Older adults in virtual communities: understanding the antecedents of knowledge contribution and knowledge seeking through the lens of socioemotional selectivity and social cognitive theories

Junjie Zhou, Rajiv Kishore, Meiyun Zuo, Ruochen Liao and Xiao Tang

(Information about the authors can be found at the end of this article.)

Abstract

Purpose – *As older adults are increasingly active in virtual communities (VCs), these platforms for knowledge exchange present opportunities for companies to use elder human capital. The purpose of this study is to understand the antecedent factors that motivate older adults' knowledge contribution and knowledge seeking (KS) behaviors in VCs.*

Design/methodology/approach – *Rooted in socio-emotional selectivity and social cognitive theories, this study included five key variables and developed models for older adults' knowledge contributing (KC)/KS behaviors. This paper tested the hypotheses using data from a sample of 204 older adults in 3 VCs in China.*

Findings – *The results provide support for most of the hypotheses and show that while other members' participation (MP) acts as a substitute for meaning in life and attitude toward aging, it acts as a complement for outcome expectations (OE) focused on others and OE focused on oneself in their impacts on KC/KS activities.*

Practical implications – *The study provides practical insights for developing elder human resources via VCs to avoid knowledge loss.*

Originality/value – *This study described older adults' unique characteristics when modeling their information and communication technologies-related behaviors and built two models to explain their KC/KS behaviors. It confirmed that the same factor has different levels of impact on older adults' KC/KS behaviors in VCs. In addition, it confirmed and reinforced the complementary and substitutive effects of other MP as an environmental factor on these behaviors.*

Keywords *Older adults, Knowledge contribution, Knowledge seeking, Virtual community*

Paper type *Research paper*

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1. Introduction

Information and communication technologies (ICTs) have significantly changed various aspects of society and turned knowledge into one of the most crucial resources for individuals and organizations (Bailey and Clarke, 2001; Del Giudice and Della Peruta, 2016; Wang *et al.*, 2020; Del Giudice and Maggioni, 2014; Cillo *et al.*, 2019). During the past two decades, industrial practitioners and scholars have paid much attention to knowledge

management practices and research and obtained very useful insights into the use of knowledge (Glyptis *et al.*, 2020; Alavi and Leidner, 2001; Chiu *et al.*, 2006; Singh, 2019; Al Ahbabi *et al.*, 2019; Singh *et al.*, 2019). As society and technologies continue to evolve, organizations have recently faced two new trends. On the one hand, they have to devise strategies to avoid the "brain drain" and the loss of valuable knowledge due to the retirement of the baby boomer generation (Noguchi, 2015; Wang *et al.*, 2017; Slagter, 2007; SHRM, 2014; Joe *et al.*, 2013). On the other hand, the rise of virtual communities (VCs), online spaces where people share "their experiences and knowledge in free-flowing, creative ways that foster new approaches to problems" (Wenger and Snyder, 2000, p. 140), has attracted numerous users, including older adults, to contribute/seek knowledge and turned these communities into valuable external knowledge repositories (Wang *et al.*, 2020; Rice *et al.*, 2019; Pan *et al.*, 2015; Di Gangi and Wasko, 2009). Older adults' knowledge contributing (KC) and knowledge seeking (KS) activities in VCs have thus, become a way for organizations to use elderly human resources, and, therefore, a topic of note in knowledge management.

Scholars have begun to explore older adults' participation in VCs and social media (Nimrod, 2010; Choi *et al.*, 2014; Zhou, 2019; Su and Tong, 2021). They have analyzed the outcomes of older adults' VC usage in terms of empowerment and well-being (Heo *et al.*, 2015; Niehaves and Plattfaut, 2014; Srivastava and Panigrahi, 2019), as well as the improvement in their quality of life through social and knowledge exchanges (Choi *et al.*, 2014; Zhou, 2018). However, compared with the volume of the studies on young people's or employees' knowledge management activities in VCs (Scuotto *et al.*, 2017; Susanty *et al.*, 2019; Alavi and Leidner, 2001; Al Ahbabi *et al.*, 2019), only a few studies have explored older adults' online knowledge or information sharing behaviors (Xiong and Zuo, 2019; Zhou, 2018; Yang, 2019). In addition, there is a paucity of research about the antecedent factors that motivate older adults' use of VCs as platforms for knowledge exchange. It is necessary to address these limitations and thereby expand our knowledge of older adults' KC/KS behaviors.

Understanding older adults' KC/KS behaviors in VCs is important because of the increasing longevity of populations (Gonzales *et al.*, 2015; Kankanhalli *et al.*, 2016; Pruchno, 2019). First, addressing this topic has the potential to promote older adults' productive endeavors and help companies to use external knowledge or open wisdom in a crowdsourcing way, similar to Dell (Di Gangi and Wasko, 2009). Second, insights into the motivations specific to KC versus KS activities can also lead to a better understanding of how older adults use VCs and, in turn, help internet companies develop sustainable VCs for older adults (Bateman *et al.*, 2011; Butler *et al.*, 2002; Choi *et al.*, 2014). Finally, actively engaging older adults in knowledge networks enabled by VCs helps older adults enrich their retired life, and thereby builds a digitally inclusive society (Nimrod, 2013; Nimrod, 2011; Afsarmanesh *et al.*, 2012; Ramírez-Correa *et al.*, 2019). Therefore, this study aimed to address the abovementioned research gap, and accordingly, we asked the following question:

Q1. How do factors germane to older adults influence their knowledge contribution and KS activities in VCs?

To address this question, we rooted the current study in socioemotional selectivity theory (SST) and social cognitive theory (SCT) and incorporated two key indicators of aging – meaning in life (MIL) and attitude toward aging (ATA) – as well as outcome expectations (OE) focused on both self (OE-self) and others (OE-others) and other members' participation (MP) in the VC as antecedents in the models of KC and KS activities, respectively. We tested our hypotheses of the complementary and substitutive effects of MP on the direct effects of ATA, MIL, OE-self and OE-others in the KC and KS models, respectively, using data from a sample of 204 participants. We arrived at several insightful findings that contribute to the literature on knowledge management that is relevant for the practices of elder human resources development.

2. Theoretical background

2.1 Older adults' knowledge contributing and knowledge seeking activities in virtual communities

Compared with traditional offline activities, VCs provide new approaches for people and organizations to conduct knowledge management activities (Wenger and Snyder, 2000; Alavi and Leidner, 2001; Bailey and Clarke, 2001). Knowledge in VCs is usually exchanged in the form of written postings, and includes experiences, insights, expertise and innovative business ideas in certain domains in professional communities (Hsu *et al.*, 2007; Wasko and Faraj, 2005; Di Gangi and Wasko, 2009), experiences of games, music, novels, comics or niche cultures among young people in leisure-oriented communities (Zhang, 2011) or life wisdom on managing family relationships, experience on retirement arrangement, maintaining health, religion, leisure travel and recommendations of books, films, shows or television programs in communities oriented toward older adults (Nimrod, 2010; Nimrod, 2011; Bennett, 2011; Choi *et al.*, 2014). Although the subjects of prior studies have mostly been younger people, the conclusions of these studies provide some insights for the present study. For example, the factors that influence KC/KS activities in VCs can be categorized into individual cognitive factors and environmental factors (Chiu *et al.*, 2006; Chen and Hung, 2010; Hsu *et al.*, 2007; Lin *et al.*, 2009; Zhou *et al.*, 2014). Among individual cognitive factors, OE is a salient factor that has been used to explain older adults' internet use (Lam and Lee, 2006). As the sustainable development of VCs depends on community MP behaviors and the knowledge resources resulting from those behaviors (Chiu *et al.*, 2006; Koh *et al.*, 2007; Yan and Tan, 2014; Zhou *et al.*, 2014), environmental factors such as MP have also been incorporated in models to explain KC/KS behaviors in VCs.

Scholars have attempted to capture older adults' characteristics and to explore the impacts of these characteristics on their ICT use (Ryu *et al.*, 2009; Wagner *et al.*, 2010; Yang, 2019; Quan-Haase *et al.*, 2016; Hong *et al.*, 2013; Ghasemaghaei *et al.*, 2019). The aging process causes a decline in older adults' physical and cognitive capabilities, as a result of which they have more barriers and a steeper learning curve in using new technologies or web applications than younger people (Wagner *et al.*, 2010; Lam and Lee, 2006). Further, older adults are also less motivated by instrumental gains in their online activities in VCs (Nimrod, 2011; Morrow-Howell, 2010; Choi *et al.*, 2014). Finally, aging may affect many aspects of older adults' life, and there has been ample evidence in the geriatrics literature that shows that perceptions about how much time they have left to live indeed change older adults' behavioral patterns (Carstensen *et al.*, 2003; Fung *et al.*, 2001; Fung and Carstensen, 2004).

The above differences that older adults exhibit relative to younger adults in their ICT usage in general and their VC usage, in particular, should inform studies about older adults (Ryu *et al.*, 2009; Wagner *et al.*, 2010; Yang, 2019; Quan-Haase *et al.*, 2016; Choi *et al.*, 2014; Sun and Zhou, 2021). Accordingly, to capture both differences and similarities between older and younger adults in the context of KC/KS behaviors in VCs, we developed a model that is rooted in two theoretical foundations:

1. SST, as it addresses unique motivations and behaviors of older adults.
2. SCT, as it has been used in the past to study KC/KS behaviors in VCs in general.

We discuss SST next.

2.2 Socioemotional selectivity theory

SST is a life-span theory of motivation that describes how individuals make decisions about activities as an adaptive response to their perceived time left in life (Carstensen *et al.*, 2003; Fung *et al.*, 2001; Fung and Carstensen, 2004). SST has been widely used to explain older

adults' online behaviors such as social media use and the sharing of online health rumors (Yang, 2019; Chang *et al.*, 2015; Kim and Shen, 2020; Rui *et al.*, 2019). The key notion of time in SST refers to people's perception of the remaining time rather than the actual time left, namely, given the same length of actual time remaining, people may have different perceptions of the remaining time and may accordingly end up behaving differently (Carstensen *et al.*, 2003; Fung *et al.*, 2001; Fung and Carstensen, 2004).

According to SST, when they perceive their remaining time as limited, older adults are more likely to pursue and invest their time and efforts in *emotionally meaningful goals* that can lead to gratification for them (e.g. sharing wisdom and life experience with others or voluntarily helping others, namely, KC activities); in such a situation, older adults' KC emotionally meaningful behaviors are altruistic in nature (i.e. focused on others) (Carstensen *et al.*, 2003; Clary and Snyder, 1999; Fung *et al.*, 2001; Fung and Carstensen, 2004; Hendricks and Cutler, 2004; Wang *et al.*, 2017). We, thus, adopted the construct MIL, which refers to the "pursuit and attainment of worthwhile goals and an accompanying sense of fulfilment" (Krause, 2007), to capture older adults' abovementioned reactions to the perception of a limited remaining time that drives them to conduct KC activities (Hicks *et al.*, 2012; Morrow-Howell, 2010).

Conversely, when their perception of the remaining time is open-ended and expansive, older adults will pursue those *future-oriented goals* that can expand their horizons and prepare them for educational and occupational achievements (e.g. seeking knowledge and learning new skills to enrich their later life and improve their productivity, namely, KS activities); in such a situation, older adults' KS behaviors for future-oriented outcomes are egotistic in nature (i.e. focused on the self) (Carstensen *et al.*, 2003; Clary and Snyder, 1999; Fung *et al.*, 2001; Fung and Carstensen, 2004; Dávila and Díaz-Morales, 2009). Therefore, we adopted the construct ATA, which refers to remaining optimistic about the future and remaining active in learning new skills (Cody *et al.*, 1999), to capture older people's abovementioned reactions to a perceived open-ended future that drives them to conduct KS activities (Vošner *et al.*, 2016; Wagner *et al.*, 2010; Xie, 2011).

2.3 Social cognitive theory

SCT is a widely accepted theory for explaining individuals' behavior and postulates that human behavior is the result of triadic reciprocal determinism of three factors, namely, environment, person and behavior (Bandura, 1986). This notion postulates that environmental and individual cognitive factors not only have direct effects on an individual's behavior but also jointly affect individual behaviors through their interaction effects (Bandura, 1986; Hmieleski and Baron, 2009). SCT has frequently been used to explain people's knowledge exchanging behaviors in VCs (Chiu *et al.*, 2006; Zhou *et al.*, 2014; Hsu *et al.*, 2007) and also to explain older adults' computer/internet use in information systems research (Lam and Lee, 2006; Wagner *et al.*, 2010). Accordingly, we used SCT as a theoretical foundation.

According to SCT, we included OE as an antecedent of KC and KS behaviors, as this variable captures an individual's perceptions about the *expected* positive outcomes of their KC/KS behavior in VCs (Chiu *et al.*, 2006). Further, based on the tenets of SST discussed above, we partitioned OE into two types, namely, expected outcomes that are altruistic, that is, focused on others (OE-others), which is well-aligned with KC behaviors that also aim at helping others by sharing knowledge to improve the prospects of others, and expected outcomes that are egotistical, that is, focused on self (OE-self), which is well-aligned with KS behaviors of older adults for future gains (Fung *et al.*, 2001; Carstensen *et al.*, 2003; Fung and Carstensen, 2004). Furthermore, we included MP in the same VC as an environmental factor in our models. This construct captures the frequency of interactions among the members of a VC and constitutes the environment of a VC (Bennett, 2011; Koh *et al.*, 2007; Chiu *et al.*, 2006; Zhou *et al.*, 2014).

2.4 Hypotheses

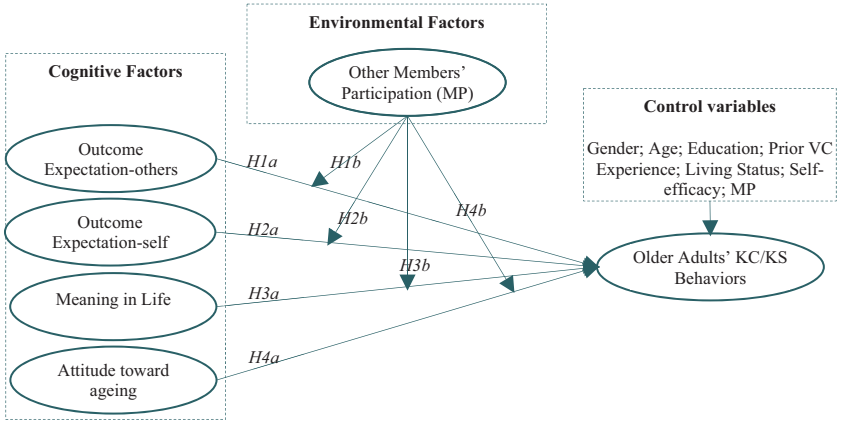
Based on the above discussion, we built two distinct models but with the same set of antecedents for KC and KS activities (Figure 1).

2.4.1 Direct effects. The notion that people's behavior is driven by the outcome they expect from that behavior has been verified by prior studies on VCs (Chiu *et al.*, 2006; Hsu *et al.*, 2007; Panigrahi *et al.*, 2018; Paroutis and Al Saleh, 2009; Fait *et al.*, 2019). The above conclusion also applies to the context of older adults in VCs. As prior studies have shown, older adults' expectations of fun, inherent joy and satisfaction they can achieve by helping others from their KC activities, that is, OE-others, motivate them to participate in VCs by way of their KC activities (Nimrod, 2010; Bennett, 2011; Nimrod, 2011; Su and Tong, 2021; Coelho and Duarte, 2016). KC/KS behaviors in VCs are usually intertwined with each other as asking a high-quality question (i.e. a KS activity) can activate other members' discussion (i.e. KC activities) and a contribution of knowledge to the community knowledge repository (Choi *et al.*, 2014; Sedighi *et al.*, 2018; Chatterjee *et al.*, 2020). Thus, OE-others may be positively related to older adults' KS behaviors and to their KC activities. Moreover, as KC activities are more altruistic and can give contributors a feeling of meaningfulness while KS activities are more egoistic (Fung *et al.*, 2001; Carstensen *et al.*, 2003; Fung and Carstensen, 2004; Knowles and Hanson, 2018; Hargittai and Dobransky, 2017), OE-others is likely to be more strongly related to KC activities than to KS activities. Therefore, we hypothesized:

H1a. An older adult's OE-others positively affects his/her KC/KS behaviors in a VC. This effect is stronger for KC than for KS1.

As seen above, KC/KS behaviors in VCs are usually intertwined with each other (Choi *et al.*, 2014; Sedighi *et al.*, 2018; Chatterjee *et al.*, 2020) and OE-self (e.g. expectation of making new friends or social ties for the future) positively influences people's KC/KS behaviors (Chiu *et al.*, 2006; Hsu *et al.*, 2007; Pan *et al.*, 2015; Xiong *et al.*, 2018; You and Hon, 2019; Ardichvili *et al.*, 2003). The above conclusion applies to the context of older adults in VCs because they also consider VCs as tools to seek fun and form new social ties (Nimrod, 2010; Nimrod, 2011; Bennett, 2011; Su and Tong, 2021; Knowles and Hanson, 2018; Hargittai and Dobransky, 2017) and achieve other meaningful goals (Choi *et al.*, 2014;

Figure 1 Knowledge contribution/seeking models for older adults in VCs



Notes: H = hypothesis; KC = knowledge contributing; KS = knowledge seeking; MP = members' participation; VC = virtual community

Sedighi *et al.*, 2018; Chatterjee *et al.*, 2020). We proposed that OE-self is expected to be positively related to older adults' KC/KS behaviors as well. However, as KS activities are self-focused and aimed at self-improvement while KC activities focus on the emotionally meaningful goals of helping others (Fung *et al.*, 2001; Carstensen *et al.*, 2003; Fung and Carstensen, 2004; Knowles and Hanson, 2018; Hargittai and Dobransky, 2017), OE-self is expected to be more strongly related to KS activities. Therefore, we hypothesized:

H2a. An older adult's OE-self positively affects his/her KC/KS behaviors in a VC. This effect is stronger for KS than for KC.

Older people are more likely to think about the meaning of life and their relationships with other people when they perceive their remaining time as limited (Krause, 2007; Krause, 2009; Fung *et al.*, 2001; Fung and Carstensen, 2004; Ten Bruggencate *et al.*, 2018; Barbosa Neves *et al.*, 2019). Older adults like helping others because sharing useful knowledge with the younger generations can make them feel a strong sense of pride and self-esteem (Lai, 2007; Wang *et al.*, 2017), and they can also get a sense of satisfaction and accomplishment via achieving goals such as gaining new knowledge (Kim and Merriam, 2004; McWilliams and Barrett, 2018; Chiu *et al.*, 2016). The above conclusion applies to the context of older adults in VCs because engaging in KC/KS activities helps older adults enrich their sense of enjoyment and meaning and directs them to meaningfully spend their remaining time. Thus, we posited that the pursuit of MIL can positively influence older adults' KC/KS behaviors. As MIL refers to the pursuit and attainment of worthwhile goals and an accompanying sense of fulfilment, and, as helping others via contributing knowledge or sharing personal life experiences usually bring people a higher level of sense of accomplishment and emotional satisfaction (Noguchi, 2015; Chai *et al.*, 2011; Zhang *et al.*, 2017), we posited that MIL is thus, likely to be more strongly related to KC activities than KS activities. We, therefore, hypothesized:

H3a. An older adult's MIL positively affects his/her KC/KS behaviors in a VC. This effect is stronger for KC than for KS.

Older adults are more likely to participate in those activities that can help them engage actively with life, become adaptive and seek self-satisfaction, when they perceive their remaining time as expansive (Cody *et al.*, 1999; Gonzales *et al.*, 2015; Dattilo *et al.*, 2018; Skirbekk *et al.*, 2019; Lai, 2007). As older adults are increasingly active in VCs, these have become important avenues for them for maintaining a positive and active lifestyle (Choi *et al.*, 2014; Zhou, 2018; Ryu *et al.*, 2009). However, many older adults are afraid that they are too old to use the internet, including participating in VCs (Hargittai and Dobransky, 2017). Considering that ATA refers to older adults' positive coping with their aging status, including continuing to learn new things to remain an active participant in life (Cody *et al.*, 1999), we posited that having an active and positive ATA motivates older adults to conduct KC/KS behaviors in VCs. In addition, as older adults are more likely to seek knowledge when they are concerned about their personal development (Fung *et al.*, 2001; Carstensen *et al.*, 2003; Fung and Carstensen, 2004; Hargittai and Dobransky, 2017; Sun and Zhou, 2021), we further posited that ATA is likely to be more strongly related to KS activities than KC activities and hypothesized:

H4a. An older adult's ATA positively affects his/her KC/KS behavior in a VC. This effect is stronger for KS than for KC.

2.4.2 Moderating effects. The sustainable development of VCs depends on community MP and the resources shared by them (Yan and Tan, 2014; Koh *et al.*, 2007; Chiu *et al.*, 2006; Zhou *et al.*, 2020; Zhang *et al.*, 2017; Wang *et al.*, 2020). MP in a VC creates two effects – complementary and substitution effects. First, we discuss the complementary effects of MP. A high degree of MP in a VC creates opportunities for creating new knowledge through KC activities and finding new knowledge resources through KS activities. High MP in terms of the frequency of the activities and discussions implies that community members are more

active in the community, more frequently seek new knowledge and ask questions in the community and contribute new knowledge that others might be looking for. Further, as a consequence of a higher level of new knowledge contribution by VC members, those seeking knowledge are more likely to find the knowledge they are looking for. Accordingly, in a VC with high MP, VC members have more opportunities for achieving their expected outcomes via their KC/KS behaviors (Yan and Tan, 2014; Koh *et al.*, 2007; Chiu *et al.*, 2006; Zhou *et al.*, 2020; Guo *et al.*, 2020).

We posited that through this above process, MP serves a complementary environmental factor that can positively moderate and thereby enhance the effects of OE-self and OE-others on VC members' KC/KS behaviors (Frey and Jegen, 2000; Osterloh *et al.*, 2002; Osterloh and Frey, 2000; Guo *et al.*, 2020; Chang and Chuang, 2011). However, as we discussed earlier, OE for older adults can be segmented into OE-self and OE-others based on the different goals prioritized by older adults depending on their perceptions of the remaining time in life. Further, as also discussed earlier, OE-others and KC activities are more aligned with emotionally-oriented goals, while OE-self and KS activities are more aligned with future-oriented goals. Accordingly, for the effects of OE-others, we expected the positive moderation by MP to be stronger for the impact of OE-others on the KC relationship than for the impact of OE-others on KS relationship. Similarly, for the effects of OE-self, we expected the positive moderation by MP to be stronger for the impact of OE-self on the KS relationship than for the impact of OE-self on the KC relationship. Therefore, we hypothesized:

H1b. Other MP positively moderates the effects of an older adult's OE-others on his/her KC/KS behaviors in a VC; that is, the positive effects of OE-others on KC/KS are enhanced when other MP is high and are diminished when other MP is low. This effect is stronger for KC than for KS2.

H2b. Other MP positively moderates the effects of an older adult's OE-self on his/her KC/KS behaviors in a VC; that is, the positive effects of OE-self on KC/KS are enhanced when other MP is high and are diminished when other MP is low. This effect is stronger for KS than for KC.

We now discuss the substitution effects of MP that curiously result as an offshoot of the high degree of participation by members in the activities and discussions within the VC, which initially created the complementary effects discussed above. As a result of a high degree of MP in the VC, which involves asking and answering questions (i.e. KS and KC activities), a bigger base of knowledge resources is created and becomes available to all members (Yan and Tan, 2014; Koh *et al.*, 2007; Chiu *et al.*, 2006; Wang *et al.*, 2020; Ardichvili *et al.*, 2003; Zhang *et al.*, 2017). This availability of already answered questions reduces the opportunities for VC members to contribute new information and knowledge that is different from what already exists in the VC's knowledge base, thereby dampening the KC activities in the VC.

Moreover, as individuals in general and older adults, in particular, are vulnerable to information overload, a bigger base of knowledge resources within the VC might also deter older adults from sifting through the large number of answers and information related to their question, thereby dampening their KS activities in the VC (Manafo and Wong, 2012; Shrivastav and Hiltz, 2013). Furthermore, even if individuals seek answers to their questions, that is, engage in KS activities, there is no guarantee that others will answer those questions if similar questions have been answered before, thereby further dampening the KC activities in the VC. This essentially becomes a vicious cycle as reduced KC activities would result in lower knowledge resources in the VC, which may then dampen KS activities in the VC.

We posited that through this process, MP serves as a substitute environmental factor that can negatively moderate and thereby dampen the effects of MIL and ATA on VC members' KC/KS behaviors (Frey and Jegen, 2000; Osterloh *et al.*, 2002; Osterloh and Frey, 2000; Guo *et al.*, 2020; Chang and Chuang, 2011). However, as we discussed earlier, MIL and KC

activities are more aligned with emotionally-oriented goals, while ATA and KS activities are more aligned with future-oriented goals. Accordingly, for the effects of MIL, we expected the negative moderation by MP to be stronger for the impact of MIL on the KC relationship than for that on the KS relationship. Similarly, for the effects of ATA, we expected the negative moderation by MP to be stronger for the impact of ATA on the KS relationship than for that on the KC relationship. Therefore, we hypothesized that:

H3b. Other MP negatively moderates the effects of an older adult's MIL on his/her KC/KS behavior in a VC; that is, the positive effects of MIL on KC/KS are diminished when other MP is high and are enhanced when other MP is low. This effect is stronger for KC than for KS.

H4b. Other MP negatively moderates the effects of an older adult's ATA on his/her KC/KS behavior in a VC; i., the positive effect of ATA on KC/KS are diminished when other MP is high and are enhanced when other MP is low. This effect is stronger for KS than for KC.

Older adults' self-efficacy, age, gender, education, prior VC experience and living status may also influence their KC/KS activities in VCs (Lam and Lee, 2006; Zhou, 2018; Choi *et al.*, 2014). Therefore, we incorporated them as control variables in our models.

3. Methodology

3.1 Data collection

We collected data using a web-based survey in three VCs supported by Baidu.com in China that specifically cater for older adults. The survey was approved by the administrators of these three VCs [3]. Participation in the survey was voluntary; however, we randomly selected 50 lucky survey participants and provided each of them with one textbook. The survey was accessible for 60 days, and 265 data points were collected. As the data were collected from three VCs, we conducted a *T*-test to check the inter-group difference. We added a categorial variable (i.e. Groups, value = 1, 2, 3) and examined the differences of two demographical variables (i.e. age and gender) among different groups. The results show there were no significant inter-group differences, and the three groups could be merged into one data set. After deleting the survey responses with incomplete data and those of respondents younger than 55 years (Lam and Lee, 2006), our final sample consisted of 204 data responses (Table 1).

3.2 Psychometric properties of scales

Scales for all variables used in this study were taken from prior research but were adapted to fit the needs of our research context (Appendix 1). Table 2 includes the descriptive statistics and reliability measures for all the variables. The Cronbach's α values, composite reliability measure values and average variance extracted (AVE) values for all variables, respectively, are greater than suggested values of 0.60 (Nunnally, 2010), 0.70 (Hair *et al.*, 1992) and 0.50 (Hair *et al.*, 1992), respectively. These tests provided sound support for the convergent validity in our measurement model.

Two methods were used to estimate discriminant validity. First, item loadings on their respective constructs are all greater than those on other constructs, as shown in Table 2,

Table 1 Demographic profile

Variables		*Fre.*	*Per. (%)*	*Variables*		*Fre.*	*Per. (%)*
Age	55~64	139	68.1	Education	High school and below	65	31.9
	>=65	65	31.9		Some college	78	38.2
Gender	Female	90	44.1		Bachelor's degree and above	61	29.9
	Male	114	55.9	Prior VC experience	=<1 year	36	17.6
Living status	Living with spouse	122	59.8		>1 year and <3 years	67	32.8
	Other living arrangements	82	40.2		>=3 years	101	49.5

Notes: Fre. = frequency; Per. = percentage; VC = virtual community

Table 2 Descriptive statistics and reliability measures

Items \ Variables	SE	MP	MIL	OE-others	ATA	OE-self	KC	KS
SE1	0.762	0.201	0.098	0.189	0.177	0.160	0.196	0.271
SE2	0.788	0.185	0.170	0.176	0.193	0.100	0.270	0.260
SE3	0.813	0.248	0.123	−0.019	0.156	0.202	0.158	0.129
MP1	0.136	0.836	0.071	0.142	0.125	0.139	0.231	0.206
MP2	0.140	0.864	0.070	0.138	0.172	0.182	0.156	0.217
MP3	0.200	0.876	0.044	0.032	0.153	0.127	0.165	0.158
MP4	0.166	0.870	0.078	0.141	0.136	0.158	0.156	0.152
MIL1	0.012	0.078	0.784	0.014	−0.040	0.043	0.148	0.181
MIL2	0.106	0.042	0.900	−0.057	0.105	0.072	0.043	0.080
MIL3	0.091	0.024	0.911	0.017	0.087	0.051	0.099	−0.004
MIL4	0.099	0.065	0.823	0.137	0.163	−0.092	0.086	0.045
OE-others1	0.229	0.343	0.039	0.648	0.220	0.342	0.284	0.286
OE-others2	0.192	0.312	0.092	0.731	0.257	0.256	0.262	0.232
ATA1	0.120	0.099	0.091	0.189	0.890	0.054	0.153	0.158
ATA2	0.129	0.173	0.104	0.201	0.866	0.061	0.155	0.143
ATA3	0.178	0.208	0.127	−0.090	0.872	0.045	0.048	0.124
OE-self1	0.265	0.361	0.018	0.198	0.073	0.743	0.231	0.278
OE-self2	0.244	0.332	0.048	0.201	0.089	0.798	0.211	0.196
KC1	0.195	0.202	0.155	0.157	0.113	0.116	0.817	0.264
KC2	0.168	0.197	0.164	0.124	0.135	0.151	0.869	0.160
KC3	0.212	0.270	0.147	0.079	0.151	0.131	0.807	0.159
KS1	0.195	0.233	0.128	0.112	0.202	0.154	0.204	0.841
KS2	0.177	0.271	0.089	0.107	0.166	0.211	0.242	0.812
KS3	0.284	0.248	0.174	0.148	0.161	0.088	0.176	0.782
Mean	5.33	5.22	5.81	5.76	5.50	5.71	5.18	5.59
SD	1.146	1.245	1.043	1.350	1.360	1.295	1.174	1.169
Cronbach's α	0.907	0.961	0.895	0.935	0.925	0.934	0.938	0.945
C.R.	0.913	0.939	0.899	0.936	0.931	0.935	0.940	0.948
AVE	0.778	0.794	0.693	0.880	0.819	0.878	0.839	0.858

Notes: ATA = attitude toward aging; KC = knowledge contributing; KS = knowledge seeking; MIL = meaning in life; MP = members' participation; OE = outcome expectations; SE = self-efficacy

which provides evidence for the discriminant validity of our scales. Second, the AVE square root values in bold on the main diagonal are all greater than the inter-correlations among all study constructs shown in the bottom triangle of this correlation table (Table 3), demonstrating good discriminant validity among all study variables.

We also addressed the common methods bias (CMB) issue. We dispersed all scale items throughout the questionnaire (Aiken *et al.*, 1991) and allowed one response per Internet protocol (IP) to control for CMB. Further, we tested the interaction models, and those interactions among variables were not likely to have been apparent to the respondents, minimizing the possibility that respondents would have provided answers based on expected correlations. Finally, we also used Harman's one-factor test method to statistically assess CMB (Podsakoff *et al.*, 2003). The first factor captured only 15.998% of the variance. Based on all these efforts, there was no reason to believe that CMB was a potential threat.

4. Results

We used a hierarchical approach to run ordinary least squares (OLS) regression models via SPSS Statistics 20 to test our hypotheses (Models 1 and 3 in Table 4) (Ke and Zhang, 2010). As some of the results from the full OLS models with all variables were not significant, we ran OLS models with only those variables and those interactions in the model where we hypothesized larger effects (in addition to control variables, Models 2 and 4 in Table 4). For example, we hypothesized a stronger effect of OE-self on KC than on KS, while we

Table 3 Correlation table

	1	2	3	4	5	6	7	8	9	10	11	12	13
Gender (1)	–												
Age (2)	0.057	–											
Education (3)	−0.010	0.084	–										
Prior VC experience (4)	0.035	0.213**	0.126	–									
Living status (5)	0.124	0.019	−0.094	−0.068	–								
Self-efficacy (6)	−0.007	−0.015	0.124	0.293**	−0.166*	**0.882**							
MP (7)	0.122	0.046	−0.082	0.309**	−0.059	0.526**	**0.891**						
MIL (8)	−0.050	0.050	0.046	0.146*	−0.065	0.298**	0.196**	**0.832**					
OE-others (9)	0.032	0.153*	0.042	0.487**	−0.121	0.584**	0.623**	0.207**	**0.938**				
ATA (10)	0.041	0.110	0.009	0.222**	−0.111	0.454**	0.411**	0.252**	0.491**	**0.905**			
OE-self (11)	−0.061	0.027	−0.001	0.353**	−0.076	0.599**	0.629**	0.157*	0.714**	0.316**	**0.937**		
KC (12)	0.074	0.043	0.018	0.330**	−0.120	0.563**	0.524**	0.325**	0.609**	0.384**	0.544**	**0.916**	
KS (13)	0.019	0.127	0.020	0.379**	−0.119	0.606**	0.564**	0.292**	0.626**	0.448**	0.587**	0.566**	**0.926**

Notes: Values in bold in the main diagonal are the AVE square roots; ATA = attitude toward aging; KC = knowledge contributing; KS = knowledge seeking; MIL = meaning in life; MP = members' participation; OE = outcome expectations; VC = virtual community; all *p*-values are reported for two-tailed t-tests; $^{*}p < 0.05$; $^{**}p < 0.01$

Table 4 Hypothesis test and model comparison

Model test / *Variables*	*KC model*				*KS model*				*Hypothesis test*
	Model 1 (full model)		*Model 2 (stronger effect variables only)*		*Model 3 (full model)*		*Model 4 (stronger effect variables only)*		
	β (S.E.)	t	*β (S.E.)*	t	*β (S.E.)*	t	*β (S.E.)*	t	
Gender	0.048 (0.107)	0.914	0.04 (0.053)	0.754	−0.001 (0.103)	−0.013	−0.003 (0.051)	−0.067	
Age	−0.006 (0.114)	−0.113	−0.017 (0.053)	−0.317	0.049 (0.111)	0.951	0.071 (0.051)	1.393	
Education	−0.008 (0.07)	−0.146	−0.016 (0.055)	−0.288	−0.009 (0.068)	−0.16	−0.021 (0.053)	−0.399	
Prior experience	0.049 (0.078)	0.836	0.044 (0.059)	0.738	0.078 (0.075)	1.359	0.122* (0.055)	2.192	
Living status	−0.014 (0.106)	−0.264	−0.012 (0.053)	−0.229	−0.016 (0.103)	−0.325	−0.023 (0.051)	−0.452	
SE	0.211** (0.072)	2.911	0.254*** (0.069)	3.693	0.272*** (0.07)	3.87	0.312*** (0.069)	4.505	
MP	0.143φ (0.073)	1.957	0.140* (0.069)	2.022	0.122φ (0.071)	1.731	0.158* (0.07)	2.249	
OE-others	**0.346** (0.111)**	**3.121**	**0.436*** (0.094)**	**4.634**	0.235* (0.107)	2.196			*H1a*: yes
OE-self	0.118 (0.087)	1.361			**0.179* (0.084)**	**2.127**	**0.260** (0.078)**	**3.351**	*H2a*: yes
MIL	**0.138* (0.055)**	**2.532**	**0.130* (0.055)**	**2.373**	0.083 (0.053)	1.562			*H3a*: yes
ATA	−0.005 (0.064)	−0.078			**0.079 (0.062)**	**1.265**	**0.137* (0.058)**	**2.386**	*H4a*: partially
MP * OE-others	**0.116 (0.082)**	**0.981**	**0.172* (0.054)**	**2.201**	0.038 (0.079)	0.330			*H1b*: partially
MP * OE-self	−0.043 (0.073)	−0.441			**0.127 (0.071)**	**1.346**	**0.126φ (0.05)**	**1.891**	*H2b*: partially
MP * MIL	**−0.136* (0.055)**	**−2.546**	**−0.120* (0.055)**	**−2.216**	0.047 (0.053)	0.899			*H3b*: yes
MP * ATA	0.163** (0.06)	2.693			**−0.120* (0.058)**	**−2.047**	**−0.108* (0.054)**	**−2.014**	*H4b*: yes
R^2 (%)	0.526		0.500		0.556		0.535		
A. R^2 (%)	0.489		0.472		0.521		0.508		
F	13.929***		17.469***		15.699***		20.046***		

Notes: All *p*-values are reported for two-tailed *t*-tests; φ $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; ATA = attitude toward aging; H = hypothesis; KC = knowledge contributing; KS = knowledge seeking; MIL = meaning in life; MP = members' participation; OE = outcome expectations; SE = self-efficacy

hypothesized a stronger effect of OE-others on KS than on KC. Therefore, in the reduced KC model (Model 2 in Table 4), we only included OE-self and not OE-others, while in the reduced KS model (Model 4 in Table 4), we only included OE-others and not OE-self.

4.1 Direct effects

The effects of OE-others on KC/KS are positive and the coefficient of KC is greater than that of KS, providing evidence that older adults with high OE focused on benefiting others are

more likely to contribute knowledge in VCs to benefit others than seek knowledge for their own future benefits. Thus, *H1a* is supported.

The effects of OE-self on KC/KS are positive and the coefficient of KS is greater than that of KC, providing evidence that older adults with high OE focused on benefiting themselves are more likely to seek knowledge for their own future benefit than contribute knowledge in VCs for benefiting others. Therefore, *H2a* is supported.

The effects of MIL on KC/KS are positive and the coefficient of KC is greater than that of KS, as hypothesized in *H3a*, providing evidence that older adults with high MIL are more likely to contribute knowledge in VCs to increase their own meaningfulness rather than seek knowledge for future gains for themselves.

The effect of ATA on KC is negative and on KS, it is positive. The coefficient of KS is greater than that of KC, as hypothesized in *H4a*, providing evidence that older adults with a positive ATA are more likely to seek knowledge in VCs for future gains for themselves rather than increase their own meaningfulness. Considering that only the effect of MIL on KC is significant, both *H3a* and *H4a* are partially supported.

4.2 Moderating effects

The effects of MP on the relationships between OE-others on KC/KS are positive and the interaction coefficient of OE-others and MP on KC is greater than that of KS, as hypothesized in *H1b*, providing evidence that MP complements the impacts of OE-others on KC/KS and the effect is stronger for KC than for KS. As both effects are insignificant, *H1b* is partially supported.

The effect of MP on the relationship between OE-self on KS is positive, as hypothesized in *H2b*, providing evidence that MP complements the impact of OE-self on KS. The interaction coefficient of OE-self and MP on KS is greater than that of KC, as hypothesized in *H2b*, providing evidence that the effect is stronger for KS than for KC. As both effects are insignificant, *H2b* is partially supported.

The effects of MP on the relationship between MIL and KC are negative, as hypothesized in *H3b*, providing evidence that MP substitutes the impact of MIL on KC. The interaction coefficient of MIL and MP on KC is greater than that of KS, as hypothesized in *H3b*, providing evidence that the effect is stronger for KC than for KS. *H3b* is partially supported. Following the procedures recommended by Aiken *et al.* (1991), we drew the plot for the significant moderating effect (Figure 2).

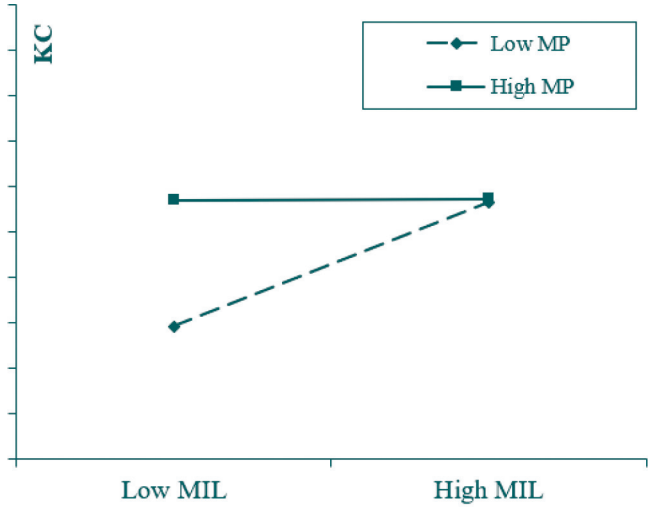
The effect of MP on the relationship between ATA and KS is negative, as hypothesized in *H4b*, supporting evidence that MP substitutes the impact of ATA on KS. The effect of MP on the relationship between ATA and KC is positive, supporting evidence that MP complements the effect of ATA on KC. The effect of MP on the relationship between ATA and KC is significant but positive, supporting evidence that MP complements the impact of ATA on KC. *H4b* is partially supported. Specifically, when MP is high, older adults will lessen their KS behaviors but increase their KC behaviors.

The positive moderating effect is unexpected. We attribute this unexpected finding to older adults' characteristics. As shown in prior research, older adults usually behave politely online and are more likely to show their approval and praise to others when they find that their age peers contribute their "wisdom" in VCs, even when that "wisdom" is of low quality (Tommaso, 2015). Namely, the enhanced KC behaviors might be participating in discussions such as showing kind words or approval other than meaningful knowledge contribution. We drew the plots for the two moderating effects (Figures 3 and 4).

5. Discussion

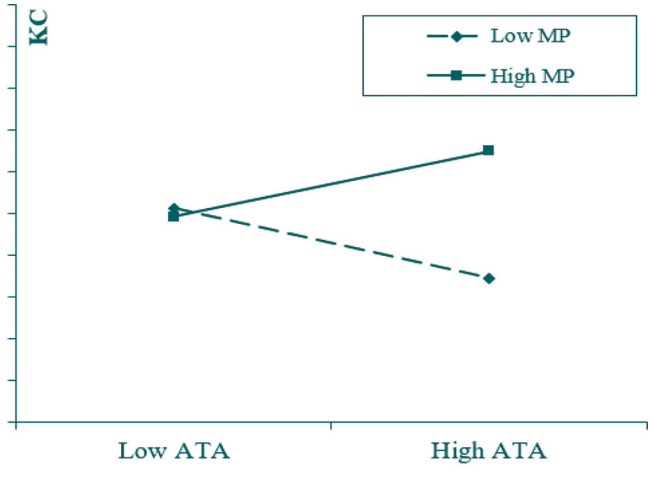
Alongside the hypotheses, our results provide some additional unique insights about the KC and KS activities of older adults in VCs. First, among all the predictors, OE-others is the

Figure 2 MP negatively moderating the effect of MIL on KC



Notes: KC = knowledge contributing; MIL = meaning in life; MP = members' participation

Figure 3 MP positively moderating the effect of ATA on KC

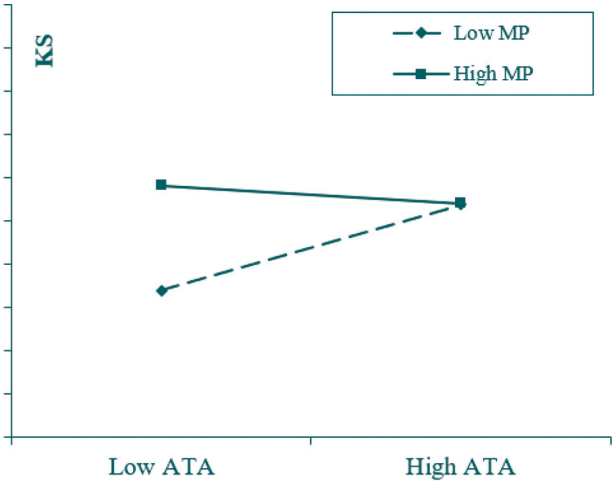


Notes: ATA = attitude toward aging; KC = knowledge contributing; MP = members' participation

most powerful factor that influences both KC and KS activities of older adults, but with a stronger effect on KC activities. MIL is the second most powerful factor that influences older adults' KC activities. Taken together, these findings suggest that older adults prioritize emotional meaningfulness over future orientation.

Second, while our *H4b* holds and we indeed found a higher negative coefficient of MP as a moderator on the ATA → KS relationship, we also found that MP has a complementary effect that enhances the impact of ATA on older adults' KC activities. Based on the literature, we expected and found that older adults with a high future orientation in terms of

Figure 4 MP negatively moderating the effect of ATA on KS



Notes: ATA = attitude toward aging; KS = knowledge seeking; MP = members' participation

high ATA are driven to primarily seek new knowledge in a VC (*H4a*). Perhaps, the ATA → KC relationship becomes stronger because future-oriented older adults feel compelled to make knowledge contributions in the VC to conform to the others when there is high MP and accordingly, high KC by others as well.

5.1 Theoretical contributions

We contributed to the literature on knowledge management in VCs by advancing our understanding of older adults' KC/KS activities in VCs, which is quite sparse, in four ways. First, by integrating the notions and variables from SST and SCT and using synthetic logic, we developed two models that are comprehensive yet parsimonious and are unique to the emerging yet crucial older adult population to explain their KC/KS behaviors in VCs. Our empirical results provide support to our hypotheses, albeit partially and/or weakly in three of the eight cases.

Second, we addressed information systems (IS) scholars' concerns about how to describe older adults' unique characteristics when modeling their ICTs-related behaviors. While OE has been established as an important predictor of behaviors in VCs, to describe and model older adults' KC/KS behaviors in VCs, we divided the OE construct into two sub-constructs based on the notions in SST. Moreover, we used MIL to capture older adults' positive reactions when they perceive their remaining time as limited and ATA to capture their positive reactions when they perceive their remaining time as open and expansive. As discussed in the theory section and in consonance with SST, we did not use biological age as this variable has not been found to be predictive of older adults' behaviors. The above endeavors – modeling older adults' characteristics and examining their impacts – are a direct response to prior appeals from IS scholars not only to provide insights into how to capture and describe older adults' characteristics that might influence their ICTs-related behaviors but also to explore the impacts of these characteristics on their ICTs usage (Ryu *et al.*, 2009; Wagner *et al.*, 2010; Yang, 2019; Quan-Haase *et al.*, 2016; Hong *et al.*, 2013; Ghasemaghaei *et al.*, 2019).

Third, we also hypothesized and found that the same factor has different levels of impact on KC and KS behaviors. In a similar vein, we found that the impact of ATA is greater on KS than on KC, while the impact of MIL is greater on KC than on KS because of the alignment of these variables with the perceptions of remaining time either as expansive or as limited, respectively. The above findings further reinforce the central role that perceptions of remaining time play in the behaviors of older adults, a concern not usually germane to younger adult populations and thereby advance the literature by demonstrating the importance of developing these unique KC/KS models for older adults.

Finally, this study also confirmed and reinforced the complementary and substitutive effects of MP as an environmental factor on older adults' KC/KS behaviors, a notion that is central to SCT and effects that have been empirically found in other studies of online behaviors. The different moderating effects of MP provide new evidence of the different roles that social environmental factors play in supporting or hindering older adults' ICT use (Xiong and Zuo, 2019; Zhou, 2018). Further, the two substitutive effects remind us that older adults' KC/KS behaviors might be impeded in VCs that are highly active and have many knowledge resources.

5.2 Practical implications

Our research has three practical implications for organizations and VC practitioners. First, organizations could use knowledge-intensive VCs to outsource some of their business to older adults. The gig economy is a new labor-hiring style that allows people to work flexibly and in a self-directed and limitless way and has been changing traditional employee-employer relationships (Ravenelle, 2019; Vallas and Schor, 2020). Organizations that want to reduce their human resource costs could post their operational or business problems in VCs and attract older adults to contribute their wisdom. Companies could provide older adults with intrinsic rewards other than money (e.g. reputational badges or titles such as "certified expert"). This approach will be costless because, as our empirical results show, older adults' KC activities are more intrinsically motivated and pay relatively less attention to material rewards.

Second, entrepreneurial companies in the gig economy can consider building older adult-specific intermediary platforms to develop elder human resources. Older adults, including elder employees, represent large reservoirs of life experience, job skills and other valuable knowledge. However, older adults have unique characteristics and behave differently than young people when using ICTs. Current gig economy platforms aimed at young people might not work for older adults. We recommend that entrepreneurial companies take older adults' characteristics into consideration and develop special platforms for them. These platforms can imitate the mechanisms of current gig economy platforms, and companies can set up business units to attract older adults and use their knowledge and life wisdom.

Finally, VC managers should encourage older adults to interact with each other. Our empirical results show that MP provides older adults with opportunities to fulfil their others/self-focused expectations. VCs managers should design and launch more activities that could bring fun, enjoyment, new friends and new social ties to older adults. These activities could attract more older adults to actively participate in VCs and, in turn, generate more knowledge.

5.3 Limitations

We acknowledge two limitations. First, we only had two items for the OE-others and OE-self variables because we divided the OE scale into two sub-constructs based on our theorizing rooted in SST of the differential impacts that these two constructs are likely to have on the KC/KS behaviors of older adults. While three or more items in a scale are preferred in survey-based empirical studies, the two-item scales used in this study might not unduly affect our findings, as two-item scales have been used in prior studies and have been found

to show acceptable reliability (Eisinga *et al.*, 2013). Further, our rigorous scale validation procedures provided evidence of high reliability and validity. Nonetheless, results should be interpreted with caution.

Second, multicollinearity is often an issue in empirical studies and may be a concern in the present study, as we used two related constructs (i.e. OE-others versus OE-self) (Mason and Perreault, 1991). Accordingly, to formally assess multicollinearity, we computed VIF values in both our models. We found only one VIF value to be greater than 5 (at 5.561), which is lower than the common rule of thumb of 10 (Mason and Perreault, 1991), indicating that while a low degree of multicollinearity exists, it is not a serious issue.

5.4 Future research

As older adults are increasingly active on online platforms such as VCs, their KC/KS activities are emerging yet promising research topics in knowledge management. This current study merely examined the antecedents of older adults' KC/KS behaviors in VCs, and more efforts are still needed. Scholars could take prior studies on knowledge management as references (Singh *et al.*, 2019; Cillo *et al.*, 2019; Singh, 2019; Wang *et al.*, 2020; Al Ahbabi *et al.*, 2019; Zhou *et al.*, 2020) and pay more attention to topics such as the process of older adults' knowledge exchange, mechanisms for older adults' knowledge governance, performance evaluation of older adults' knowledge exchange and the monetization of knowledge. We hope that more scholars would shift their interests to older adults and address the abovementioned topics to enrich knowledge management research.

Notes

All "a" hypotheses are of direct effects.

All "b" hypotheses are of interaction effects.

A virtual community in Baidu is essentially a Baidu Tieba, which is literally translated as a subforum. The three VCs in this current study were, namely, "happy 1950s (subjective: learning and communication, health and happiness; members: 3,690 as of March 2021)," "retired elderly (subjective: happy and free communication; members: 4,561 as of March 2021)" and "see you in 1950s (subjective: making friends with literature, reading and thinking; members: 5,704 as of March 2021)." The specific topics include life wisdoms on managing family relationships, balance between work and family, experience of retirement arrangements, maintaining health, religions, leisure travel and recommendations of books, films, shows and television programs.

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Author affiliations

Junjie Zhou is based at the School of Business, Research Institute for Guangdong-Taiwan Business Cooperation, Shantou University, Shantou, China.

Rajiv Kishore is based at the Lee Business School, University of Nevada, Las Vegas, Nevada, USA.

Meiyun Zuo is based at the School of Information, Renmin University of China, Beijing, China.

Ruochen Liao is based at the College of Business, The University of Texas at Arlington, Arlington, Texas, USA, and

Xiao Tang is based at the Johnson College of Business and Economics, University of South Carolina Upstate, Spartanburg, South Carolina, USA.

Appendix

Table A1 Scales for constructs

Constructs	*Items*	*Sources*
Other members' participation	Other members usually participate in this virtual community's operation Other members frequently participate in the activities in this virtual community Other members frequently participate in the discussions in this virtual community Other members usually communicate with each other in this virtual community	(Koh *et al.*, 2007)
Outcome expectation-others	I enjoy helping others by contributing knowledge in this virtual community I feel that contributing knowledge in this virtual community will give me a feeling of happiness	(Liao *et al.*, 2013)
Outcome expectation-self	I feel that sharing knowledge in this virtual community could bring me more friends I feel that sharing knowledge could strengthen my ties with other members in this virtual community	(Chiu *et al.*, 2006)
Self-efficacy	I have confidence in my ability to share knowledge that other members in this virtual community consider valuable I have confidence in responding or adding comments to messages or articles posted by other members in this virtual community I have confidence in my ability to solve some of the other members' problems in this virtual community	(Chen and Hung, 2010)
Attitude toward aging	I feel like I can learn new things I feel like I am an active participant in life I feel optimistic about the future	(Cody *et al.*, 1999)
Meaning in life	I have a philosophy of life that helps me understand who I am I feel like I have found a really significant meaning in my life I have a sense of direction and purpose in life I am at peace with my past	(Krause, 2007)
Knowledge contribution	I frequently participate in knowledge contribution activities in this virtual community I usually share my knowledge with other members in this virtual community I always contribute information in this virtual community	(Hsu *et al.*, 2007)
Knowledge seeking	I frequently seek useful knowledge from this virtual community I usually seek information from other members in this virtual community I usually involve myself in learning various types of knowledge that is available in this virtual community	

Corresponding author

Meiyun Zuo can be contacted at: zuomy@ruc.edu.cn

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