004.

[28] J. Roed, "Language learner behaviour in a virtual environment," *Comput. Assist. Lang. Learn.*, vol. 16, nos. 2–3, pp. 155–172, 2003. doi: 10.1076/call.16.2.155.15880.

[29] S. Rodan and C. Galunic, "More than network structure: How knowledge heterogeneity influences managerial performance and innovativeness," *Strategic Manage. J.*, vol. 25, no. 6, pp. 541–562, Jun. 2004.

[30] D. C. Hambrick, T. Cho, and M.-J. Chen, "The influence of top management team heterogeneity on firms' competitive moves," *Administ. Sci. Quart.*, vol. 41, no. 4, pp. 659–684, Dec. 1996.

[31] S. O. de Almeida, U. Dholakia, J. M. C. Hernandez, and J. A. Mazzon, "The mixed effects of participant diversity and expressive freedom in online peer-to-peer problem solving communities," *J. Interact. Marketing*, vol. 28, no. 3, pp. 196–209, Aug. 2014. doi: 10.1016/j.intMar.2014.02.003.

[32] L. Biggiero, "Industrial and knowledge relocation strategies under the challenges of globalization and digitalization: The move of small and medium enterprises among territorial systems," *Entrepreneurship Regional Develop.*, vol. 18, no. 6, pp. 443–471, 2006. doi: 10.1080/08985620600884701.

[33] C. Sijoria, S. Mukherjee, and B. Datta, "Impact of the antecedents of eWOM on CBBE," *Marketing Intell. Planning*, vol. 36, no. 5, pp. 528–542, 2018. doi: 10.1108/MIP-10-2017-0221.

[34] Y. Takhteyev, A. Gruzd, and B. Wellman, "Geography of Twitter networks," *Social Netw.*, vol. 34, no. 1, pp. 73–81, 2012. doi: 10.1016/j.socnet.2011.05.006.

[35] M. Fiedler and M. Sarstedt, "Influence of community design on user behaviors in online communities," *J. Bus. Res.*, vol. 67, no. 11, pp. 2258–2268, Nov. 2014. doi: 10.1016/j.jbusres.2014.06.014.

[36] H. S. Bansal and P. A. Voyer, "Word-of-mouth processes within a services purchase decision context," *J. Service Res.*, vol. 3, no. 2, pp. 166–177, 2000.

[37] M. C. Gilly, J. L. Graham, M. F. Wolfinbarger, and L. J. Yale, "A dyadic study of interpersonal information search," *J. Acad. Marketing Sci.*, vol. 26, no. 2, pp. 83–100, Mar. 1998.

[38] H. Kumar, M. K. Singh, and M. P. Gupta, "Socio-influences of user generated content in emerging markets," *Marketing Intell. Planning*, vol. 36, no. 7, pp. 737–749, 2018. doi: 10.1108/MIP-12-2017-0347.

[39] J. E. Phelps, R. Lewis, L. Mobilio, D. Perry, and N. Raman, "Viral marketing or electronic word-of-mouth advertising: Examining consumer responses and motivations to pass along email," *J. Advertising Res.*, vol. 44, no. 4, pp. 333–348, 2004.

[40] J. Sweeney, G. Soutar, and T. Mazzarol, "Factors enhancing word-of-mouth influence: Positive and negative service-related messages," *Eur. J. Marketing*, vol. 48, nos. 1–2, pp. 336–359, 2014. doi: 10.1108/EJM-06-2012-0336.

[41] T. L. Childers, "Assessment of the psychometric properties of an opinion leadership scale," *J. Marketing Res.*, vol. 23, no. 2, pp. 184–188, May 1986. doi: 10.2307/3151666.

[42] J. C. Mowen, S. Park, and A. Zablah, "Toward a theory of motivation and personality with application to word-of-mouth communications," *J. Bus. Res.*, vol. 60, no. 6, pp. 590–596, Jun. 2007. doi: 10.1016/j.jbusres.2006.06.007.

[43] M. Sinha and J. Sheth, "Growing the pie in emerging markets: Marketing strategies for increasing the ratio of non-users to users," *J. Bus. Res.*, vol. 86, pp. 217–224, May 2018. doi: 10.1016/j.jbusres.2017.05.007.

[44] C. Fornell and D. F. Larcker, "Evaluating structural equation models with unobservable variables and measurement error," *J. Marketing Res.*, vol. 18, no. 1, pp. 39–50, Feb. 1981. doi: 10.2307/3151312.

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