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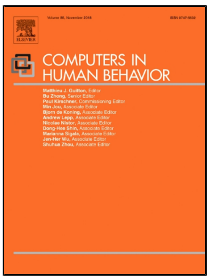

Characterizing the relationship between conscientiousness and knowledge sharing behavior in virtual teams: an interactionist approach

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PII:	S0747-5632(18)30476-X
DOI:	10.1016/j.chb.2018.09.035
Reference:	CHB 5726
To appear in:	*Computers in Human Behavior*
Received Date:	19 July 2018
Accepted Date:	24 September 2018

Please cite this article as: Qi Hao, Weiguo Yang, Yijun Shi, Characterizing the relationship between conscientiousness and knowledge sharing behavior in virtual teams: an interactionist approach, *Computers in Human Behavior* (2018), doi: 10.1016/j.chb.2018.09.035

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Abstract: Extensive previous work has studied individuals' knowledge sharing behavior (KSB) in a virtual environment, revealing several key factors. However, prior work focused solely on simple correlations between these factors and KSB. And relatively little attention has been assigned to the complex relationships between them. This study argued that better understanding of the complex relationships may be more important because the nature and wide scope of the determinants of KSB may yield different interaction effects. Thus, to better understand the interaction effects of contextual factors and personal factors on KSB, this study adopted a person-situation interactionist approach which proposes that conscientiousness (C), job demands of skill variety (JDSV), and knowledge sharing self-efficacy (KSSE) have joint effects on virtual team (VT) members' KSB. We empirically validated the main effects and the two-way and three-way interaction effects using data collected from 219 VT members from an information technology company. Our results showed that (1) C, JDSV, and KSSE are all positively related to KSB; (2) KSSE positively moderates the relationship between C and KSB; and (3) JDSV and KSSE jointly moderate the relationship between C and KSB. This study offers a new research perspective on knowledge sharing and integrates personality traits theories, Job Characteristics Model, Job Demands-Resources Model, and social cognitive theory into a single research model to examine the underlying mechanisms and boundary conditions of KSB in a virtual environment. The results of the study might direct VT mangers how to recruit members and when to redesign members' job and foster their KSSE.

Keywords: Knowledge sharing, virtual team, conscientiousness, job demand, skill variety, self-efficacy.

1. Introduction

In the current knowledge economy era, knowledge is considered a valuable but intangible asset for the survival, prosperity, and success of an organization (Pangil & Chan, 2014). Thus, it is essential that organizational knowledge is diligently managed. A common method for managing knowledge within an organization is the encouragement of knowledge sharing among employees. Knowledge sharing refers to an individual converting his or her own knowledge into a form that can be readily understood, absorbed, and employed by others (Ipe, 2003). Knowledge sharing behavior (KSB) allows organizations leverage and capitalize on knowledge-based resources, build on prior experience. In addition, it also enables organizations to make rapid reaction to problems encountered previously, generate creative ideas and insights, and avoid repeating prior mistakes. These, in turn, cut costs, promote innovation, and improve performance (Marouf & Alrikabi, 2015; Pee & Lee, 2015; Wang & Noe, 2010). Hence, some scholars claim that KSB "is an important part of building knowledge-based competitive advantage" in today's dynamic business environment (Foss, Minbaeva, Pedersen, & Reinholt, 2009, p.872).

With rapid advancements in online interactive technology and the proliferation of online communication tools, many organizations have shifted to online knowledge sharing (OKS). This is because OKS enables employees to efficiently and widely exchange ideas and views throughout an organization, thereby enhancing the benefits of knowledge sharing (Pee & Lee, 2015; Pi, Chou, & Liao, 2013). This phenomenon, coupled with the rapid expansion of organizational scales, has led to the emergence of new organizational forms of knowledge sharing (Ardichvili, 2008). One new form that has rapidly gained popularity is the virtual team (VT; Cohen, & Bailey, 1997). The VT has revolutionized the way employees work (Powell, Piccoli, & Ives, 2004): not only does VT

enable communication without the limitations of time and location, but it also equips companies with greater flexibility and responsiveness (Pangil & Chan, 2014; Powell et al., 2004). However, despite these advantages and its increasing popularity, successfully encouraging employees to spontaneously share their knowledge via VTs remains a challenge (Fang & Chiu, 2010).

Previous studies indicate that people resist sharing their exclusive knowledge "even when an organization makes a concerted effort to facilitate knowledge exchange" (Ardichvili, 2008, p.543). In fact, people do not exhibit KSB under all circumstances, and when they do, they may not "share as much [knowledge] as their organizations would like them to" (Yu, Lu, & Liu, 2010, p.32). Many researchers so far have argued that a VT's effectiveness and success depend, to a great extent, on the frequency and intensity of its members' participation in KSB (Ardichvili, 2008; Fang & Chiu, 2010; Hsu et al., 2007; Lin et al., 2009; Pangil & Chan, 2014). Thus, better understanding the factors that lead to effective and successful knowledge sharing in VTs becomes a crucial task for knowledge management theoreticians and practitioners alike.

Extensive study has been dedicated to KSB in the context of virtual environments (e.g., VTs, virtual communities) which has revealed several key factors (Zhang, Fang, Wei, & Chen, 2010). A comprehensive review conducted by Ardichvili (2008) described the motivating factors, barriers, and enablers of KSB in a virtual environment. Others then divided these factors into two categories: contextual factors and personal factors (Lin, Hung, & Chen, 2009). Despite these efforts, a meticulous review of the literature uncovers that a key approach, the person-situation interactionist perspective (George & Zhou, 2001), has been neglected. Rather, prior research has focused solely on simple correlations between these factors and KSB. For example, Pei-Lee, Chen, Chin, and Siew (2011) studied how big five personality, subjective norm, and intention to share knowledge affect

individuals' KSB. They focused on the simple relationship between these factors and KSB, but neglected the complex relationships such as interaction effects between them. The same problem is presented in Ho, Kuo, and Lin's study (2012). They investigated the simple relationships between factors such as social identification, trust, and KM system quality and KS. However, they did not consider the interaction effects between these factors either. We argue that this approach may be inadequate due to the nature and wide scope of the determinants of KSB. These factors may interact in various ways with each other, yielding more complex effects than those described using the above approach. To address this shortcoming, the current study investigates the joint effects of personality, job design, and self-efficacy on KSB in VTs. Specifically, we selected the following three constructs as research variables: conscientiousness (C; independent variable), job demands of skill variety (JDSV; moderator), and knowledge sharing self-efficacy (KSSE; moderator).

The current study uses C as independent variable for several reasons. First, based on previous reports, the relationship between C and KSB is unclear: some authors identifying a strongly positive relationship (e.g., Gupta, 2008), others a slightly positive relationship (Anwar, 2017), and still others a null relationship (e.g., Marouf & Alrikabi, 2015; Pei-Lee et al., 2011). This suggests that further examination of moderating variables is necessary. Second, among the Big Five Personality traits (BFP) which include neuroticism, extraversion, openness to experience, agreeableness, and C, C is considered the most salient predictor of job performance (Barrick & Mount, 1991). This suggests that C may be the most important personality trait in the workplace. Third, a previous study stated that C is "most relevant to person-situation interaction theory" in a work context (Shaffer & Postlethwaite, 2013, p.184).

JDSV, derived from the Job Characteristics Model (JCM; Hackman & Oldham, 1976), refers

to "the extent to which an employee can use different skills in carrying out the work" (Chen & Chiu, 2009). The rationale for the selecting JDSV as a contextual moderator is two-fold. First, although job characteristics (e.g., skill variety, job autonomy, task feedback) are valid predictors of job performance, job attitudes, and absenteeism (e.g., Abbott, Boyd, & Miles, 2006; Chen & Chiu, 2009; Hackman & Oldham, 1976), empirical studies on the relationship between them and KSB are scarce. In addition, people with higher C are described as thorough, dependable, efficient, achievement-oriented, and hardworking (Barrick & Mount, 1991), suggesting that JDSV and C may have significant joint effects on KSB.

Self-efficacy is defined as "a form of self-evaluation that influences decisions about what behaviors to undertake" (Hsu, Ju, Yen, & Chang, 2007, p.155). KSSE is the combination of the concepts of self-efficacy and KSB, and refers to an individual's confidence and ability to initiate KSB (Lin et al, 2009). The current study assigns KSSE as a personal moderator for three reasons. First, as previously described by others, lack of confidence and ability are the primary barriers for KSB (Ardichvili, Page, & Wentling, 2003), indicating a need for more research on KSSE and KSB. Second, according to social cognitive theory (SCT; Bandura, 1977), self-efficacy is considered a basic determinant of an individual's response in a social environment. This finding piqued our interest in the interactions between KSSE and factors related to work environment, such as JDSV. Furthermore, the responsible, careful, and conservative nature associated with C may affect an individual's confidence in the context of sharing knowledge (Barrick & Mount, 1991). This suggests that further studies on the joint effects of C and KSSE on KSB are necessary.

By adopting a person-situation interactionist perspective, the present study examines the conditions under which C leads to KSB in the context of VT. In the next section, we will briefly

review relevant constructs and theories. Then, we will describe our hypotheses. Next, we will describe our research design and methodology including the sample, measurement, and data collection process. We will test our hypotheses using our data sample and describe our results. Finally, we will conclude by discussing the major findings, as well as their theoretical and practical implications and limitations, and suggested directions for further study.

2. Theory and hypotheses

2.1. KSB in VT

In this age of increasing globalization and internationalization, organizations strive to minimize the cost of bringing employees together in a single location (Pangil & Chan, 2014). Hence, supported by advances in information technology, the VT structure has been introduced to solve this problem. VT refers to a group of individuals who "are geographically dispersed, have limited face-to-face contact, and work interdependently" through electronic mediums to achieve a shared objective (Dulebohn, & Hoch, 2017, p.569). VTs connect knowledge workers together without limitations of time and location to combine expertise of individuals, gain a competitive advantage, and realize common goals. This enables organizations to allocate unevenly distributed knowledge resources. The benefits of using VTs include: (1) the ability to hire experts who are geographically dispersed, (2) increasing the global workday to 24 hours, (3) reducing travel, relocation, and overhead costs, and (4) enabling knowledge sharing across organizational and geographical boundaries (Dulebohn & Hoch, 2017; Pangil & Chan, 2014). Due to its great promise, VT has experienced explosive growth over the past few decades. Recent statistics reported that 85% of 1372 respondents from 80 countries stated that VT is critical to their job (RW3 CultureWizard, 2016). However, the availability of VTs does not guarantee that their members will share their knowledge

efficiently. As a result, nearly 50% of VTs fall short of either their strategic or operational goals (Zakaria, Amelinckx, & Wilemon, 2004). This suggests that knowledge sharing is crucial for the effectiveness of VTs. Not only can KSB facilitate the use of existing knowledge resources, but it can also enhance the performance of VTs by generating new knowledge during the sharing process (Pangil & Chan, 2014). Identifying the facilitators and barriers for KSB in VTs is therefore an urgent task.

A common opinion among researchers is that achieving effective knowledge sharing in a virtual environment is more difficult than in a traditional context (e.g., Ardichvili et al., 2003; Pangil & Chan, 2014). The rationale for this argument is threefold. First, in a virtual environment, there is potentially less engagement in face-to-face communication. This may make it more difficult to establish personality-based trust among members, which hinders KSB because people tend to share knowledge with others who can be naturally trusted (Pangil & Chan, 2014). Second, online KSB is largely considered "an extra-role, pro-social, organizational citizenship behavior (OCB) rather than an obligatory job responsibility" (Pee & Lee, 2015, p.680). This perspective, coupled with complicated and unreliable technology, means that spontaneously participating in KSB in a virtual environment is potentially more time- and energy-consuming. Third, lack of knowledge sharing confidence and ability is recognized as an important barrier of KSB (Ardichvili et al., 2003). In a virtual environment, information flows quickly and extensively. This may increase one's anxiety regarding losing face, letting colleagues down, or misleading others. Here, we attempted to promote KSB in a virtual environment by addressing the latter two barriers. To accomplish this, we introduced JDSV and KSSE, and examined their joint effect with C on KSB.

2.2. C and KSB

The field of psychology has long been aware of the strong influence that personality exerts on individual behavior in the workplace. Previous work primarily relied on the BFP traits, which explain the majority of meaningful variance in personality among adults, to examine the relationship between personality and behavior (e.g., Marouf & Alrikabi, 2015; Zhou, 2015). Thus, a number of encouraging findings have been published concerning the relationship between BFP and KSB in the context of either traditional or virtual environments (e.g., Gupta, 2008; Marouf & Alrikabi, 2015; Pei-Lee et al, 2011). It is noteworthy that almost all of these studies, so far, have assumed a positive relationship between C and KSB (e.g., Anwar, 2017; Gupta, 2008; Matzler, Renzl, Müller, Herting, & Mooradian, 2008), albeit several groups have reported unexpected findings (e.g., Pei-Lee et al., 2011). These positive hypotheses were based on the following premises: (1) conscientious people tend to be willing to cooperate with others (Pei-Lee et al., 2011); (2) KSB is a form of OCB, and C is positively related to OCB (Matzler et al., 2008); (3) people with higher C feel self-esteem in KSB (Anwar, 2017); and (4) conscientious people are likely to be trusted naturally by their colleagues (Gupta, 2008). Thus, we hypothesize:

H1. C is positively related to KSB.

2.3. JDSV and KSB

It is not a new idea that JCM (Hackman & Oldham, 1976) can impact employees' KSB (Foss et al., 2009). The Job Demands-Resources Model (JD-R; Bakker, Demerouti, & Schaufeli, 2003) has been the dominant approach for explaining the relationship between JCM and KSB. According to the JD-R model, job characteristics can be categorized into two types: job demands and job resources (Pee & Lee, 2015). Job demands refer to "physical, psychological, social, or organizational aspects of job that require sustained physical and/or psychological effort or skills"

(Bakker & Demerouti, 2007). Chronically high levels of job demands drain one's mental and physical resources, thereby leading to the depletion of vigor and even to health problems (Bakker & Demerouti, 2007). Since skill variety reflects a core aspect of job demands, a job requiring various skills calls for more mental effort, becomes more taxing, and in turn increases job stress. A high degree of mental strain tends to decrease employees' emotional attachment to the organization, which may impede KSB (Pee & Lee, 2015). However, job demands are not necessarily adverse. For example, Chen and Chiu (2009) found that task identity was positively related to job involvement, which positively affected OCB, resulting in behaviors such as KSB. Regarding JDSV, several studies suggested that low JDSV tends to make employees feel bored and depressed (Fullagar & Kelloway, 2009; Wiesner, Windle, & Freeman, 2005). Thus, heightening JDSV through management practices such as job rotation is considered an efficient method to enhance employees' affective commitment, which in turn prompts KSB (Humphrey, Nahrgang, & Morgeson, 2007; Pee & Lee, 2015).

These contrasting arguments regarding the impact of JDSV reveal that the relationship between JDSV and KSB remains unclear. We here tend to agree with the former view that high degree of JDSV impede KSB. A successful KSB in VTs requires extra time and energy to deal with the potential challenges caused by the virtual environment including difficulties in establishing trust, complicated and unreliable technology, and the lengthy process of letting others understand exactly (Ardichvili et al., 2003; Dulebohn, & Hoch, 2017). As mentioned previously, perceived time and energy consumption is a potential barrier of for KSB (Ardichvili et al., 2003). Thus, when faced with a job that demands various skills, people tend to focus on enhancing their job skills, thereby having no spare time to perform extra-role behaviors such as KSB. Based on this premise, we

propose the following hypothesis:

H2. JDSV is negatively related to KSB.

2.4. KSSE and KSB

Scholars contended that in the virtual environment, the desire to contribute knowledge is not sufficient to successfully carry it out (Hsu et al., 2007). This is because one of the important barriers for KSB is that "[people] are not always clear on what information should be posted" (Ardichvili et al., 2003, p.70). Hsu et al. (2007) referred to this barrier as a self-efficacy deficit, and argued that if someone doubts his/her capability to execute a behavior successfully, the expectations of positive outcome of this behavior is likely to be fruitless. Wasko and Faraj (2005) support this argument, affirming that people are unlikely to share their knowledge when they feel their abilities and expertise to be inadequate. They further pointed out that individuals' confidence, skills, and abilities may increase their likelihood to share knowledge with others. In addition, others have reported a positive relationship between KSSE and KSB from another angle (e.g., Bock, & Kim, 2002; Kankanhalli, Tan, & Wei, 2005; Lin et al., 2009). They argued that when people share knowledge useful to others, they gain knowledge sharing confidence which in turn increase their KSSE (Constant, Kiesler, & Sproull, 1994). This perception of KSSE enhancing can act as an incentive force for knowledge contributors to share their expertise within organizations (Kankanhalli et al., 2005). Based on this premise, we propose the following hypothesis:

H3. KSSE is positively related to KSB.

2.5. Two-way interaction effect hypothesis

Although the present study suggests a positive relationship between C and KSB, this relationship seems to be contingent on other contextual or personal factors. We regard JDSV as a

valid contextual moderator that may influence the relationship between C and KSB. KSB requires the explication and codification of knowledge (Kankanhalli et al., 2005). In VTs, successful KSB requires the participant to overcome several challenges including technical complexities, language problems, cultural differences (Dulebohn, & Hoch, 2017). Each of these challenges represents an expense of time and energy. Others have noted that individuals are unlikely to share their knowledge because the sharing process usually "[requires] them to incur non-chargeable hours or give up their personal time" (Kankanhalli et al., 2005, p.120). Highly conscientious people, because of their responsible, organized, and cooperative nature, may be willing to participate in knowledge sharing even though it may take up their own personal time. However, this willingness is on the condition that they have the extra time and energy. When encountering a job with high level of JDSV, highly conscientious people tend to have no spare time or energy to proactively share their expertise. Because of their hardworking and achievement-oriented nature, they instead concentrate on enhancing their job skills to meet job requirements and accomplish tasks. Thus, the following hypothesis is proposed:

H4. JDSV negatively moderates the positive relationship between C and KSB, such that the positive relationship is weaker when JDSV is high than when it is low.

Here, we propose that KSSE is a personal moderator which influences the positive relationship between C and KSB. Highly conscientious people generally show dutiful deference to organizational benefits and team norms (Matzler et al., 2008). If, in addition, they possess a high level of KSSE, they may believe that efficient KSB can help the recipients solve work-related problems, thereby enhancing overall team and organizational performance. Thus, KSSE may amplify the positive influence of C on KSB. Conversely, in the case of low KSSE, potential

knowledge contributors may be fear that what they shared may not deserve to be posted, or may not be absolutely correct, or may not be quite relevant (Ardichvili et al., 2003). These suspicions and uncertainties may enhance highly conscientious individuals' negative traits such as high self-esteem and being risk-averse, which in turn would reduce their engagement in KSB. Based on this premise, we hypothesize:

H5. KSSE positively moderates the positive relationship between C and KSB, such that the positive relationship is stronger when KSSE is high than when it is low.

2.6. Three-way interaction effect hypothesis

We further propose a three-way interaction of C, JDSV, and KSSE on KSB. That is, we believe that JDSV and KSSE jointly moderate the relationship between C and KSB. This assumption is theoretically grounded on the aforementioned literature on personality traits theory (Barrick & Mount, 1991), JCM (Hackman & Oldham, 1976), JD-R model (Bakker et al., 2003), and SCT (Bandura, 1977).

We predict distinct reactions from highly conscientious employees when JDSV is high. As JD-R model (Bakker et al., 2003) suggests, high levels of JDSV indicate that individuals need to invest a great deal of physiological and/or psychological costs to meet their job requirements. Highly conscientious people who are hardworking and achievement-oriented will make every effort to improve their job skills and capacity. In this regard, VTs which bring the best employees together without time and space limitations, set a great stage for people to learn and gain work-related knowledge and skills. However, there is an important issue in VTs that is the VT members tend to help others who also pitch in but may refuse to help the others who are considered free-riders (i.e., people who get knowledge from others yet contribute little) (Fang & Chiu, 2010). In another words,

265 if the members want to obtain more expertise from others, they need first to be actively involved in
266 the sharing process. KSSE then plays a crucial role under such circumstances. When JDSV is high,
267 conscientious people who score higher in KSSE, due to their confidence in knowledge sharing and
268 desire to improve job skills, will contribute more knowledge. Conversely, in the case of low KSSE,
269 the participant may be too timid to participate in knowledge sharing, making them appear to be free-
270 riders. In this case, improving job skills by learning from other VT members may be impossible.
271 Instead, they must spend more time and energy enhancing job skills using other approaches, which
272 in turn reduces KSB. In essence, when JDSV is high, we propose a discordant interaction effect in
273 which the slopes of the cross terms C and JDSV have opposite signs, depending on the degree of
274 KSSE.

275 When a job requires few skills and talents, there is sufficient time and energy for a
276 conscientious employee to participate more extra-role behaviors. Previous work has recognized two
277 important motivators that facilitate KSB: one is based on moral obligation and community interest
278 while the other is based on the desire to achieve expertise (Ardichvili et al., 2003). These two
279 motivators fit perfectly with a conscientious person's nature as they are considered cooperative,
280 achievement-oriented, and have high self-esteem. Therefore, we propose that when JDSV is low,
281 there will be a positive relationship between C and KSB, regardless of the levels of KSSE.
282 Furthermore, the degree of this positive relationship will be affected by KSSE levels such that it is
283 stronger when KSSE is high than when it is low (consistent with H5).

284 In sum, we hypothesize:

285 **H6.** C, JDSV, and KSSE participate in a three-way interaction to affect KSB, such that:

286 (1) When JDSV is high and KSSE is high, conscientious employees will have the highest KSB

compared to any other combination of these two variables (JDSV and KSSE).

(2) When JDSV is high, there will be a positive relationship between C and KSB when KSSE is high, and a negative relationship when KSSE is low.

(3) When JDSV is low, there will be a positive relationship between C and KSB, and this relationship is stronger when KSSE is high than when it is low.

In summary, we integrate personality traits theories, JCM, JD-R model, and SCT into the research model shown in Fig.1. Conscientiousness was considered independent variable and knowledge sharing behavior was considered dependent variable. Job demands of skill variety and knowledge sharing self-efficacy were considered contextual moderator and personal moderator, respectively. The main effects were H1, H2, and H3; the two-way interaction effects were H4 and H5; and the three-way interaction effect was H6 (See Fig.1).

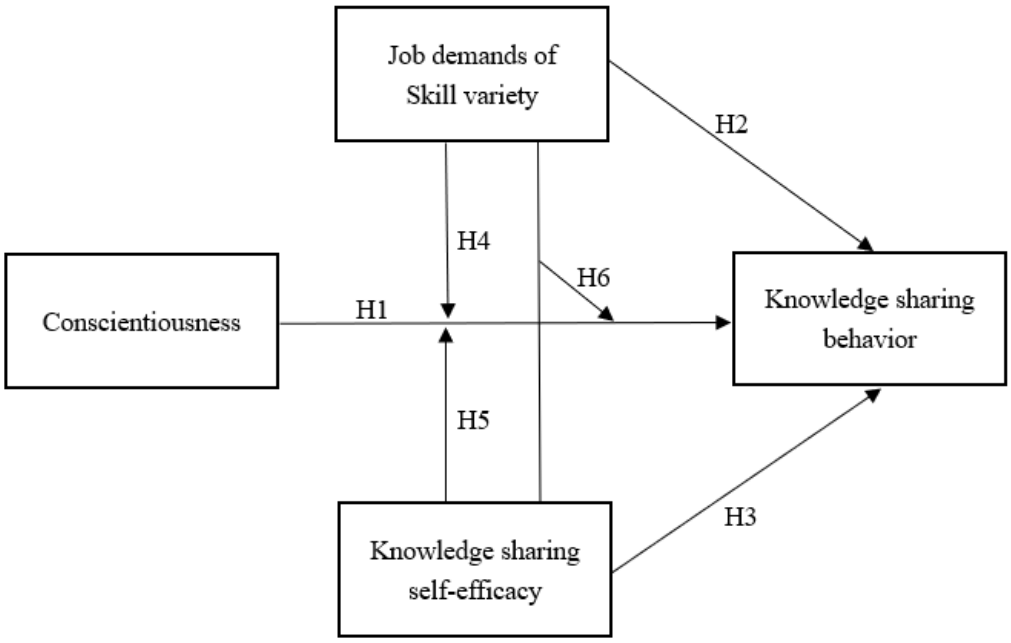

Fig.1. Research model

3. Research methodology

3.1. Sample and procedures

We conducted a survey within an information technology (IT) company that has multiple branches throughout China. Because of this widespread geographical distribution, the majority of employees work in virtual functional or project teams. Many researchers have claimed that online surveys not only have advantages including lower costs, faster responses, and higher response rate, but also have the same data quality as paper surveys (e.g., Hsu et al., 2007; Ng & Feldman, 2013). Additionally, in order to be able to make stronger causal inferences between predicting factors and dependent variables (Ng & Feldman, 2013), we conducted a two-phase online survey with the help of human resources department of this company. To mitigate the confound of social desirability response bias as much as possible (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003), we attached a cover letter to the survey to inform subjects that participation was voluntary, the survey was anonymous, the data would only be used for research purposes, and their responses were confidential.

At the first phase of the survey (Time 1), participants were asked to provide demographic information (age, gender, education, job tenure, member history, and online history), levels of C, JDSV, and KSSE. Four months later, a second wave of data collection was conducted (Time 2), in which the participants were asked to rate their levels of KSB. We randomly assigned a number to each of the participants during the first wave of data collection. When subjects participated in the second wave of data collection, they were asked to sign the number before answering the questionnaires. Thus, data from their questionnaires could be matched within the two-phase survey. In phase one, a total of 271 responses were collected, out of a possible 310 employees. In the second phase of the survey, a total of 219 employees returned their questionnaires, for a final response rate of 71%. The demographic information of respondents is listed in Table 1.

Table 1

Sample characteristics

Demographic characteristics		Counts	% of Total	Cumulative %
Gender	Male	136	62	62
	Female	83	38	100
Age	< 21 years	19	9	9
	21-30 years	81	37	46
	31-40 years	91	42	87
	41-50 years	21	10	97
	> 50 years	7	3	100
Education	High school or below	16	7	7
	Bachelor degree	167	76	83
	Mater degree	30	14	97
	PhD	6	3	100
Job tenure	< 1 year	22	10	10
	1-5years	81	37	47
	6-10 years	87	40	87
	11-15 years	19	9	96
	> 16 years	10	4	100
Member history	< 6 months	26	12	12
	6-11 months	39	18	30
	1-2 years	102	46	76

	> 2 years	52	24	100
Online history	< 1 years	2	1	1
	1-5 years	48	22	23
	6-10 years	94	43	66
	> 10 years	75	34	100

Note: N=219.

3.2. Measures

All measures were adopted from previously published papers to ensure their validity. We made minor modifications to fit the survey background. Furthermore, the Chinese versions were developed using a translation-back-translation procedure which can generally solve the problem of semantic differences.

The Big Five Inventory short version (BFI-S; Hahn, Gottschling, & Spinath, 2012) was used to measure C. Participants were asked to indicated the extent (1 = *strongly disagree* to 5 = *strongly agree*) to which they agreed with the statements listed in the inventory. There are 3 items in this scale, and an example item is "I see myself as someone who does a thorough job".

JDSV was measured using Morgeson and Humphrey's (2006) 3-item scale. Participants were asked to rate the extent (1 = *not at all* to 5= *to a very great extent*) to which they perceived their levels of JDSV. An example item is "To what extent is your job complex and non-repetitive".

Items for measuring KSSE were adapted from Lin et al.'s (2009) 3-item scale. Participants were asked to indicated the extent (1 = *strongly disagree* to 5 = *strongly agree*) to which they agreed with the statements. An example item is "I have confidence in my ability to provide knowledge that other members in this virtual team consider valuable".

Items for measuring KSB were also adapted from Lin et al.'s (2009) 3-item scale. Participants were asked to indicated the extent (1 = *strongly disagree* to 5 = *strongly agree*) to which they agreed with the statements. An example item is "I usually spend a lot of time conducting knowledge-sharing activities in this virtual team".

In line with previous recommendations (Edú-Valsania, Moriano, & Molero, 2016), the current study controlled for the demographic variables of age, gender, and education.

3.3. Data analysis

3.3.1. Common methods bias

Because we used self-report measures, common method bias (CMB) may be a potential confound for the results. To address this potential problem, we used Harman's (1967) single-factor test. According to previous work, CMB is an issue if one of the factors interprets more than 50% of total variance (Podsakoff et al., 2003). Results of our exploratory factor analysis showed that there was no single factor that could interpret more than 23.89% of the total variance. This indicates that CMB does not pose a serious problem in the current study.

3.3.2. Measurement model

Measurements of convergent validity and discriminant validity were used to assess the measurement model. According to previous literature (Fornell & Larcher, 1981; Pi et al., 2013), four thresholds are important to ensure the validity of the measurement model: (a) all factor loadings should exceed 0.7; (b) average variance extracted (AVE) of each construct should exceed 0.5; (c) composite reliability (CR) should exceed 0.7; and (d) Cronbach's α should exceed 0.7. Regarding discriminant validity, the square root of the AVE for each construct should be greater than all other correlation coefficients for the construct.

The results (see Table 2) reveal that the factor loadings ranged from 0.71 to 0.86; the AVEs ranged from 0.52 to 0.66; the CRs ranged from 0.77 to 0.85; and the Cronbach's α ranged from 0.74 to 0.84. Thus, all values were within the recommended ranges. Moreover, as can be seen from Table 3, the square root of each construct's AVE exceeded other correlation coefficients for the construct, indicating an acceptable degree of discriminant validity.

Table 2

Convergent validity and reliability analysis

Constructs	Item	Factor loading	Composite reliability (CR)	Average variance extracted (AVE)	Cronbach's α
C	C_1	0.72	0.77	0.52	0.74
	C_2	0.73			
	C_3	0.72			
JDSV	JDSV_1	0.86	0.83	0.62	0.82
	JDSV _2	0.78			
	JDSV _3	0.71			
KSSE	KSSE_1	0.79	0.84	0.63	0.82
	KSSE_2	0.79			
	KSSE_3	0.80			
KSB	KSB_1	0.84	0.85	0.66	0.84
	KSB_2	0.78			
	KSB_3	0.81			

Note: N=219.

Table 3

Correlation between constructs

Variables	Mean	SD	AVE	1	2	3	4
1.C	3.70	0.61	0.52	(0.72)	0.29***	0.56***	0.44***
2.JDSV	3.97	0.64	0.62		(0.79)	0.22**	0.29***
3.KSSE	3.72	0.70	0.63			(0.79)	0.55***
4.KSB	3.66	0.70	0.66				(0.81)

Note: N=219. *p < .05; **p < 0.01; ***p < 0.001. Square roots of AVE are displayed on the diagonal in parentheses.

3.3.3. Hypotheses testing

The hypotheses were tested using conducting multiple regression analysis with jamovi software (version 0.9.1.3). The results of the main effects were displayed in Table 4. As can be seen from the table, both C and KSSE were positively related to KSB (C, $\beta = 0.44$, $p < .001$; KSSE, $\beta = 0.55$, $p < .001$). Thus, H1 and H3 were supported by these results. However, a significantly positive relationship was found between JDSV and KSB (JDSV, $\beta = 0.29$, $p < .001$) which leads to a rejection of H2.

Table 4

Summary of the main effects predicting KSB

Variables	B	SE	β	95% CI		t	p	ΔR^2
				Lower	Upper			
C	0.50	0.07	0.44	0.36	0.64	7.18	<.001	0.19
JDSV	0.32	0.07	0.29	0.18	0.46	4.43	<.001	0.08

KSSE	0.56	0.06	0.55	0.44	0.67	9.68	<.001	0.30

Note: Main effects are taken from three separate models. SE refers to standard error; CI refers to confidence interval.

To address H4 and H5, we used two separate moderation models. The results are summarized in Table 5. The nonsignificant cross product (C × JDSV, β = -0.04, p = 0.749) indicates that JDSV does not play a moderating role in the relationship between C and KSB. H4 was rejected due to this result. In addition, Table 5 shows that the cross product (C × KSSE, β = 0.16, p = 0.002) was significantly related to KSB. In addition, to fully characterize the moderating effect, we plotted this two-way interaction and carried out a simple slope test according to Dawson's (2014) recommendations. The results (see Fig. 2 and Table 6) reveal that when KSSE was high (one SD above the mean), C was significantly related to KSB (B = 0.43, p < .001). In contrast, when KSSE was low (one SD below the mean), the relationship between C and KSB was no longer significant (B = 0.07, p = 0.403). In conclusion, H5 was supported.

Table 5

Summary of the two-way interaction effects predicting KSB

Variables	B	SE	β	95% CI		t	p	ΔR^2
				Lower	Upper			
C × JDSV	-0.04	0.11	-0.02	-0.25	0.18	-0.32	0.749	<.001
C × KSSE	0.26	0.08	0.16	0.09	0.42	3.07	0.002	0.03

Note: Interaction effects are taken from two separate moderation models. SE refers to standard error; CI refers to confidence interval.

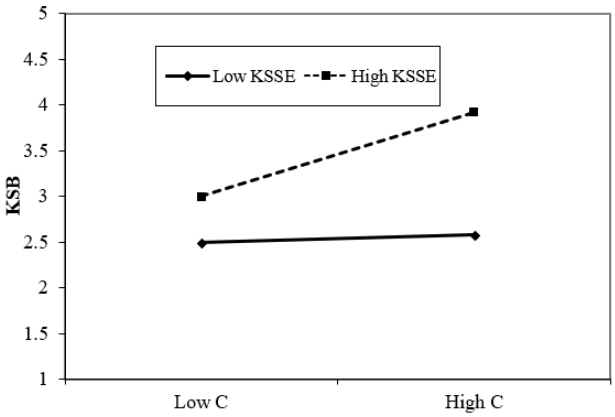

Fig. 2. Interaction effect of C and KSSE on KSB

Table 6

Simple slope test (two-way interaction effect)

Moderator Levels	B	SE	t	p
Low KSSE	0.07	0.09	0.84	0.403
High KSSE	0.43	0.10	4.23	< .001

Note: Low refers to one SD below the mean; High refers to one SD above the mean; SE refers to standard error.

To address the three-way interaction effect hypothesis, we used a 4-step moderation model. First, the control variables were entered; second, the independent variable and moderators were entered; then the two-way cross products were entered; finally, the three-way cross product was entered. The results are shown in Table 7. We observed that the three-way cross product (C × JDSV× KSSE, $\beta = 0.11$, $p = 0.037$) was significantly related to KSB, and additionally explained 1% of variance in KSB ($\Delta R^2 = 0.01$).

Table 7

Three-way interaction effect predicting KSB

Step	Variables	B	SE	β	95% CI	t	p

					Lower	Upper		
1	Gender	-0.03	0.08	-0.02	-0.19	0.14	-0.34	0.735
	Age	-0.07	0.07	-0.10	-0.21	0.06	-1.12	0.266
	Education	0.02	0.05	0.03	-0.08	0.11	0.37	0.715
2	C	0.21	0.08	0.18	0.05	0.36	2.63	0.009
	JDSV	0.08	0.07	0.08	-0.05	0.22	1.20	0.232
	KSSE	0.41	0.07	0.41	0.28	0.55	6.09	< .001
3	C × JDSV	-0.12	0.12	-0.07	-0.37	0.12	-1.00	0.321
	C × KSSE	0.17	0.09	0.11	-0.01	0.35	1.91	0.058
	JDSV × JDSV	0.14	0.10	0.09	-0.05	0.33	1.43	0.154
4	C × JDSV× KSSE	0.28	0.13	0.11	0.02	0.54	2.09	0.037

Note: N=219. Step1: $R^2 = 0.01$, $\Delta R^2 = 0.01$; Step2: $R^2 = 0.36$, $\Delta R^2 = 0.35$ ($p < .001$); Step3: $R^2 = 0.39$, $\Delta R^2 = 0.03$ ($p = 0.018$); Step4: $R^2 = 0.40$, $\Delta R^2 = 0.01$ ($p = 0.037$). SE refers to standard error. CI refers to confidence interval.

Furthermore, based on recommendations from previous work (Aiken & West, 1991; Dawson, 2014; Dawson & Richter, 2006), we plotted this interaction and conducted a slope comparison analysis. The results showed that (1) when JDSV and KSSE values were both high (one SD above the mean), highly conscientious people performed more KSB than in other conditions (e.g., high JDSV and low KSSE, and Low JDSV and high KSSE; see Fig. 3); (2) when JDSV was high (see Table 8), if KSSE was also high, C was positively related to KSB ($B = 0.37$, $p = 0.004$); and if KSSE was low (one SD below the mean), the relationship between C and KSB was significantly negative ($B = -0.26$, $p = 0.019$). This result was also confirmed by the slope comparison analysis (see Table

9) which showed that slope (1) and slope (2) were significantly different (t = 2.206, p = 0.029). We also found that (3) when JDSV was low (see Table 8), C was positively related to KSB for both high KSSE (B = 0.24, p = 0.046) and low KSSE (B =0.29, p = 0.034). This result was also confirmed by the slope comparison analysis (see Table 9) which showed that no significant differences existed between slope (3) and slope (4) (t = -0.743, p = 0.458). In conclusion, H6a and H6b were fully supported, and H6c was partially supported.

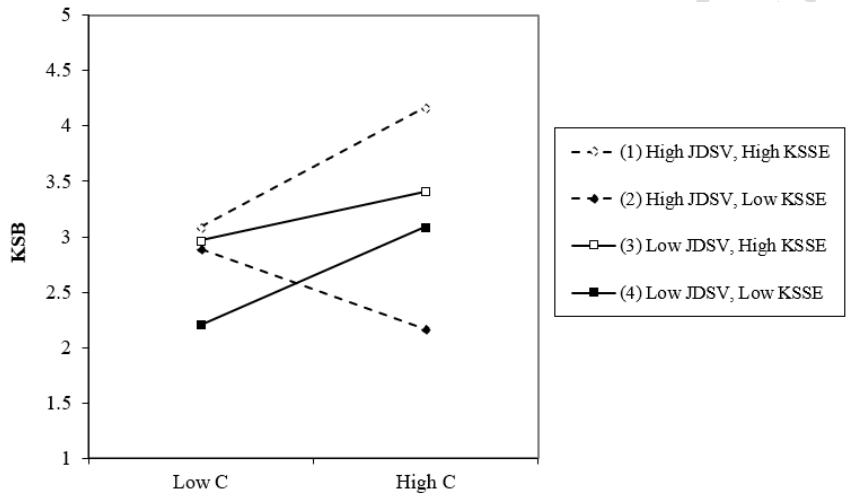

Fig. 3. The joint effect of C, JDSV, and KSSE on KSB

Table 8

Simple slope test (three-way interaction effect)

Moderator Levels	B	SE	t	p
High JDSV, High KSSE	0.37	0.13	2.89	0.004
High JDSV, Low KSSE	-0.26	0.12	-2.71	0.019
Low JDSV, High KSSE	0.24	0.11	1.87	0.046
Low JDSV, Low KSSE	0.29	0.13	2.14	0.034

Note: High refers to one SD above the mean; Low refers to one SD below the mean; SE refers to standard error.

Table 9

Slope comparison analysis

Pair of slopes	t	p
(1) and (2)	2.206	0.029
(1) and (3)	1.006	0.316
(2) and (4)	-2.604	0.010
(3) and (4)	-0.743	0.458

Note: (1) refers to High JDSV, High KSSE; (2) refers to High JDSV, Low KSSE; (3) refers to Low JDSV, High KSSE; and (4) refers to Low JDSV, Low KSSE (See Fig. 3)

4. Discussion and conclusions

The current study sought to examine under what conditions conscientious employees participating in a VT will perform more KSB. To address this problem, we consulted the current literature focusing on personality, job design, self-efficacy, and KSB to develop a person-situation perspective which incorporated both individual factors (e.g., C and KSSE) and contextual factors (e.g., JDSV). This approach combines personality traits theories, JCM, JD-R model, and SCT to study the underlying mechanisms and boundary conditions of VT members' KSB. Our results supported the majority of our hypotheses and revealed three key findings: (1) the main effects test indicated that C, JDSV, and KSSE were all positively related to KSB; (2) the two-way interaction effects test showed that KSSE positively moderates the relationship between C and KSB, and furthermore, when KSSE was high, C was positively related to KSB; (3) the three-way interaction effect test revealed that C, JDSV, and KSSE jointly affected employees' KSB. Specifically, we found that (3.1) VT members will perform the most KSB when values of JDSV and KSSE were

both high; (3.2) when both JDSV and KSSE were high and JDSV was low, C was positively related to KSB; (3.3) when JDSV was high and KSSE was low, C was negatively related to KSB. These findings confirm and extend existing literature to enhance our understanding of KSB in a virtual workplace setting.

First, consistent with previous research conducted in a traditional work environment (e.g., Anwar, 2017; Gupta, 2008; Matzler et al., 2008), we found a positive association between C and KSB in a virtual environment, such that more conscientious individuals are more likely to share knowledge and are more willing to participate in communication activities in VTs. These findings (1) confirm the argument that although individuals are not necessarily born to share knowledge, some people may be more inclined to share their own expertise than others (Wasko & Faraj, 2005); (2) imply that highly conscientious people tend to share more of their knowledge than others both in a traditional and a virtual environment; and (3) extend existing literature on KM by empirically examining the role of personal disposition as a factor that influences KSB.

Second, to the best of our knowledge, relative little attention has been assigned to studies concerning the relationship between job design and KSB. Foss et al. (2009) found that job design (e.g., job autonomy, task identity, and feedback) were positively related to KS intent, thereby influencing employees' KSB. Nonetheless, their study overlooked the factor of JDSV which may have an important impact on KSB. At the same time, although Chen and Chiu's (2009) study took JDSV into account, their research focused on OCB and cannot be assumed to be directly applicable in the context of KSB. Notably, Pee and Lee (2015) assumed that the effect of JDSV on KSB could be described by a curvilinear relationship, and their empirical study confirmed their hypothesis. Drawing on the scarce existing literature and Ardichvili et al.'s (2003) model, the current study gave

consideration to JDSV's consumption of time and energy, and proposed a negative relationship between JDSV and KSB. However, contrary to our hypothesis, a positive relationship between them was found. One plausible explanation for the rejection of our hypothesis is that high levels of JDSV may increase employees' job involvement, which in turn motivates more OCB such as KSB (Chen & Chiu, 2009). Thus, our research represents one of the first to provide an unexpected empirical result related to this topic and demonstrate the elusive nature of the relationship between JDSV and KSB.

Third, previous work has suggested that perceived self-efficacy plays a vital role in an individual's motivation and behavior (e.g., Chen & Hung, 2010; Hsu et al., 2007). As an extension of these studies, our results confirm the notion of self-efficacy theory by illustrating the positive impact of KSSE on KSB. Not only does KSSE positively predict VT members' KSB, but it can also be enhanced by continuously contributing expertise to other members. This virtuous circle makes remarkable contributions in stimulating KSB.

Fourth, although many previous studies have highlighted the important role of contextual factors and individual factors on individuals' KSB (e.g., Chen & Hung, 2010; Lin et al., 2009), as far as we can know, few have combined these factors to examine the joint effect of contextual and personal factors for predicting KSB in VTs. By assuming a person-situation perspective, the current study attempts to broaden our understanding of KSB in VTs from the perspective of personality traits, job design, and self-efficacy theories. Using this approach, we were able to obtain several key results. With regard to the two-way interaction effects, the results, contrary to our expectations, rejected the assumption that JDSV negatively moderates the relationship between C and KSB. This rejection may be due to the unexpected positive relationship between JDSV and KSB. When

considering the effects of JDSV here, it is possible that too much attention was paid to its negative effects (e.g., time consumption, exhaustion, and creating job strain; Bakker & Demerouti, 2007; Xie & Johns, 1995). Rather, JDSV's positive role regarding KSB, such as increasing job involvement, affective commitment, and intrinsic motivation of knowledge sharing (Chen & Chiu, 2009; Pee & Lee, 2015) may underlie the rejection of these two hypotheses. An alternative explanation is that our unexpected empirical results indicate other factors may exist that affect the moderating role of JDSV.

In terms of the moderating role of KSSE, the results, as predicted, showed that KSSE positively moderates the relationship between C and KSB. In additional, a simple slope analysis revealed that whether C was positively related to KSB or not was contingent on KSSE: when employees' KSSE was high, there was a positive relationship between C and KSB. Although many prior studies have demonstrated the positive role C plays in predicting KSB (e.g., Anwar, 2017; Gupta, 2008; Matzler et al., 2008), few have considered the boundary conditions of this topic. Our work is, to our best knowledge, the first empirical examination of the moderating role of KSSE in the relationship between C and KSB. Thus, our research moves a tangible step forward by shedding new light on the boundary conditions of the relationship between C and KSB. Furthermore, it also presents a reasonable explanation for the unexpected empirical results that we observed regarding this relationship (e.g., Pei-Lee et al., 2011).

Finally, the primary contribution of this study is the verification of three-way interaction effects of C, JDSV, and KSSE on KSB. We report only one condition under which C had a negative effect on KSB, namely when JDSV was high but KSSE was low. In addition, despite the fact that JDSV was positively related to KSB, the results revealed that when JDSV was low, no matter what KSSE's

level was, C exhibited a positive effect on KSB. In a similar vein, although KSSE had a significant positive main effect on KSB, the moderating role of KSSE was only observed when JDSV was high. These findings suggest that employees working in jobs with high levels of JDSV have the greatest potential to obtain valuable know-how and share their accrued expertise through KSB. However, this relationship is fragile for individuals who score high in C. Namely, when JDSV is high, high levels of KSSE may enhance its positive effect, causing a positive relationship between C and KSB. However, when JDSV was low, C will positively affect KSB regardless of the degree of KSSE. Moreover, our results in the low JDSV condition were unexpected. Although we posited that under this condition, when KSSE was high, C would be more positively related to KSB than when it was low, we observed the opposite (see Table 9). This result can be attributed to the fact that C-KSB relationship is highly vulnerable to the moderating impacts of other factors (e.g., perceived trust, identification, and justice; Fang & Chiu, 2010; Hsu et al., 2007) and that KSB is itself a highly spontaneous and socially risky behavior (Ardichvili et al., 2003; Pee & Lee, 2015).

The current study has practical implications for managers as well as other members of VTs. Our findings indicate that C is positively related to KSB in VTs. Other scholars have also argued that highly conscientious workers are more inclined to engage into their effort to organize their expertise in order to share it with colleagues (e.g., Matzler et al., 2008). In this regard, a practical implication is that VTs could improve KSB through personnel screening. Since the selection of members and their retention are central management issues for VTs, the VT managers should regularly require applicants and members to submit self-reports about personality or personality-like traits (Barrick, Mount, & Judge, 2001). Based on the premise that those who score higher on the C dimension are more willing to engage in KSB, VT managers can assign documentation or

sharing roles to these people accordingly.

Another important practical implication relates to the design of jobs and to the enhancement of KSSE. The current study revealed that when JDSV is high, the relationship between C and KSB is dependent on the levels of KSSE, presenting a positive relationship when KSSE is high and a negative relationship when it is low. Thus, when a highly conscientious VT member suffers due to high demands of job skills, managers should provide some strategies (e.g., providing positive feedbacks to members who contribute their expertise to the team, conducting online training programs, and offering support mechanism) to enhance members' KSSE. This would enable members to better be able to share their knowledge in this VT, and potentially motivate them to share more in the future. With respect to when JDSV is low, our findings reveal that regardless of KSSE level, C will positively affect KSB. Managers should design or redesign jobs accordingly to reduce the job complexity of highly conscientious VT members who score low in KSSE. By doing so, these members may have enough time and energy to share their expertise with other members.

These encouraging findings notwithstanding, this study is not without limitations. First, the current sample was relatively small, and the participants were all from a single IT company. Whether or not our findings can be generalized to other situations is unclear. For instance, IT jobs are traditionally deemed more complex than those in other settings which potentially leads to higher levels of JDSV in the current study. Future confirmation of the generalizability of these findings is highly encouraged. For example, subsequent studies could recruit a large sample of workers from diverse industries, including those whose jobs are considered conventionally uncomplicated and repetitive. Second, since previous study argued that "self-selection issue is the common problem of the questionnaire survey process" (Hsu et al., 2007, p.167), it is possible that our data were collected

from VT members who are more willing to share, and their answers may not be representative of the entire population. Third, it should be noted that there may be other unknown factors that affect the relationship between C and KSB (e.g., justice; Fang & Chiu, 2010) or such factors possibly predict individuals' KSSE (e.g., trust; Hsu et al., 2007). Supplemental studies are therefore recommended to extend our research model by embracing additional suitable constructs. Fourth, although the data were collected by conducting a two-phase survey over a 4-month period, our research design did not allow us to explain explicit determinations of causality among the variables definitely. In addition, all of the variables were measured by through self-report instruments. Although our results showed that CMB was not a serious problem, it was not completely eliminated. Thus, data should be collected from multiple sources (e.g., from managers or colleagues) in future studies to corroborate the results of the present research.

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Highlights

- Conscientiousness positively affects knowledge sharing behavior.
- Job demands of skill variety positively affects knowledge sharing behavior.
- knowledge sharing self-efficacy positively affects knowledge sharing behavior.
- Personality, job design, self-efficacy jointly affect knowledge sharing behavior.