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Abstract

Purpose – The purpose of this paper is to explain how sociability and usability enhanced members' satisfaction, and how such satisfaction in turn, influenced their continuance intention of knowledge sharing in academic virtual communities (AVCs).

Design/methodology/approach – Drawing on social capital theory and technology acceptance model, this study proposed a theoretical socio-technical model, and the partial least squares method is used to examine the proposed model, based on data collected from 431 subjects in a well-known academic community in China (i.e. ScienceNet).

Findings – Both sociability and usability were important to improve members' satisfaction with knowledge sharing in AVCs. Specifically, social interaction ties, trust, reciprocity, shared vision, perceived ease of use and perceived usefulness are antecedents of members' satisfaction, which in turn positively affects their continuance intention of knowledge sharing in AVCs.

Practical implications – This study provided insights that can help AVCs' administrators develop effective strategies that could encourage continued knowledge sharing behavior through promoting members' satisfaction.

Originality/value – While the socio-technical framework has mainly been used to study initial adoption and participation of knowledge sharing. This study proposed a socio-technical model to move a step forward by explaining the exact roles of sociability and usability in terms of promoting members' satisfaction and identifying its critical effect on their continuance intention to share knowledge in AVCs, leading to a more comprehensive picture of members' satisfaction and continuance intention of knowledge sharing in AVCs.

Keywords Knowledge sharing, Satisfaction, Continuance intention, Academic virtual communities, Socio-technical perspective

Paper type Research paper

1. Introduction

The rapid development of both the internet and Science 2.0 has greatly facilitated the popularity of academic virtual communities (AVCs), such as Academia.edu, ResearchGate, Mendely, ScienceNet.cn and emuch.net, etc. These AVCs give each member a profile and provide unprecedented opportunities to connect to each other without physical constraints (Thelwall and Kousha, 2014; Sun *et al.*, 2014). As a kind of academic social platform, AVCs have millions of users and so it is possible that they are having an impact on patterns of informal scholarly communication, especially in terms of information seeking and

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knowledge sharing (Mangan, 2012). More and more scholars proactively take part in various AVCs that enable them to seek, collect, or even contribute expertise and knowledge to improve their capabilities, to disseminate their research interests, to absorb advanced insights, to create innovations and to resolve academic problems (Nistor *et al.*, 2014; Lin *et al.*, 2009; Chen, 2007).

Compared to traditional and formal academic communications, knowledge sharing in AVCs will not be limited by time and space (Lu and Yang, 2011; Chang and Chuang, 2011). Thus, knowledge sharing in AVCs has several advantages, such as open and free interaction, convenience and efficiency. However, some constraints in AVCs, including public goods characteristics of knowledge (Wasko and Teigland, 2004), weak ties and voluntary participation (Chiu *et al.*, 2011), may negatively affect members' experience and impede their continuance intention to share knowledge. Prior research has widely demonstrated that the sustainability of AVCs depends largely on whether members are willing to initially and continually share their knowledge (Jin *et al.*, 2013; Cheung *et al.*, 2013). The value derived from these AVCs can only be realized when there is ongoing knowledge sharing (Fang and Chiu, 2010), which often does not occur (Ma and Agarwal, 2007). Some AVCs attract a large number of members in the early stages, but suffer from huge turnover at a later stage (Chen, 2007). If there are few members who are willing to stay and contribute their knowledge continuously, this would reduce the quantity of knowledge shared by members and further accelerate the decline of AVCs (Phang *et al.*, 2009). Accordingly, it is important to understand how to sustain an AVC by improving members' satisfaction and motivating them to continue to share their knowledge.

With the aforementioned motives, this study aims to examine significant motivators of members' satisfaction and to identify its critical effect on continuance intention to share knowledge in AVCs. Previous studies have shown that virtual communities consist of social and technical system and that social and technological perception are crucial to members' continuous participation (Lu *et al.*, 2011; Chai and Kim, 2012) and knowledge sharing intention (Liao and Chou, 2012). Considering a socio-technical perspective provides a useful framework to investigate members' knowledge sharing behaviors in AVCs, we integrate social capital and technology acceptance model (TAM) to propose a socio-technical framework for gaining a more comprehensive picture of members' satisfaction and continuance intention of knowledge sharing in AVCs. We choose TAM model to integrate with social capital theory to investigate members' satisfaction and continuance intention of knowledge sharing motivated by the reasons. First, the fact that AVCs are usually considered as a type of socio-technical systems (Phang *et al.*, 2009) provides the base for combining them into a hybrid model with enhanced explanatory power by incorporating their different constructs. Second, TAM has been generally proven to be one of the most parsimonious, but valid and robust theoretical models and has been used extensively to explain user satisfaction and post-adoption behaviors (Bhattacherjee, 2001; Cheng, 2014). Third, the general applicability of TAM has been consistently validated in different time spans, application technologies and use contexts through the integration of various domain-specific constructs (Tsai *et al.*, 2014).

The remainder of this paper is organized as follows. First, we provide a brief literature review related to knowledge sharing in AVCs and a socio-technical perspective on knowledge sharing. Second, we theorize a socio-technical research model for members' satisfaction and continuance of knowledge sharing in AVCs. Next, we describe the research methodology used to empirically test the model, and present the results of data analysis. Finally, we summarize the findings and discuss the implications for both research and practice.

2. Theoretical background

2.1 Knowledge sharing in AVCs

AVCs, aiming to promote academic exchanges in the network environment, have increasingly become important platforms of information exchange and knowledge sharing among scientists, scholars, researchers, academics and professionals mainly coming from universities, research institutes and R&D departments of enterprises. An AVC without a supply of productive knowledge is unable to satisfy members and thus its growth is limited (Liao *et al.*, 2013). Knowledge sharing among members is especially critical to the survival and growth of AVCs (Xu and Ye, 2011). In this study, knowledge sharing refers to a process of communication between two or more participants involving the provision and acquisition of academic information, ideas, suggestions and expertise by posting questions, providing answers and debating issues based on shared interests (Cheung *et al.*, 2013). The activity of knowledge sharing in AVCs has the following typical characteristics: providing services for academic research, focussing on the expertise of academic areas, being more realistic identity of members, and being more rational and prudential behavior.

2.2 A socio-technical perspective on knowledge sharing

The term "socio-technical" was initially introduced by Trist (1963) to investigate the interrelationship between the social system and the technical system of an organization. While the social system takes into account the processes, tasks and technologies to produce designated output, the technical system focusses on the relationship among people and their attributes (Chai and Kim, 2012). The two systems need to work mutually to produce optimized outputs (Bostrom and Heinen, 1977). Thus, in a socio-technical AVC that provides interpersonal communications, knowledge sharing needs knowledge management technology to accomplish, simultaneously establishing the social relationship. That is, the socio-technical framework reveals that the success of knowledge sharing depends on both sociability and usability of AVCs (Lu *et al.*, 2011; Phang *et al.*, 2009; Liao and Chou, 2012). Employing a socio-technical approach, this study investigates how sociability and usability enhance members' satisfaction, and how such satisfaction in turn, influences their continuance intention of knowledge sharing in AVCs.

Sociability refers to the extent to which a virtual community system mediated by technology is perceived to facilitate social interaction and to enhance social connectivity (Shin, 2013). Specifically, members of AVCs further connect with one another by acquiring and contributing knowledge (Chai and Kim, 2012). These knowledge sharing behaviors will provide an insight into the nature of their interaction in AVCs. Essentially, knowledge sharing is social activities embedded in specific AVCs. The sociability of AVCs is established through knowledge sharing of purpose, it virtually develops community social capital and vice versa (Preece, 2003). Therefore it is reasonable to use social capital perception adequately to assess sociability (Liao and Chou, 2012). Social capital, consisting of structural capital, relational capital and cognitive capital, has been conceptualized as the sum of the assets or resources produced by social relationships as a result of social networking (Coleman, 1988; Nahapiet and Ghoshal, 1998).

Usability is an inclusive concept in terms of denotation and connotation (Tsai *et al.*, 2014). Usability has been defined as the "extent to which (a product) can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" (ISO 9241-11, 1998). In the context of virtual communities, usability can be referred to the extent to which a virtual community system can be

utilized with efficiency and effectiveness to perform intended activities (Shackel, 1991), such as knowledge sharing and information exchange. Usability capturing the ease of use and task facilitation effectiveness (Nambisan and Watt, 2011), facilitates members to share knowledge in an AVC system smoothly and effortlessly without any obstructions or annoyances that might distract them from their goals in the community (Phang *et al.*, 2009; Lu *et al.*, 2011). Previous studies have asserted that the usability of a virtual community can be conceptualized as its effectiveness and efficiency which are closely similar to usefulness and ease to use (Lu *et al.*, 2011; Liao and Chou, 2012). As such, the application of usability to AVCs primarily focusses on usefulness and ease of use, the two interrelated beliefs of TAM (Davis, 1989).

3. Research model and hypotheses

We integrated social capital theory and TAM model to propose a socio-technical model, which is illustrated in Figure 1. We hypothesized that sociability (social capital) and usability (perceptions of usefulness and ease-of-use) would positively enhance members' satisfaction, which further influenced their continuance intention of sharing knowledge in AVCs.

3.1 Satisfaction and continuance intention

Satisfaction defined as a sense of contentment that arises from an actual experience in relation to an expected experience (Hernon and Whitman, 2001), is an individual's emotional or psychological state following virtual community usage experiences (Bhattacherjee, 2001). Continuance intention refers to an individual's intention to continue participating in an activity after having previously adopted it (Park, 2014). The positive relationship between satisfaction and continuance intention has also been found to be significant in numerous empirical studies of virtual communities (Chen, 2007),

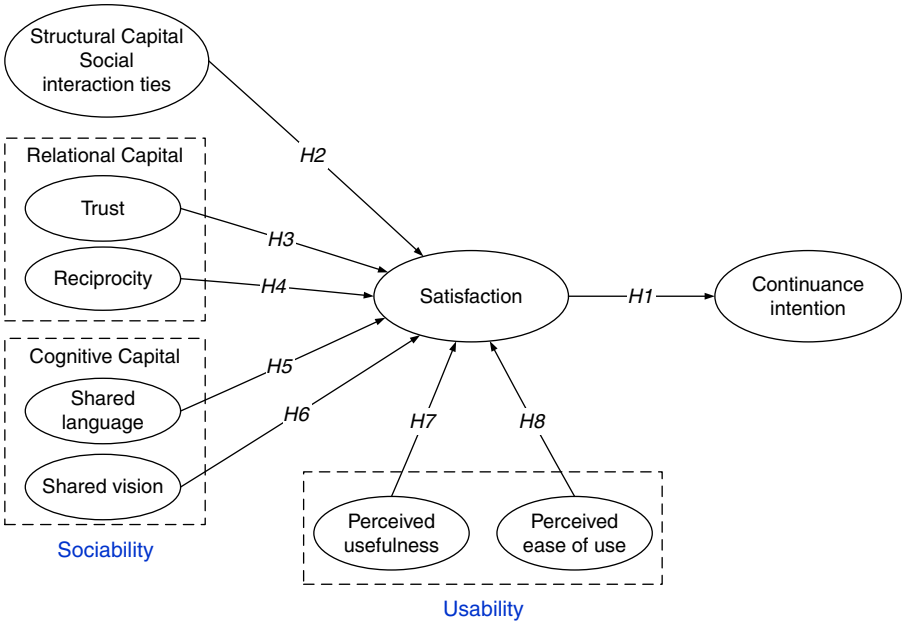


Figure 1.
Research model

social networks (Lin *et al.*, 2014) and knowledge sharing (Zheng *et al.*, 2013). In the context of AVCs, when members are satisfied with the shared knowledge, their intentions to continue sharing knowledge will be increased (Cheung *et al.*, 2013). Thus, this leads to the following hypothesis:

H1. Satisfaction has a positive impact on continuance intention to share knowledge in AVCs.

3.2 Social capital and satisfaction

3.2.1 Structural capital and satisfaction. Structural capital refers to the overall pattern of connections between actors in a social network, where interaction ties provide available resources and information channels that reduce the time and effort required (Nahapiet and Ghoshal, 1998). Social interaction ties among members of a virtual community have enhanced knowledge sharing behavior in providing a cost-effective way (Chiu *et al.*, 2006; Liao and Chou, 2012). The more social interaction ties have been built, the greater the intensity, frequency and breadth of the knowledge exchanged (Chang and Chuang, 2011). Furthermore, as part of the appraisal process, strong social interaction ties will likely help form positive emotional reactions toward knowledge sharing by increasing members' satisfaction and sense of belonging with AVCs (Lin *et al.*, 2014). This leads to the following hypothesis:

H2. Social interaction ties have a positive impact on their satisfaction with knowledge sharing in AVCs.

3.2.2 Relational capital and satisfaction. Relational capital is defined as the nature and quality of personal relationships that individuals develop with each other through repeated interactions. Key aspects of relational capital are trust and reciprocity (Nahapiet and Ghoshal, 1998). Trust reflects a willingness to be in vulnerability based on the positive expectation toward another party's future behavior (Mayer *et al.*, 1995). Mutual trust increases the desire to give and receive knowledge, resulting in improved performance of sharing knowledge in virtual communities (Chen and Hung, 2010). Previous studies have shown evidence that trust is an important determinant of knowledge sharing intention (Inkpen and Tsang, 2005; Liao and Chou, 2012). Higher level of trust leads to members sharing more knowledge with others, and which in turn more likely satisfy members' needs. These arguments lead to:

H3. Trust has a positive impact on members' satisfaction with knowledge sharing in AVCs.

According to social exchange theory, reciprocity refers to the expectation of participants that their contributions will lead to their future requests for resources being met (Blau, 1986). Reciprocity that represents a sense of mutual indebtedness (Liao *et al.*, 2013) facilitates members who believe in reciprocity to share knowledge (Chiu *et al.*, 2006). If the invested efforts in knowledge sharing behavior can be reciprocated, members are motivated to contribute more (Chang and Chuang, 2011). The more knowledge shared by members, they would perceive more satisfaction. This leads to the following hypothesis:

H4. Reciprocity has a positive impact on members' satisfaction with knowledge sharing in AVCs.

3.2.3 Cognitive capital and satisfaction. Cognitive capital is conceptualized as some resources forming possible shared interpretations and meanings within a collective

(Nahapiet and Ghoshal, 1998). It mainly involves shared language and vision. Shared language is a strong predictor of knowledge sharing because it assists members in understanding community goals and in improving community perception (Tsai and Ghoshal, 1998; Liao and Chou, 2012). Through mutual communication, shared language provides a frame of reference for interpreting knowledge shared by members. When members have shared language, they are less likely to misunderstand knowledge and other's intention, and more likely to feel satisfied with knowledge sharing in AVCs. This leads to the following hypothesis:

H5. Shared language has a positive impact on members' satisfaction with knowledge sharing in AVCs.

Shared vision implies a degree to which network members have mutual understandings of community goals and approaches to achieve those goals (Tsai and Ghoshal, 1998). Shared vision is conducive to generate a common ground for mutual understanding and information communication (Inkpen and Tsang, 2005). Members who share the vision within a virtual community hold a positive attitude toward knowledge exchange in their community, thus shared vision lays groundwork for knowledge sharing (Liao and Chou, 2012). Shared vision, including value, goal and interest, binds the members of a community together, makes cooperative action possible, and finally benefits knowledge sharing (Cohen and Prusak, 2001). Consequently, shared vision benefits members to understand the meaning of their knowledge sharing, further to bring satisfaction with knowledge sharing. This leads to the following hypothesis:

H6. Shared vision has a positive impact on members' satisfaction with knowledge sharing in AVCs.

3.3 Technological perception and satisfaction

In TAM model, perceived usefulness (PU) and perceived ease of use (PEU) have been defined as "the extent to which users believe that using a particular system will enhance their performance" (Davis, 1989) and "the extent to which an individual believes that using a particular system will be free of effort" (Davis, 1989), respectively. Previous researches have demonstrated that PU and PEU are strongly related to user satisfaction with web-based behaviors (Bhattacherjee, 2001; Park, 2014). In AVCs, a member's satisfaction may result from a cognitive evaluation process based on the knowledge sharing received against one or more comparison standards. As such, satisfaction can be understood as the knowledge sharing's perceived performance as it matches the expectations of the member (Lim *et al.*, 2013). Therefore, members who believe knowledge sharing is more useful and relatively easier to implement may appraise satisfaction with knowledge-sharing experience positively. Then, the following hypotheses are stated:

H7. PU has a positive impact on members' satisfaction with knowledge sharing in AVCs.

H8. PEU has a positive impact on members' satisfaction with knowledge sharing in AVCs.

4. Methodology

4.1 Instrument development

The items used for each investigated variable were primarily adopted from previous studies, while incorporating the necessary validation and wording changes. The items

for social interaction ties were adapted from Liao and Chou (2012) and Chang and Chuang (2011). Measures for trust were modified from Lu and Yang (2011) and Chang and Chuang (2011). Measures for reciprocity were modified from Chiu *et al.* (2006) and Wasko and Faraj (2005). Items measuring shared language were adapted from Chiu *et al.* (2006) and Chang and Chuang (2011). The construct shared vision was taken from Liao and Chou (2012). Items measuring PU and PEU were adapted from Davis (1989). Satisfaction and continuance intention were adapted from Bhattacherjee (2001). Each item was measured using seven-point Likert scales ranging from (1) "strongly disagree" to (7) "strongly agree." The survey questions are shown in the Appendix.

Before implementing the large-scale survey, the instruments were reviewed by five researchers in the field of information behavior to check problems with wording, format, content and question ambiguity. After the items were slightly modified based on feedback from these researchers, a small sample pilot test of the questionnaire was conducted before the formal questionnaires were distributed. Based on 43 questionnaires collected in the pilot test, some changes were made to the questionnaires. Following this, the formal questionnaire was administered.

4.2 Data collection

Our target population was members of the ScienceNet community (www.sciencenet.cn/), which is one of the most well-known AVC for providing scientific information services and for exchanging knowledge in China. Thus, it was appropriate to choose ScienceNet's members as our survey targets. The large-scale formal survey collected data for four months through an online survey web site which provides convenient functionality for designing questionnaires. After publishing the questionnaire online, we collected the information for 1,298 researchers from the columns of ScienceNet blog, including their contact e-mail address. We then sent individual invitation letters to these selected researchers to explain the purpose of our study and solicit their participation. The respondents were asked to click on the URL link provided in the e-mail message, which linked to our online survey. Finally, 431 valid responses were available, with a response rate of 33 percent. Table I documents the demographic information of the 431 respondents.

Category	Item	Frequency	%
Gender	Male	369	85.62
	Female	62	14.38
Position	Professor	142	32.94
	Associate Professor	190	44.08
	Assistant Professor	69	16.01
	PhD student	17	3.94
	Others	13	3.02
Age	< 29	24	5.57
	29-35	144	33.41
	36-45	178	41.30
	> 45	85	19.72
Research field	Natural sciences	342	79.35
	Social sciences	36	8.35
	Arts and humanities	11	2.55
	Inter-discipline sciences	42	9.75

Table I.
Respondent demographics

Several control variables that might influence individual behavior, such as gender, age, position and research field, were included in the analysis. To test for possible non-response bias, the *t*-test of the demographic characteristics of the participants who responded in the first two months did not significantly differ from those who responded in the last two months. On this basis, response bias was not considered to be a concern.

5. Data analysis

Partial least squares (PLS) method does not require the same distributional assumptions of normality for data and can handle small- to medium-sized samples (Chin *et al.*, 2003). Thus, PLS was chosen for the current study using the software application SmartPLS. It was used in a two-stage approach, measurement and structural model testing.

5.1 Measurement model

The measurement model can be assessed by examining the reliability, convergent validity and discriminant validity. Specifically, reliability which refers to the internal consistency of measurement, can be assessed by checking if the value of composite reliability (CR) is more than 0.7 and the average variance extracted (AVE) is greater than 0.5 (Fornell and Larcker, 1981; Hsu and Lin, 2008). As shown in Table II, the constructs' CR ranged from 0.823 to 0.958 and the constructs' AVE ranged from 0.539 to 0.884. These values are higher than the benchmarks of 0.70 and 0.50. This demonstrated good construct reliability.

Convergent validity indicates the extent to which the items of a scale that should be theoretically related to each other are actually related. It was examined by seeing if loading is significant and exceeds minimum recommended level 0.5 (Steenkamp and Van, 1991). In this study, all item loadings are larger than 0.6 and *t* values indicate that all loadings are significant at 0.001. Thus, the scale has a good convergent validity.

Discriminant validity measures whether the measurements reflect the construct in question or whether they reflect another related construct of the research. It can be assessed by checking if the square root of the AVE for each construct is greater than the correlations between that construct and all other constructs (Fornell and Larcker, 1981). Table III presents the correlation matrix of the constructs are blow the square root of AVE for each construct, demonstrating a satisfactory discriminant validity of the measurements.

Since our data were collected from a single source at the same virtual community, common method variance might be a concern (Podsakoff *et al.*, 2003). We used the method suggested by Liang *et al.* (2007) to examine this issue. The results showed that the trait factors (e.g. the proposed constructs) explained 77.1 percent of the variance, while the method factors explained only 1.50 percent of the variance, indicating that common method bias was not a threat to the present study. In addition, as shown in Table III, some variables were found to have relatively high correlation (e.g. reciprocity and shared vision: 0.717), easily leading to multicollinearity. According to multicollinearity test, every variance inflation factor value (ranged from 1.043 to 2.444) was less than ten, and tolerance value (ranged from 0.409 to 0.959) was higher than 0.1 (Mason and Perreault, 1991). This indicated that multicollinearity did not seem to pose a threat.

5.2 Structural model

Following Chin (1998), bootstrapping method was performed in SmartPLS software to test the statistical significance of path coefficients (β). As illustrated in Figure 2, the results showed that except for the relationship between shared language and satisfaction, all other proposed relationships were significant.

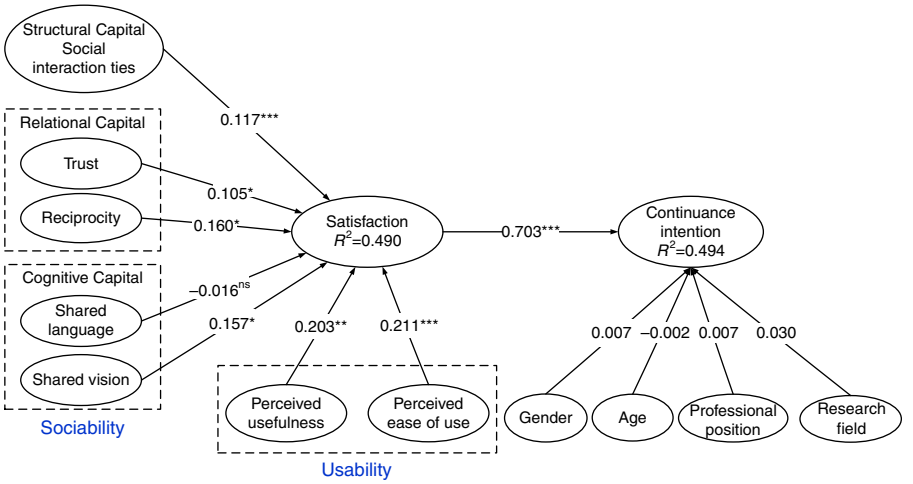
Constructs	Items	Factor loading	Mean	SD	CR	Cronbach's α	AVE
Social interaction ties (SIT)	SIT1	0.887	2.879	1.624	0.938	0.900	0.834
	SIT2	0.919	2.239	1.312			
	SIT3	0.934	2.357	1.380			
Trust (TRU)	TRU1	0.826	5.128	1.372	0.823	0.732	0.539
	TRU2	0.658	3.601	1.854			
	TRU3	0.678	3.794	1.671			
	TRU4	0.764	5.107	1.532			
Reciprocity (REC)	REC1	0.871	5.299	1.490	0.926	0.894	0.759
	REC2	0.893	5.090	1.451			
	REC3	0.863	5.515	1.411			
	REC4	0.857	5.367	1.439			
Shared language (SL)	SL1	0.865	5.044	1.285	0.927	0.882	0.809
	SL2	0.923	5.169	1.241			
	SL3	0.910	5.186	1.200			
Shared vision (SV)	SV1	0.907	5.162	1.418	0.934	0.895	0.826
	SV2	0.913	5.278	1.376			
	SV3	0.906	5.179	1.417			
Perceived usefulness (PU)	PU1	0.845	5.668	1.225	0.908	0.865	0.711
	PU2	0.862	4.817	1.396			
	PU3	0.849	4.729	1.480			
	PU4	0.816	5.557	1.274			
Perceived ease of use (PEU)	PEU1	0.853	5.420	1.288	0.937	0.910	0.788
	PEU2	0.922	5.255	1.274			
	PEU3	0.865	4.910	1.355			
	PEU4	0.909	5.035	1.330			
Satisfaction (SAT)	SAT1	0.925	4.838	1.333	0.958	0.935	0.884
	SAT2	0.953	5.016	1.286			
	SAT3	0.942	4.921	1.317			
Continuance intention (CI)	CI1	0.935	5.353	1.305	0.957	0.933	0.882
	CI2	0.941	5.626	1.258			
	CI3	0.943	5.575	1.292			

Table II.
Results of construct assessments

	SIT	TRU	REC	SL	SV	PU	PEU	SAT	CI
SIT	*0.913*								
TRU	0.276	*0.735*							
REC	0.200	0.552	*0.871*						
SL	0.192	0.494	0.697	*0.900*					
SV	0.183	0.477	0.717	0.696	*0.909*				
PU	0.223	0.463	0.682	0.595	0.642	*0.843*			
PEU	0.220	0.392	0.517	0.444	0.460	0.518	*0.888*		
SAT	0.296	0.470	0.591	0.494	0.560	0.588	0.531	*0.940*	
CI	0.235	0.445	0.625	0.574	0.566	0.665	0.479	0.703	*0.939*

Note: The numbers in italic in the diagonal lines represent the square root of AVE of corresponding constructs

Table III.
Correlations between constructs and square roots of AVEs



Notes: ns = not significant. *p<0.05; ***p<0.001

Figure 2.
PLS results

Specifically, members' continuance intention was positively affected by their satisfaction with knowledge sharing in AVCs ($\beta = 0.703$, $t = 21.785$), and 49.4 percent of its variance was explained by satisfaction. Thus, *H1* was supported. The four factors of social capital (social interaction ties, trust, reciprocity and shared vision) and technological perception (PEU and PU) jointly explained 49.0 percent of the variance of satisfaction. Specifically, social interaction ties had a significant positive effect on satisfaction ($\beta = 0.117$, $t = 3.310$), supporting *H2*. Two factors of relational social capital, trust ($\beta = 0.105$, $t = 1.963$) and reciprocity ($\beta = 0.105$, $t = 2.118$) were found to be significantly related to satisfaction, respectively, and thus *H3* and *H4* were supported. Contrary to our expectation, shared language does not have an impact on satisfaction, therefore *H5* was not supported. Shared vision was also found to positively affect satisfaction ($\beta = 0.157$, $t = 2.250$), lending support to *H6*. In addition, the results also showed that user satisfaction was significantly and positively affected by PU ($\beta = 0.203$, $t = 3.382$) and PEU ($\beta = 0.211$, $t = 4.281$), so *H7* and *H8* were supported. Table IV summarizes the results of path coefficient analysis.

Path (hypothesis)	β	t	p	Results
Satisfaction→continuance intention to share knowledge (*H1*)	0.703	21.785	***	Supported
Members' social interaction ties→satisfaction with knowledge sharing in AVCs (*H2*)	0.117	3.310	***	Supported
Trust→satisfaction with knowledge sharing in AVCs (*H3*)	0.105	1.963	*	Supported
Reciprocity→satisfaction with knowledge sharing in AVCs (*H4*)	0.105	2.118	*	Supported
Shared language→satisfaction with knowledge sharing in AVCs (*H5*)	−0.016	0.213		Not supported
Shared vision→satisfaction with knowledge sharing in AVCs (*H6*)	0.157	2.250	*	Supported
Perceived usefulness→satisfaction with knowledge sharing in AVCs (*H7*)	0.203	3.382	***	Supported
Perceived ease of use→satisfaction with knowledge sharing in AVCs (*H8*)	0.211	4.281	***	Supported

Notes: *$p < 0.05$; ***$p < 0.001$

Table IV.
Summary of hypothesis testing results

To test the interaction effects between the antecedents of satisfaction, a hierarchical analysis of the four models was conducted (see Table V). The regression analysis would help to assess the unique predictive power of additional test variables after controlling for others (Lim *et al.*, 2011). In model 1, shared language and shared vision were significant predictors of satisfaction. In model 2, the addition of two relational capital factors (reciprocity and trust) accounted for an additional 7.1 percent (from 0.334 to 0.405) of variance from model 1. As for shared language, it was no longer a significant predictor when the additional variables were incorporated into the model. Model 3 included social interaction ties. It yielded an R^2 variation of 0.021. Model 4 incorporated the additional variables of PU and PEU. The incorporation of these additional variables contributed an additional 6.2 percent increase in accounting for the variance of satisfaction from model 3. The variables in the final regression model accounted for 48.7 percent of variance in satisfaction.

6. Discussion and conclusion

6.1 Key findings

The primary insights from this research are as follows. First, satisfaction was found to be a strong predictor of the continuance intention to share knowledge in an AVC, coinciding with previous findings in the literature (Bhattacherjee, 2001; Jin *et al.*, 2013; Chiu *et al.*, 2011; Cheung *et al.*, 2013).

Second, the results render empirical support for social capital's capacity to improve members' satisfaction with knowledge sharing. Specifically, social interaction ties significantly affect members' satisfaction. Similar to previous studies, strong social interaction ties will likely help form positive emotional reactions toward knowledge sharing by increasing members' satisfaction (Lin *et al.*, 2014; Hsu and Hung, 2013). As hypothesized, trust and reciprocity are important antecedents of members' satisfaction (Sun *et al.*, 2012; Cheung *et al.*, 2013; Jin *et al.*, 2013). Regarding cognitive capital measured by shared vision and shared language, the results show that the former has a positive and significant influence on members' satisfaction and the latter has no significant impacts. This is partially consistent with the finding of Sun *et al.* (2012) that cognitive capital has positive and significant impacts on user satisfaction. One plausible explanation is that members tend to put more emphasis on the utilitarian value of disciplinary knowledge than on the expression of knowledge when evaluating their feeling of satisfaction.

	DV – user satisfaction			
IVs	Model 1	Model 2	Model 3	Model 4
Shared language	0.203**	0.038	0.032	−0.010
Shared vision	0.418**	0.248**	0.242**	0.160**
Reciprocity		0.312**	0.305**	0.167**
Trust		0.150**	0.117**	0.087*
Social interaction ties			0.152**	0.117**
Perceived usefulness				0.203**
Perceived ease of use				0.216**
R^2	0.334	0.404	0.425	0.487
Adjusted R^2	0.331	0.398	0.418	0.479
Change of R^2		0.070	0.021	0.062

Notes: *$p < 0.05$; **$p < 0.01$

Table V. Hierarchical regression analysis

Third, technological factors were found to be more dominating factors than social factors in improving members' satisfaction with knowledge sharing in AVCs. This finding is contrary to those found in prior knowledge sharing studies (Thomas *et al.*, 2001; Chai and Kim, 2012) which indicated technological factors were not significantly related to knowledge contribution in the cyber world. A possible explanation might be that technologies facilitating social interaction are more important than social factors regarding members' knowledge sharing in AVCs.

6.2 Theoretical implications

This study contributes to research in several ways.

First, this study focussed on the special type of professional virtual communities, namely, AVCs, which have seldom been investigated in prior research. An AVC is the result of concurrent configuration of social and technical aspects, which are vital to members' satisfaction and continuance intention of knowledge sharing. This study advanced the theoretical development in areas of knowledge sharing and user satisfaction by investigating a new research context (i.e. AVCs).

Second, previous studies have largely investigated knowledge-sharing adoption and initial behaviors, this study moved a step forward by identifying sociability and usability factors that influence members' satisfaction with knowledge sharing in AVCs after their initial knowledge sharing. And it offers a new theoretical understanding by reconceptualizing knowledge sharing from a socio-technical perspective. It advanced the scholarly understanding of social capital and technological perception as key antecedents to members' satisfaction with knowledge sharing. In addition, members' satisfaction was found to exert a strong influence on their intention to continue share knowledge in AVCs. This study provided additional support for Bhattacherjee's contention that users' satisfaction with the IS determines continuous intentions (Bhattacherjee, 2001).

Third, the sociability is established through knowledge sharing of purpose, and it virtually develops community social capital (Preece, 2003). It is deeply rooted in the ongoing knowledge sharing relationships among members and stimulates them to appraise satisfaction with knowledge sharing. Meanwhile, the usability reflects the capability of an AVC to be used easily and effectively by members to achieve their knowledge sharing. Prior research have shown that sociability was often considered as the opposite factor of usability (Shin, 2013). However, this study indicated that the sociability and the usability represented two fundamental dimensions of AVCs (Phang *et al.*, 2009) and were important to enhance members' satisfaction with knowledge sharing in AVCs. Thus, this study added new knowledge of various effects of sociability and usability on members' satisfaction with knowledge sharing in AVCs.

6.3 Practical implications

This study makes several important contributions to practice. Given the significant effects of satisfaction on continuance intention, administrators of AVCs can encourage continued knowledge sharing behavior through promoting members' satisfaction.

First, this study raised some issues of balancing both social and technological factors in the AVCs to promote members' satisfaction with knowledge sharing. Although this study empirically proved that technological factors are the more

dominating factors than social factors, it does not mean that administrators and designers can ignore social factors, they instead need employ socio-technical solutions to improve members' satisfaction with knowledge sharing.

Second, apart from shared language, other social capital factors, including social interaction ties, trust, reciprocity and shared vision, were significant predictors of member satisfaction. Administrators should develop strategies that encourage members' interaction and enhance members' social capital of AVCs to make weak ties in AVCs share knowledge more frequently and make sharing relationships less likely to break up. To produce and maintain the public good of knowledge that is stored and is available to anyone in the community (Lu and Yang, 2011), administrators may encourage members to share research results and academic publications, and further to participate in some research forum or interest group so as to create an academic social network which has the shared vision of discovery, communication and collaboration. Moreover, administrators of AVCs could also encourage reciprocity by using extrinsic motivators such as rewards for sharing knowledge. Like other types of virtual communities, Chinese AVCs would provide a mechanism that knowledge receivers can donate value-added points to knowledge contributors as a return of favors.

Third, technological perception factors appear to be more important in leading to higher levels of satisfaction. Hence, focus needs to be placed on improving the practical value and ease of operation of AVCs. Specifically, well designed interfaces and high quality knowledge can increase perceptions of ease-of-use and usefulness to facilitate knowledge sharing. For example, Chinese AVCs may consider providing a rating system where members can review and rate other's knowledge and developing a semantic search engine used to search resources within the community and external free database, such as PubMed, CiteSeer, arXiv, etc. to help members find more research resources. Furthermore, collecting some insights (e.g. the demand, habit or experience) from members provides administrators with information that will help to understand members' technological perceptions.

6.4 Limitations and future research

There are some limitations, which call for additional research. First, we have selected only one particular virtual community in China (i.e. ScienceNet) as our research community. The research results were probably influenced to some extent by the community characteristics and the culture of China. Future research will investigate different AVCs in several countries and further compare the research results to enhance the generalizability of our research findings.

Second, although TAM has been widely used in explaining behavioral intentions and satisfaction with an IS system or services, it ignores the impact of other belief-related variables (e.g. technology readiness). To overcome this limitation, future research will adopt other models, such as TRAM (Lin *et al.*, 2007), and involve additional variables suitable for the context of AVCs, thus leading to greater predictive power. Additional research is also needed to increase the dimension of usability to fully reveal its connotation.

Third, this study did not consider the effects of mediating or moderating variables on the relationship between independent and dependent variables. Future studies may address variables such as knowledge self-efficacy (mediating) or knowledge quality (moderating) in addition to the current model.

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Appendix

Construct	Items	Source
SIT	I maintain close social relationships with some members of ScienceNet I spend a lot of time interacting with some members of ScienceNet I have frequent communication with some members in ScienceNet	Liao and Chou (2012), Chang and Chuang (2011)
TRU	The members of ScienceNet are trustworthy I believe that the members of ScienceNet do not use unauthorized knowledge I believe that the members of ScienceNet use other's knowledge appropriately The members of ScienceNet are honest in dealing with one another	Lu and Yang (2011), Chang and Chuang (2011)
REC	I know that other members in ScienceNet will help me, so it's only fair to help other members I believe that members in ScienceNet would help me if I needed it When I share my knowledge through ScienceNet, I believe that my queries for knowledge will be answered in future When I share information through ScienceNet, I believe that my questions will be answered in the future	Chiu, *et al.* (2006), Wasko and Faraj (2005)
SL	Members in ScienceNet use common terms or jargons Members in ScienceNet use an understandable communication pattern during discussions Members in ScienceNet use understandable narrative forms to post messages or articles	Chiu *et al.* (2006), Chang and Chuang (2011)
SV	Members in ScienceNet share the vision of helping others solve their problems Members in ScienceNet share the same goal of learning from each other Members in ScienceNet share the same value that helping others is pleasant	Liao and Chou (2012)
PU	Topics in ScienceNet are useful to me Sharing knowledge in ScienceNet would enable me to accomplish tasks more quickly Sharing knowledge in ScienceNet would improve my work performance I would find that sharing knowledge in ScienceNet is useful for my work	Davis (1989)
PEU	I would find it easy to use ScienceNet to share knowledge I expect that learning how to use ScienceNet to share knowledge would be easy for me In the process of knowledge sharing, my interaction with ScienceNet would be clear and understandable I expect that it would be easy for me to become skillful at using ScienceNet to share knowledge	Davis (1989)

(*continued*)

Table AI.
Constructs and items

Construct	Items	Source
SAT	I feel very displeased/extremely pleased with my previous experience of sharing knowledge in ScienceNet	Bhattacherjee (2001)
	I feel very frustrated/extremely contented with my previous experience of sharing knowledge in ScienceNet	
	I feel very terrible /absolutely delighted with my previous experience of sharing knowledge in ScienceNet	
CI	I intend to continue sharing knowledge in ScienceNet in the future	Bhattacherjee (2001)
	I expect knowledge sharing in ScienceNet to continue in the future	
	I plan to share knowledge in ScienceNet in the future	

Table AI.

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