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Abstract: Most existing researches explore continuous knowledge - sharing from the perspective of the rational cognition. This paper argues that the continuous intention and behaviors should be influenced by long-term emotional factors, and it can be explored from the perspective of emotional attachment to the influential factors of continuous knowledge sharing willingness of virtual communities. Based on the Expectation Confirmation Theory, this paper introduced the attachment and constructed a model of virtual community users' continuous knowledge sharing intention. Structural equation modeling method is used to analyze the data and verify the model. The results show that attachment not only has a direct positive effect on the long-term knowledge sharing intention of virtual community users, but also mediated the relationship between satisfaction, perceived usefulness and the intention of continuous knowledge sharing.

Keywords: continuous knowledge sharing, attachment, expectation confirmation theory, virtual community

1. INTRODUCTION

In the era of knowledge economy, virtual community has become an important platform for people to communicate and share information and knowledge. Virtual communities bring together users with common interests, hobbies and interpersonal relationships to create a good learning and exchange atmosphere for users and promote the flow of information and knowledge in the community as well as the creation of new technology, new ideas. The realization of the value of virtual community depends on the voluntary investment of time and energy by members of the community, as well as their own experience and knowledge, which contradicts the assumption of rational man in economics. Therefore, how to realize the sustainability of users' knowledge sharing behavior is an important problem for the long-term development of virtual communities.

Many scholars have conducted in-depthstudies on persistent behavior[1-3]. These studies mainly explain the continuous knowledge sharing behavior from the perspective of rational factors (such as cost, benefit, etc.). However, the emerging information system represented by the virtual community, which is mostly used by individuals, not purely pursuing economic benefits, so it is not suitable to adopt rational judgment mode to study[4].

Continuous user behavior depends on satisfaction, which is a generalized state of mind that revolves around uncertain expectations and consumers' pre-adoption experiences[5]. That is to say, people's continuous use behavior has a strong subjective emotional color. Attachment is the emotional connection and bond between people or people and the environment. As a psychological model of long-term interpersonal relationship dynamics, attachment has a low value intensity and a long duration, which is suitable for explaining long-term persistent behaviors. Therefore, this study attempts to construct the continuous knowledge sharing model of virtual community from the perspective of emotional attachment, and further explores the effect of attachment on users' long-term intention of knowledge sharing of different types in the virtual community.

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2.　THEORETICAL BACKGROUND

2.1　Virtual communities and continuous knowledge sharing

Knowledge sharing behavior refers to the behavior that users with common interests, expectations and background voluntarily share knowledge through publishing, answering and discussing questions based on their common interests in the virtual community[6].When the user repeatedly participates in the knowledge sharing activity, the user's knowledge sharing behavior again will develop into the continuous knowledge sharing behavior[7].The continuous knowledge sharing behavior of users includes not only the continuous behavior process, but also the methods and means to manage and promote the continuous knowledge sharing[8].The continuous knowledge　sharing behavior explored in this paper is defined as the behavior that virtual community voluntarily　carries out different types of knowledge sharing activities for a long time.

2.2　Expectancy - confirmation theory

Expectation Confirmation Theory (ECT) is the basic Theory of studying consumer satisfaction proposed by Oliver[9]. Bhattacherjee,A[5] first introduced the expectation-confirmation theory into the information systems domain, suggesting that the information system user's continuous use decision is similar to the consumer's buyback decision, and is a continuation of the initial adoption decision, influenced by the initial use, and may lead to the termination of the initial adoption. As an information system that relies on user participation and interaction, the research on the continuous participation behavior of virtual community users should draw on the research results of the continuous use behavior of information system users. Further research believed that users' initial sharing behavior could help other members to achieve performance equal to or higher than expected (honor or excitement), which would result in confirmation or positive unconfirmed, and meanwhile increase users' satisfaction with knowledge sharing[10].This means that the ECT model has strong explanatory power for both first-time and reusage by users of the virtual community.

Although ECT theory is widely used to explain the willingness of information systems to persist after adoption, it does not explain the possibility that long-term persistent behavior may lead to irrational factors. Since there is no guarantee that every knowledge sharing can bring positive feedback to the knowledge provider, the ECT model of after-thought expectation and confirmation belongs to cognitive judgment, which does not go beyond the short-term perspective and has certain limitations.

Pleasant emotions have a stronger effect on the user's ongoing behavior than perceived usefulness [11].Further research refined the role of emotion into specific activities and pointed out that emotional experience value had a significant positive impact on the co-creation of participation value[12]. Thus, the continuous creative sharing behavior of users may be affected by emotional attachment. The influence of emotional attachment on the long-term behavior of virtual community should be stronger than the previous cognitive judgment. When emotional attachment to the virtual community is enhanced and negative cognitive judgments coexist, emotional attachment will dominate the user's behavioral tendency.

At present, there is no theoretical basis to directly prove that virtual community attachment leads to continuous willingness to share knowledge. Users' knowledge sharing behavior in the virtual community will generate immersive experience, and such experience dominated by psychological emotion will promote users' willingness to experience with high expectations again, so as to continue to repeat the knowledge sharing behavior[13]. However, immersion experience is essentially a short-term psychological feeling, and it does not penetrate into the long-term emotional factors that have a stronger impact on user behavior. The intrinsic motivation of users' long-term knowledge sharing behavior is irrational, which needs to be explained by emotional factors that are closer to the instinctive behavior and can explain the long-term interpersonal relationship dynamics.

2.3 Attachment theory

Based on the previous discussion, there is a lack of research on the willingness of continuous knowledge sharing in virtual communities from the perspective of long-term emotion. Therefore, this paper introduces the theory of attachment into the context of continuous knowledge sharing in virtual community.

Attachment theory is a psychological model that attempts to describe the dynamics of long-term and short-term human relationships, which is suitable for explaining long-term persistent behavior. The initial attachment of an individual is to one's parents, and at other moments in his life, the individual can also establish a lasting attachment to others outside the family[14].Further research transformed interpersonal attachment into personal and group attachment, believed that attachment was the core of various relationships in brand community[15].Knowledge sharing is a purposeful interaction between the sender of knowledge and the receiver of knowledge. In this interaction process, both users promote the development of the community, and the effect of the community on the relationship between users may also be strengthen through attachment. Attachment, one of two strategies used in connection research, can infer emotional connections in social networks.

In this paper, attachment is defined as a long-term and strong emotional connection that users show to a self-consistent virtual community. This positive emotional attitude can shorten the psychological distance between the community and customers and enhance the active degree of knowledge sharing in the community. Attachment can promote the long-term knowledge sharing behavior of users in the virtual community, and enable knowledge providers to continue knowledge sharing on the premise of ensuring positive confirmation of users, even if they have to pay more costs.

3. STUDY MODELS AND ASSUMPTIONS

The continuous knowledge sharing behavior of virtual community is similar to the buyback decision behavior of consumers. Therefore, this study still takes ECT theory as the basic theory of this study, introduces the latent variable of attachment on this basis, and studies the continuous knowledge sharing behavior of virtual community from the perspective of psychological emotion. The research model is shown in Figure 1.
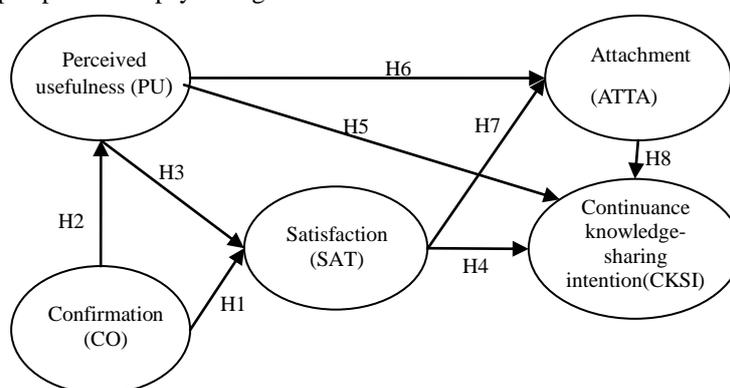
Figure 1.   Research model

Expectancy confirmation theory assumes that users' satisfaction is determined by their expectation of information system and expectation confirmation after actual use. Users determine their satisfaction based on the expected standard evaluation[9]. Accordingly, we divide the expectation of knowledge sharing into high expectation (the effect that knowledge sharing is expected to achieve) and low expectation (the impact that knowledge sharing is not expected to have). Before knowledge sharing, community members will have an expectation of its effect (ex ante expectation), and the ex post expectation generated after the user's first knowledge sharing behavior is compared with ex ante expectation. If the expectation afterwards meets the expectation beforehand, confirmation is generated. In user's knowledge sharing behavior, the user's ex-ante

expectations of the usefulness of knowledge sharing significantly affects users' post-acceptance affect (satisfaction)[16].

H1: The degree of confirmation of community members is positively correlated with their satisfaction with knowledge sharing.

H2: The degree of confirmation of community members is positively correlated with their perceived usefulness to knowledge sharing

H3: The perceived usefulness of community members is positively correlated with their satisfaction.

Perceived usefulness and satisfaction are both effective indicators of the user's continued willingness. Satisfaction includes the sense of experience in the process of user interaction in the virtual community and the value evaluation after knowledge sharing behavior[17].When users are satisfied with their past knowledge sharing experience in virtual communities, they are more likely to have the next knowledge sharing behavior. The higher the user's perception of the performance of using the platform in the virtual community, the more likely they are to have the willingness to contribute their knowledge to communicate with other users[18]. After users share knowledge in the virtual community, they gain practical expertise, which improves work efficiency and saves the cost of searching for knowledge. Also, their idea will be broadened and inspired, and their willingness to continue knowledge sharing will become stronger[19].

H4: Community members' satisfaction with knowledge sharing for the first time is positively correlated with their willingness to share knowledge continuously.

H5: The perceived usefulness of community members is positively correlated with their continuous knowledge sharing intention .

As a new IS system, users' attachment to virtual community IS influenced by subjective factors. Usefulness has a positive effect on organizational attachment in the context of Internet brand community[20]. Also, it has been found that satisfaction has a significant predictive effect on users' attachment to the virtual community through an empirical study on XiaoMi community[21]. For the virtual community, users will become attached to the organizational environment after they expect to obtain strong satisfaction based on information, benefits and satisfaction from knowledge sharing. Therefore, this paper proposes the following hypothesis:

H6: Perceived usefulness is positively correlated with attachment.

H7: Satisfaction is positively correlated with attachment.

As a long term emotion, attachment may affect human behavior. Further empirically study based on the model of continuous use of information system, believed that attachment has strong motivation and tendency, which can prompt users of virtual reading community to consume resources and generate behavioral reactions such as continuous use[22]. User's excellent experience of knowledge sharing in the virtual community will produce a pleasant feeling, and this psychological feeling will promote users' continuous knowledge sharing[23]. Therefore, this paper proposes the following hypothesis:

H8: Attachment is positively correlated with the intention of continuous knowledge sharing.

4. SCALE DESIGN AND DATA

4.1 Scale design

The research model of this paper includes 5 potential variables, each of which is composed of 3~4 measurement variables. In order to ensure the content validity of potential variables and measurement variables, all potential variables and measurement variables in the research model in this paper were adapted from the existing literature. Confirmation, satisfaction and willingness to continue knowledge sharing are all adapted from the study of Bhattacherjee,A [5] et al. Perceptual usefulness was adapted from the study of Davis.F.D[24]. Attachment is adapted from the study of Allen, N.J[25]. Measurement variables were measured using a 7-point

Likert scale, with 1 indicating strong disagreement and 7 indicating strong agreement. The scale of this study is shown in Table 1.

Table 1.   contents and sources of measurement variable

Noun	Main points (questions)	Source
Perceived usefulness	Sharing knowledge is good for me	Davis. F.D etc [24]
	When completing a specific task, using virtual community for knowledge sharing can improve work efficiency	
	Knowledge sharing makes it easier for me to get things done	
Confirma-tion	My knowledge sharing experience in the virtual community was better than I expected	Bhattacherjee,A etc.[5]
	My actual experience of sharing knowledge with other users in the virtual community was better than I expected	
	In general, most of my expectations for the virtual community were met.	
Satisfaction	I like to share knowledge with others in the virtual community	Bhattacherjee,A etc. [5]
	I am satisfied with the experience of sharing knowledge in virtual communities	
	My experience with knowledge sharing in virtual communities has been very rewarding	
Attachment	The virtual community I use is important to me	Allen, N.J, etc [25]
	I miss virtual communities when I haven't used them for a long time	
	I have an emotional attachment to the virtual community	
Continuance knowledge-sharing intention	If possible, I would like to continue to share knowledge in the virtual community in the future	Bhattacherjee,A etc.[5]
	I will continue to share knowledge with other virtual community users in the future	
	I am confident that I can reply to or add comments to messages or articles posted by other members of the virtual community	
	I will use this virtual community as often as I do now	

4.2 The data collection

Before the formal questionnaire was issued, this paper conducted a preliminary survey. Firstly, 25 college students with knowledge sharing experience were invited to participate in the pre-survey, and some statements of the questionnaire were adjusted according to their feedback. Subsequently, this study conducted a formal survey on users of virtual communities (ZhiHu, BaiDu TieBa, etc.) by means of online questionnaire survey. After eliminating invalid questionnaires (the filling time is less than 180 seconds), 209 samples were finally obtained. The statistical table of basic information of these samples is shown in Table 2.

Table 2.   basic information statistics of respondents

Category	Item	Frequency	Percentage（%）
Gender	male	98	46.89
	female	111	53.11
Age	<18	7	3.35
	18-25	103	49.28
	26-35	73	34.93
	More than 35	26	12.44
Record of formal	Junior high school or below	16	7.66
	High school	120	57.42
	Undergraduate course	58	27.75
	Bachelor degree or above	15	7.18

Category	Item	Frequency	Percentage（%）
Virtual community knowledge sharing experience	Less than 6 months	37	17.70
	Six months to a year	34	16.27
	1-3 years	89	42.58
	More than 3 years	49	23.44

5. DATA ANALYSIS AND RESULTS

5.1 Validation of measurement model.

The validity of measurement model is usually expressed in content validity, convergent validity and discriminant validity. In terms of content validity, all the potential variables and measurement variables (items) in this paper are adapted from the existing literature, so as to ensure that the measurement model has a good content validity. As shown in Table 3, average variance extracted (AVE) for each construct both exceed 0.50, indicating that the measurement model in this paper has ideal convergent validity[26]. The Reliability of the measurement model can be tested by Composite Reliability (CR) and Cronbach's alpha. All CR and AVE values are significant and meet the recommended thresholds(>0.7)[28]. Therefore, the measurement model in this paper has a good reliability.

Table 3.　AVE, Cronbach's alpha and CR values of the model were measured

	Item number	AVE	Cronbach's alpha	CR
ATTA	3	0.719	0.805	0.884
CKSI	3	0.648	0.818	0.880
CO	3	0.802	0.876	0.924
PU	3	0.814	0.885	0.929
SAT	4	0.674	0.759	0.861

Discriminant validity can be tested by comparing the square root of potential variable AVE with the correlation coefficient between potential variable. When the square root of potential variable AVE is larger than the correlation coefficient between potential variable AVE and other variables, it indicates that the measurement model has good discriminant validity[28]. Table 4 shows that the AVE square roots of potential variables in the measurement model are all larger than the correlation coefficients between this variable and other variables. The result suggest an adequate discriminant validity of the measures.

Table 4.　correlation coefficients between potential variables and AVE square root

|	ATTA	CO	CKSI	PU	SAT
ATTA	0.848				
CKSI	0.705	0.827			
CO	0.709	0.657	0.896		
PU	0.723	0.700	0.715	0.902	
SAT	0.791	0.689	0.731	0.733	0.820

Table 5 shows loading and cross-loading analysis. It can be seen that item loadings in the corresponding columns are all higher than the loadings of the items used to measure the other constructs. The same is true across the rows. Both results further verify that the measurement model has good convergent validity and discriminant validity.[28]

Table 5.   loadings and cross-loading

	ATTA	CO	CKSI	PU	SAT
ATTA1	0.885	0.697	0.683	0.668	0.751
ATTA2	0.863	0.574	0.590	0.671	0.656
ATTA3	0.792	0.513	0.502	0.478	0.591
CO1	0.659	0.906	0.619	0.680	0.685
CO2	0.630	0.915	0.619	0.636	0.667
CO3	0.613	0.864	0.523	0.601	0.607
CKSI1	0.595	0.506	0.848	0.558	0.569
CKSI2	0.547	0.562	0.764	0.568	0.619
CKSI3	0.614	0.583	0.852	0.627	0.573
CKSI4	0.506	0.453	0.749	0.488	0.443
PU1	0.669	0.652	0.615	0.912	0.663
PU2	0.677	0.691	0.679	0.914	0.677
PU3	0.606	0.587	0.596	0.879	0.643
SAT1	0.536	0.478	0.424	0.446	0.735
SAT2	0.670	0.648	0.578	0.661	0.852
SAT3	0.724	0.653	0.665	0.668	0.871

5.2 Research model results

Partial Least Squares (PLS) Structural Equation Model (SEM)[24] was used to verify the research Model. Its significance was tested by bootstrap repeated sampling method. The number of repeated samples was selected as 5000 in this paper, larger than the threshold value(500)[28]. The results of the research model are shown in Figure 2.
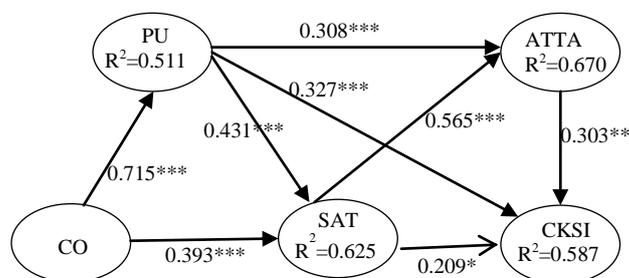
*** means p<0.001; ** means p<0.01; *means p<0.05

Figure 2.   Results of the research model

It can be seen that R (explained variance) of perceived usefulness, satisfaction, attachment and Continuance knowledge-sharing intention are 0.511, 0.625, 0.670 and 0.587, indicating that the research model has a good prediction effect [28].

Confirmation has a significant positive impact on users' perceived usefulness and satisfaction with knowledge sharing in virtual communities (0.715, 0.393), so hypothesis H1 and H2 are established. Perceived usefulness of users has a significant positive impact on user satisfaction and willingness to continue knowledge sharing (0.431, 0.327). Hypothesis H3 and H5 are established. Satisfaction also significantly positively affected the willingness to continue knowledge sharing (0.209), assuming that H4 was true. Perceived usefulness has a significant positive impact on attachment (0.308). Hypothesis H6 is valid. Satisfaction has a significant positive

impact on attachment (0.565), and hypothesis H7 is valid. In terms of the effect of emotional attachment, attachment significantly positively affects the willingness of users to continue knowledge sharing in the virtual community (0.303), assuming that H8 is valid.

5.3 Mediating effect test

To test the mediating effect of attachment, Baron and Kenny's[29]steps were used to test the mediating effect.

Step 1: Test whether the regression coefficient c of independent variable (IV) versus dependent variable (DV) is significant

Step 2: Whether the regression coefficient a of independent variable → mediating variable (M) is significant.

Step 3: Test the influence of independent variables and mediating variables on dependent variables, and the influence of both mediating variables and independent variables is significant, indicating the influence of part of mediating variables on dependent variables.

The mediating effect test results of emotional attachment are shown in Table 6.

Table 6. Mediating effect of attachment to virtual community

IV	M	DV	IV→DV	IV→M	IV+M→DV	
					IV	M
SAT	ATTA	CKSI	0.696***	0.791***	0.353***	0.426***
PU	ATTA	CKSI	0.701***	0.724***	0.396***	0.418***

*** means $p<0.001$; ** means $p<0.01$; * means $p<0.05$

The model analysis results of the above mediating variable M show that, on the one hand, satisfaction and perceived usefulness have a direct positive effect on the intention of continuous knowledge sharing, that is, the higher the degree of satisfaction of users with virtual community knowledge sharing and the degree of usefulness of users with knowledge sharing, the more willing the users are to continue knowledge sharing. On the other hand, satisfaction and perceived usefulness have an indirect positive effect on the willingness to continue knowledge sharing through the user's attachment on the community. In other words, the higher the user's satisfaction and usefulness degree of knowledge sharing in the virtual community is, the more likely they will become attached to the virtual community, and the attachment will affect the user's willingness to continue knowledge sharing.

6. DISCUSSION AND REVALATION

In this paper, the continuous knowledge sharing model of virtual community is constructed from the emotional perspective of psychology, and the latent variable of attachment is introduced on the basis of expectation confirmation model to discuss the continuity of knowledge sharing intention of users in virtual community from the long-term situation.

6.1 Satisfaction and positive confirmation work together on continuous knowledge sharing

Satisfaction and positive confirmation of knowledge sharing in virtual communities significantly affect user satisfaction ($t> 3.29$). The higher the user satisfaction is, the more consistent the ex-post feelings and ex-ante expectations of the knowledge sharing behavior of the virtual community are, and the higher the value brought by the behavior is. The value brought by users' effective knowledge sharing in virtual communities will help users increase the promotion of the virtual community among their friends. This trend can increase the users' attachment to the virtual community, and reduce the promotion cost of the virtual community as well.

6.2 The effect of attachment on the continuous intention of knowledge sharing of virtual community users in the long-term context

The research results show that attachment not only has a direct and significant positive impact on the long-term sustainable intention of knowledge sharing of virtual community users, but also mediates the relationship between satisfaction, perceived usefulness and sustainable intention of knowledge sharing.

On the one hand, attachment to the virtual community reflects the importance of the virtual community in the eyes of users. As shown in figure 2, the explanatory quantity of attachment to the intention of continuous knowledge sharing in virtual community is 0.303, second only to perceived usefulness, and its importance is higher than satisfaction, which is an important decisive factor of continuous knowledge sharing in virtual communities. For users who are accustomed to sharing knowledge in virtual communities, knowledge sharing behavior has become an essential part of their daily lives, and gradually developed into emotional attachment, and the willingness to pay extra for virtual communities such as personal time and energy resources, in the virtual community knowledge sharing activities. In this case, attachment to the virtual community represents the users' strong cognitive and emotional connection to the virtual community and can be one of the influencing factors in the long run.

On the other hand, the attachment part mediates the influence of perceived usefulness and satisfaction on the intention of continuous knowledge sharing. Specifically, perceived usefulness and satisfaction can change users' attitudes and emotions towards virtual communities (attachment to virtual communities), thus further affecting users' willingness to continue knowledge sharing. This indicates that perceived usefulness and satisfaction have a long-term slow effect on the intention of continuous knowledge sharing in virtual communities. Perceived usefulness is users' cognitive judgment of the virtual community, which will affect their attitudes towards the virtual community (such as satisfaction), and thus affect the tendency and behavior of knowledge sharing. At the same time, the continuous accumulation of perceived usefulness and satisfaction will gradually change users' feelings towards the virtual community and make them generate their attached to the virtual community. Users will regard the virtual community as a part of them and are willing to spend more time, energy, knowledge and other personal resources on knowledge sharing in the virtual community. Under the effect of this emotional mechanism, users' willingness to share knowledge in the virtual community is more permanent and stable. Users' attachment to the virtual community often means continuous participation and use, including voluntary contribution, blind exclusion and many other irrational factors. This emotional attachment transcends the rational judgment of the user. Although the user's long-term knowledge sharing behavior will inevitably produce some dissatisfied behavior perception, this dissatisfied perception will be partially diluted due to the role of attachment. Even if the long-term behavior will produce several unpleasant experiences, the user will continue to use this virtual community because of the user stickiness formed by the accumulation of previous satisfaction.

This indicates that the manager of virtual community needs to conduct fine management on users at present. For first-time users or potential users, the emphasis of management should be placed on guiding and encouraging users to share knowledge, and the satisfaction of users will be improved through a series of incentive mechanisms and personalized services. For loyal users, the key to reducing user loss should focus on deepening users' attachment to the virtual community through internal factors such as the atmosphere, culture and activities of the community, so as to enhance user stickiness.

6.3 Short-term and long-term factors affecting knowledge sharing

The research results show that among the influencing factors of continuous knowledge sharing behavior in virtual communities, the effect of perceived usefulness on the willingness of continuous knowledge sharing is greater than the effect of attachment on it. This is because perceived usefulness, which means whether the users

believe that the behavior is beneficial to themselves, plays a leading role in affecting the short-term effects of knowledge sharing. Attachment is a long-term influencing factor caused by the goodwill of a virtual community and may promote the creation of knowledge sharing behavior. Its effect will not be obvious because of the time span. From a product perspective, a virtual community is a service experience product. Users are no longer just receiving information. They also pay more attention to the experience of sharing behaviors. A long-term good experience will promote the provision and dissemination of knowledge and make the allocation of long-term knowledge resources more efficient.

7. CONCLUSION

This research combines expectation confirmation theory and attachment theory, and explores the common influence of cognitive and emotional factors on the willingness of virtual communities to continue knowledge sharing. The results show that perceived usefulness, satisfaction and attachment all significantly affect the willingness to continue knowledge sharing. The role of attachment mediating perceived usefulness and satisfaction on continuous knowledge sharing. This study theoretically combines the theory of attachment with the theory of expectation confirmation, expanding the scope of knowledge sharing research. The findings of this study can help virtual community developers recognize the direct and mediating effects of attachment and develop appropriate content, functions and services, and it has some practical significance.. In addition, the research in this paper has a certain time limitation, and the future research can add some new variables generated by the development of virtual community on the basis of this paper, so that the research can be meet the needs of the long-term construction of virtual community.

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