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How Can Information Systems Strengthen Virtual Communities? Perspective of Media Richness Theory

Completed Research Paper

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Abstract

Media richness was known as important in designing information and communication technologies (ICTs). However, no studies have examined how the four aspects of media richness could help fuel users' commitment to virtual communities, indicating a gap. Hence, we use media richness theory and initiate to use its key elements (i.e., message certainty and message unequivocality) to construct a research framework. We collected 1,971 responses from virtual communities in online games and used structural equation modeling for testing the hypotheses. We found that immediate feedback and personal focus are positively related to message certainty and message unequivocality that are further positively related to network convergence and interdependence, thus contributing to commitment to virtual communities. This study is the first formally incorporating and testing the key elements of media richness, i.e., message certainty and message unequivocality, and examining how media richness of information systems could fuel users' commitment to virtual communities.

Keywords: Media richness, survey, online game, virtual communities, information systems

Introduction

Virtual communities (VC) (or online communities) provide IS managers with variety of benefits, including improving brand experiences and fulfilling customer needs (Zhang et al. 2018), integrating organizational knowledge (Chou & Hsu 2018), speeding technological progress (Huang et al. 2018b), sharing information, making better decisions (Yan & Tan 2017), and enhancing entertainment value (Kim & Kim 2017). VCs can boost organizational performance. For example, VCs provide the Facebook company with a quarterly revenue of US\$9.16 billion in 2017 (Swant 2017). Such revenue roots in strongly connected VCs, indicating the importance of research into users' VC commitment.

VC literature has identified antecedents of commitment to VCs, including satisfaction, investment size (the magnitude of resources furnished in a relationship) (Hashim & Tan 2015), perceived support for member communication, perceived recognition for communication, perceived freedom of expression (Yang et al. 2017), and identification trust (Hashim & Tan 2015). Moreover, relational cohesion deepens commitment to online relationships in VCs (Huang et al. 2018a). These antecedents have indicated the importance of presentation, expression, and communication in forming users' commitment to VCs. Communications are strongly recognized and encouraged by VCs (Yang et al. 2017), indicating that VCs highly value communication effectiveness. Communications can be effective as IS capabilities support users to express rich information, i.e., enhanced media richness. Media richness provides social rewards and encourages individuals to engage in self-disclosure (Jiang et al. 2013), improves decision quality (Dennis & Kinney 1998), and delivers functional and social values to

users (Tseng et al. 2017), indicating that media richness is important to forming commitment to virtual communities. However, the literature has not yet examined whether and how media richness can help formulate commitment to VCs, indicating a research gap.

Research filling this gap can assist IS managers to enhance users' commitment to VCs, which helps produce enormous revenue (Swant 2017), indicating the practical relevance. Research filling this gap could also introduce the usefulness of media richness theory (MRT) to IS studies for explaining users' commitment to VCs, indicating the academic impact. Both the academic and practical contribution of research on filling this gap warrant its necessity to the scholarly communities (Rai 2017).

To fill the gap, we reviewed the VC literature and found that members' participation in VCs can be predicted by their engagement in message exchange (Bock et al. 2015). Message exchange via media has been well explained by the MRT in the ICT contexts (Tseng et al. 2017), motivating the present study to adopt this theory. MRT has four message characteristics as its core elements, i.e., immediate feedback, personal focus, language variety, and multiple cues (Daft & Lengel 1986), justifying adoption of these four elements for explaining commitment to VCs.

In VCs, message content is important to effective communication. Specifically, expressing positive, concise, and simple messages is important for being identified as community leaders (Johnson et al. 2015), indicating the importance of message characteristics. MRT (Daft & Lengel 1986) has identified two independent aspects to evaluate message characteristics, i.e., unequivocality (the degree to which information is easy-to-understand) and certainty (information sufficiency). These two characteristics should enhance communication effectiveness. Effective communications are strongly encouraged and recognized in VCs (Yang et al. 2017), indicating their suitability in VCs. Hence, we include these two characteristics in our research framework.

VCs can be evaluated in terms of network convergence (i.e., the degree to which members shared common friends) and interdependence (i.e., the degree to which members depend on each other to make decisions) (Teng 2015). Moreover, shared common friends can be shared information sources, while dependency on friends to make decisions likely reflects their strong emotional ties. Both shared information sources and strong emotional ties could predict sustainability of virtual communities (Bock et al. 2015), indicating the importance of network convergence and interdependence and motivating us to adopt these two variables as the process variables.

In addition to identifying and filling an existing research gap, this study follows the suggestion of Alvesson and Sandberg (2011) to engage in the problematization process. Specifically, we identify that MRT has an implicit assumption that message interpretation only impacts the outcomes in one-to-one communication. However, we challenge this assumption with an alternative assumption, i.e., media characteristics influence the outcomes in networked communication. Our alternative assumption extends the MRT to explain issues on VCs, boosting its usefulness in the IS area.

Therefore, the purpose of this study is to examine how the four aspects of media richness impact the message certainty and unequivocality, fuel network convergence and interdependence, and subsequently on users' commitment to the VCs. Overall, this study contributes to the IS area by clarifying the impact of the four aspects of media richness on building strongly connected VCs and clarifying the underlying mechanism. Such clarification guides IS managers to effectively allocate their resources for designing their systems for developing their user communities. The inclusion of IS/IT features (i.e., media richness) justifies this study as an IS study (Rai 2017).

Compared with the pertinent IS studies, this study contributes in several aspects. First, Jiang et al. (2013) examined the links among media richness, social rewards, and self-disclosure in online chat rooms. Consistent with Jiang et al. (2013), the present study examined how media richness impacts users' behavior in computer-mediated communications. However, the present study is novel in examining the four aspects of media richness, providing enhanced insights for effectively improving media richness. Moreover, the present study uniquely clarifies how media richness could help build strongly connected VCs. Such clarification could lead future IS studies to examine the usefulness of media richness in VCs, enhancing the impact of the media richness literature.

Second, in online community contexts, Spaeth et al. (2015) examined the relations among community-based credibility, social identification with the community, and motivation to participate in non-incentivized projects. Such relations demonstrate the importance of members' devotion into VCs. The present study is consistent with Spaeth et al. (2015) in examining devotion into VCs. However, the present study clarifies how IS providers could focus on media richness aspects and thus enhance members' commitment to VCs. The present study contributes to the literature by indicating the likelihood that media richness and its elements may be sources to effective community-based communications, leading to community-based credibility and motivation to participate.

Third, Yang et al. (2017) examined how social relations moderate the impact of online communities' support for communication on members' commitment. Our study also examines the role of social relations in the impact of communications on members' commitment, but is new in using network convergence and interdependence (i.e., two network features) to describe the social relations embedded in the members' networks, envisioning future studies to include network features to explore how they moderate the impact by Yang et al. (2017).

Literature Review

Commitment to Virtual Communities

Commitment to VCs (or community involvement) refers to members' active participation, contributing behavior (Choi et al. 2015), and strong psychological attachment to the VCs (Gupta et al. 2010). Such commitment is important to IS managers as it represents strong intensity of interactions that are closely related to trust (Bapna et al. 2017) and the intention to remain with the community (Casaló et al. 2010). Commitment to VCs is important to IS managers in helping develop software (Bateman et al. 2011). Moreover, commitment to VCs motivates members to contribute to the VCs, including voluntary participation (Spaeth et al. 2015). Continuous contributions help develop VCs.

The IS literature has identified antecedents to commitment to VCs, including perceived support for member communication, perceived recognition for communication, perceived freedom of expression (Yang et al. 2017), attitude toward VCs (Gupta et al. 2010), social capital (Huang et al. 2016). Moreover, IS studies have found that network structure can bring value to its network residents (Leonardi 2014), indicating the social networks could be sources of commitment to VCs. Among social network variables, the pertinent literature has recently examined network convergence and interdependence (Huang et al. 2018a), motivating us to review the literature on these important factors.

Network Convergence and Interdependence

Network convergence refers to the degree to which individuals share friends (Parks & Floyd 1996), which usually forms strong relationships in social communities (Choi et al. 2015) and create relational switching cost (Tseng et al. 2015). Network convergence encourages continual engagement (Huang et al. 2018a), justifying our inclusion of network convergence. Network convergence has various antecedents, including conscientiousness (Huang et al. 2018a), the need for affiliation, altruism, social intelligence, and their interactions (Teng 2015). These known antecedents are either personality-related or team orientation, which may not be viable by IS managers, warranting research on viable IS capacity of delivering rich information to facilitate communications.

Interdependence refers to the degree to which individuals depend on one another to make decisions (Parks & Floyd 1996). Interdependence has been considered in the IS area as important in understanding group behavior (Hwang & Schmidt 2011), because the IS jobs frequently require teamwork, thus imposing interdependency among colleagues (Sykes et al. 2014). Interdependence can help deepen partner relationships (Im & Rai 2014), and enhance trust toward project participants to encourage knowledge sharing (Park & Lee 2014). Individuals in VCs often depend on each other in executing tasks to complete goals (Yang et al. 2015), or make decisions (Dewon et al. 2017). Such dependence enhanced members' continual engagement (Tseng et al. 2015), justifying its inclusion.

Network convergence and interdependence describe the structure of social networks that can include the feature of core vs. periphery, which impacts users' motivation to ask questions in VCs (Lu et al. 2017), justifying their suitability in virtual community contexts.

Interdependence originates from members' personality traits, e.g., conscientiousness and agreeableness (Huang et al. 2018a). Moreover, interdependence can be formulated when individuals encounter tough challenges (Teng et al. 2012), highly complex tasks, and perceive great expertise in their partners (Park & Lee 2014). However, none studies have examined message characteristics as potential sources of interdependence, motivating us to review the media richness theory to fill the gap.

Media Richness Theory

Media richness theory (MRT) (Daft & Lengel 1986) posits that the nature of a message (equivocal or unequivocal) drives the choice of messaging medium. This theory indicates that the media providing sufficiently rich information could satisfy task needs, thus enhancing task performance (Dennis et al. 2008). This theory has been applied to online communities (Johnson et al. 2015), justifying online communities as suitable for our application of MRT as the underpinning framework.

Message richness varies across the forms of communications. For example, audio message carries richer information than instant messaging, reducing how partners perceive ending concessions as manipulative in negotiations (Johnson & Cooper 2015), i.e., media possess varied richness.

Media richness has four aspects: immediate feedback (e.g., speed in sending and receiving messages), language variety (availability of symbols that can be used to convey a large range of meaning in a message), personal focus (ability to personalize the message according to the receivers' situations), and multiple cues (number of communication channels for comprising a message) (Daft et al. 1987). Communication media influence communication effectiveness owing to two message characteristics, i.e., message certainty and unequivocality (Daft & Lengel 1986). Message certainty was defined as information sufficiency (Daft & Lengel 1986), which frees individuals from seeking more information to make messages assertive and undoubted. Unequivocality is that individuals perceive the message as easy-to-understand, straightforward, and without alternative interpretations (Daft & Lengel 1986).

These aspects of media richness and their impact have been examined in pertinent studies. Specifically, immediate feedback and multiple cues offered by computer-mediated communication tools (e.g., electronic meeting system) enhance message clarity and social perceptions, thus improving decision quality (Kahai & Cooper 2003). Moreover, these aspects of media richness deliver functional, social, and self-expressive values to users, thus formulating users' continuance intention (Tseng et al. 2017), supporting the inclusion of this theory and the four aspects of media richness in studying VCs.

Development of Hypotheses

Members in VCs have strong motivation to complete goals by sharing information. Information sharing is highly useful (Kim et al. 2017). Prompt transmission and receipt of responses via the media is defined as immediate feedback (Daft & Lengel 1986). The MRT (Daft & Lengel 1986) posits that immediate feedback enhances media richness and effective communication. Such prompt transmission of responses enables users to quickly obtain information, fueling information sufficiency, which is core to message certainty (Daft & Lengel 1986). Immediate feedback also enables synchronized communications that facilitates interactions (Dennis et al. 2008). Facilitated interactions increase perceived assertiveness and undoubtedness, i.e., message certainty (Daft & Lengel 1986).

H1: Immediate feedback is positive related to message certainty.

Language variety is helpful for delivering self-expressive value to users (Tseng et al. 2017). The reason can be explained by the MRT (Daft et al. 1987), which posits that language variety represents the range of meaning that can be expressed using language symbols in media channels (Daft et al. 1987). Language symbols provide additional information, supplying sufficient information. Moreover, expressing meanings via language symbols facilitates personal interactions (Huang et al. 2008), which further eliminate the lack of information, i.e., enhancing message certainty (Daft & Lengel 1986).

H2: Language variety is positively related to message certainty.

The MRT (Daft & Lengel 1986) posits that media richness could be enhanced via a high level of personal focus. Personal focus describes the media capability of personalizing the messages according to receivers' situations (Daft & Lengel 1986). Personalized messages effectively trigger behavior that the messages attempt to invoke (Fortin & Dholakia 2005). In VCs, such behavior could be responding to senders with messages, increasing the amount of message and providing sufficient information, or enhancing message certainty (Daft & Lengel 1986), building the link.

H3: Personal focus is positively related to message certainty.

Personal focus referred to the extent to which messages can be designed according to the situations of the receivers (Daft & Lengel 1986), i.e., create personalized messages. Personalized messages are usually appealing to message receivers, and thus can motivate message receivers to disclose their personal information, e.g., the information of their locations (Zhao et al. 2012). MRT (Daft & Lengel 1986) posits that disclosing personalized messages enriches mutual understandings that help clarify the messages, which is the core to message unequivocality (Daft & Lengel 1986).

H4: Personal focus is positively related to message unequivocality.

Multiple cues refer to the media capabilities to compose messages by using multimedia features (Daft & Lengel 1986). Multimedia representation could reduce perceived equivocality (Lim & Benbasat 2000), i.e., enhancing message unequivocality and thus building the link between multiple cues and message unequivocality. Moreover, MRT (Daft & Lengel 1986) posits that multiple cues help clarify the meaning conveyed in the messages, i.e., provide various modalities for receivers to decode the messages, thus making the messages easy to understand. Being easy-to-understand is also the core to the definition of message unequivocality (Daft & Lengel 1986).

H5: Multiple cues are positively related to message unequivocality.

MRT defines message certainty as the degree to which messages carry sufficient information for receivers to interpret the messages (Daft & Lengel 1986). Message certainty contains a key element, i.e., assertiveness, which offers strong persuasiveness to message receivers who intend to understand important messages (Kronrod et al. 2012). Therefore, message certainty could lead the receivers to concentrate on the important messages, thus improving their understanding and perceive the messages as easy-to-understand, i.e., the essence of message unequivocality (Daft & Lengel 1986).

H6: Message certainty is positively related to message unequivocality.

MRT defines message certainty as the perception of sufficient information (Daft & Lengel 1986). Perception of information sufficiency in interpreting messages reduces VC participants' hesitation to post messages (Preece et al. 2004), thus encouraging message creation and dissemination. That is, message certainty could boost the dissemination of messages via friendship networks. Message introduced by friends' friends' would be likely accepted, as individuals tend to accept those introduced by own friends (Block 2015). Receivers who tend to accept the messages would know more about, tend to agree with, and tend to make friends with the message senders, increasing the degree of overlap in friendship networks, i.e., enhanced network convergence (Parks & Floyds 1996).

H7: Message certainty is positively related to network convergence.

Message unequivocality indicates the degree to which messages are easy-to-understand, as posited by the MRT (Daft & Lengel 1986). Messages that are easy-to-understand could enhance receivers' perceived trustworthiness toward message sources (Elsbach & Elofson 2000). Trustworthiness strengthens cooperation in groups with a specific goal, i.e., IS project teams (Ferrin et al. 2008). In cooperation, partners need to consult each other to make decisions. The degree to which individuals depend on each other to make decisions indicates interdependence (Parks & Floyd 1996).

H8: Message unequivocality is positively related to interdependence.

Network convergence refers to the extent to which users share friends and create a common social circle (Parks & Floyd 1996). Network convergence is important in VCs, as it could increase relational switching cost (Tseng et al. 2015). Such cost indicates the relevancy of shared friends. Shared friends

could play the role of the influential third party, and thus should be important to the partners (who have shared friends). Therefore, an increased number of shared friends should make the partners perceive each other as more important, motivating the partners to consult each other before making decisions. Such consultation before making decisions is interdependence (Parks & Floyd 1996).

H9: Network convergence is positively related to interdependence.

Network convergence indicates the degree to which individuals share friends (Parks & Floyd 1996). Shared friends help formulate a sense of community (Tseng et al. 2015), which motivates continual engagement in VCs (Huang et al. 2018a) and to help peers (Tseng et al. 2015). Helping peers requires participants to contribute their own resources, e.g., time and expertise. Active engagement, helping peers, and contribution to peers are the core elements of commitment to VCs (Tseng et al. 2015).

H10: Network convergence is positively related to commitment to VCs.

Interdependence refers to the extent to which individuals depend on one another to make decisions (Parks & Floyd 1996). Individuals in VCs depend on each other to overcome challenges (Teng et al. 2012) and achieve their mutual goals, e.g., defeating rivals. In software project teams, interdependence facilitates members' interactions, thus enhancing members' trust toward each other (Park & Lee 2014). Trust further strengthens members' commitment to online communities (Gharib et al. 2017). Moreover, interdependence increased knowledge sharing (Park & Lee 2014), i.e., increased contribution to the communities that is the core elements of commitment to VCs (Tseng et al. 2015).

H11: Interdependence is positively related to commitment to VCs.

This framework, as shown in Figure 1, is new in including the two key elements of the MRT, i.e., message certainty and message unequivocality. Hence, these two elements and their associated hypotheses (H1-H8) are unique to the literature. Moreover, the links among network convergence, interdependence, and commitment to VCs have not been examined in the literature (H9-H11), also supporting the newness of this framework. To enhance analytical rigor, this study included six control variables, i.e., gender, age, education, income, years spent, and weekly hours spent in the VCs. These control variables were frequently used (e.g., Liao & Teng 2017), justifying our inclusion.

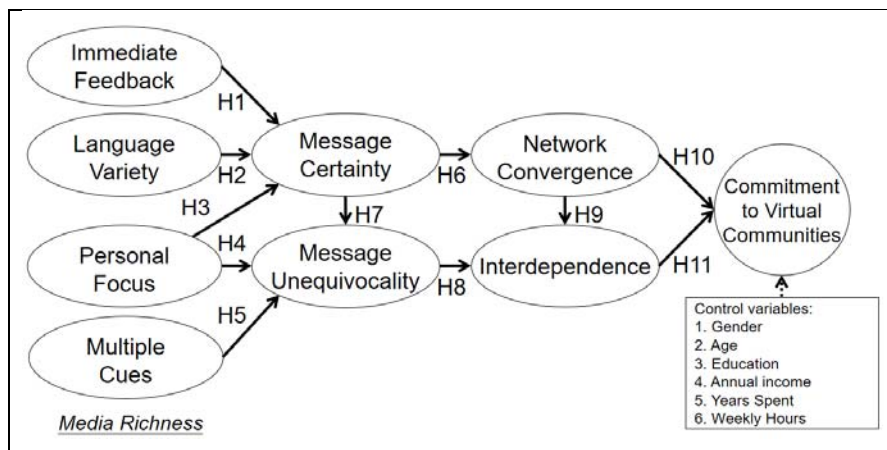


Figure 1. Research Framework

Methods

Sample and Data Collection Process

A cross-sectional design is adopted. The study constructs were verified as applicable to online gaming contexts (Teng 2015), where communication is important for engagement in games (Ho et al. 2016). Moreover, online games are valid IS contexts (Yang et al. 2015), justifying their inclusion.

This study uses an online form to collect data during September, 2017. An online form is suitable since online gamers are accustomed to using online means for communication. Invitations stated that this

study is interested in social networks and communication among online gamers. Invitations were posted on the websites and forums where online gamers frequently visit, e.g., www.gamer.com.tw. Posting in multiple websites and forums reduces the biases owing to the single source of participants.

Each participant was asked to nominate and evaluate an online game which the participant played in the recent month prior to filling the online form. This approach could increase the generality of findings by covering a variety of online games, and minimize the bias owing to the loss in memory retrieval. Inclusion of multiple online communities is acceptable, as observed in the literature (Zhao et al. 2016). However, one may note that this approach would increase the number of the targets for assessment. This issue is discussed in the limitation subsection.

The online form states that the participants should be volunteers. Informed consent process was conducted. The online form then asks the participants to rate the nominated game, rate its communication functions of the game, and assess the perceptions that are included in the research framework. Moreover, the participants were asked to provide the information on their gender, age, education, annual income, years spent playing the game, and weekly hours spent playing the game.

Participants submitting complete responses were eligible for entering in a lottery, which randomly selects 50 winners and each received a US\$6.50 gift certificate. Holding a lottery is common in online survey (e.g., Tseng et al. 2017). Moreover, the incentives are relative small in magnitude, supporting the non-substantial self-selection biases owing to such incentives.

Totally, 2,355 participants completed the online form. We consulted Steelman et al. (2014) to carefully screen invalid responses. Specifically, 39 of the participants nominated non-existent games, two indicated that they played the game longer than their age, 333 failed to pass the attention check, and ten provided duplicated responses. These 384 responses were determined as invalid and discarded, leaving 1,971 responses (83.7%) for further analyses. This study found that the early half of the responses ($n = 985$) do not significantly differ from the latter half of the responses ($n = 986$) in all study items ($t \geq 1.78$, $p \geq .08$), not showing nonresponse bias. However, as indicated by Steelman et al. (2014), online surveys typically obtain non-probabilistic samples, thus are restrained from effectively testing nonresponse bias and sampling bias. Hence, this issue is discussed in the limitations subsection.

Measurement

The four items measuring commitment to VCs came from Gupta et al. (2010), and has exhibited adequate reliability ($r = .94$) in the online gaming context, i.e., Teng (2013). The five items measuring network convergence came from Tseng et al. (2015). Such items had an origin in a communication study, i.e., Parks and Floyd (1996), while they demonstrated sufficient reliability ($r = .86$) in online gaming contexts, i.e., Tseng et al. (2015). The four items measuring interdependence came from Teng (2015). All these items were applied in online gaming contexts, indicating their applicability herein.

The present study adapted the 12 items of Tseng et al. (2017) to measuring the four aspects of media richness (three items for each aspect). Among the aspects, multiple cues were defined by using the number of available channels (e.g., text, icons, and video phones), indicating that the availabilities of channels would not be correlated, while should be summated. Therefore, the present study used the summated score on the three items for assessing multiple cues to represent its level, and used the summated score as the single item for assessing multiple cues. The definitions of message certainty and message unequivocality (Daft & Lengel 1986) were used for developing the three items for measuring each of them. Since these items were developed herein, the use of CFA is necessary.

All items had a response option ranging from 1 (very disagree) to 5 (very agree). Significance level was set at .05. Two-tailed tests were used. This study has pre-determined which items should be used to measure what constructs. Therefore, CFA was conducted to confirm such assignment.

Psychometric Properties

This study used the LISREL software to conduct CFA and SEM. The CFA was used for directly assessing reliability and validity. Specifically, all Cronbach's α values were $\geq .84$ and their 95%

confidence intervals were $\geq .82$, indicating confident reliability. The composite reliability (CR) values were $\geq .88$ and the average variance extracted (AVE) values were $\geq .69$, demonstrating sufficient reliability. All indicator loadings (λ) were $\geq .59$, indicating convergence validity (Hair et al. 1998). Moreover, all correlations were below the corresponding AVE values, reflecting discriminant validity.

The measurement model fit the data acceptably, i.e. CFI = .97, IFI = .97, NNFI = .97, RMSEA = .07. Moreover, the methodological literature (Guide & Ketokivi 2015) suggested further testing on the statistics. The present study found that RMSEA is significantly lower than .08 ($p < .001$). This study did not use χ^2 and χ^2/df as critical indices, as they were sensitive to sample size (Hair et al. 1998).

All but two correlations were between .22 and .70, indicating a ratio of 94% (=34/36). Moreover, all correlations passed the discriminant validity tests, i.e., all correlations were below the corresponding AVE values, suggesting acceptable correlations. These correlations indicate the necessity of formally testing the common method variance (CMV). As recommended by Guide and Ketokivi (2015), the present study follows the suggestion of Podsakoff et al. (2003) to include a construct for measuring all constructs. Such inclusion results in a significantly inferior fit with the data, i.e., $\Delta df = 90$, $\Delta \chi^2 = 7240.62 > \chi^2(\alpha = .05, df = 90) = 113.14$. In short, the CMV issue is not substantial in our study.

Results

Sample Profile

The participants had a profile of male (79.7 percent), no elder than 30 years old (93.1 percent), college-educated or higher (75.3 percent), and had an annual income no more than US\$ 20,000.00 (94.6 percent). This profile reflected the characteristics of the local gaming population. Moreover, the gender composition is comparable to that in the literature, i.e., 77.0 percent in Goh and Wasko (2012), 94.0 percent in Yang et al. (2015). The age range conforms to the literature, i.e., 99.7 percent of the participants were below 30 years old in Yang et al. (2015). Furthermore, the college or higher education profile is consistent with that in Goh and Wasko (2012) who found 91.8 percent of online gamers receive college or higher education.

In average, the participants played the game for 3.45 years with a standard deviation of 2.89 years. Moreover, the participants averagely spent 15.06 hours per week playing the game with a standard deviation of 16.53 hours. To retain the information on the study items, we retained the responses that contain incomplete information regarding the demographic items.

Hypothesis Testing

This study used SEM for testing the hypotheses. The use of survey and SEM is acceptable in the IS literature (Goh & Wasko 2012; Yang et al. 2015). The analysis revealed that all but two hypotheses were supported. Specifically, immediate feedback was positively related to message certainty (p.c. = .63, $t = 29.40$, $p < .001$), supporting H1. Language variety was not related to message certainty (p.c. = -.03, $t = -0.93$, $p > .05$), not supporting H2. The reason may be that a large pool of emoticons or symbols may require users' additional time and costs, and may not always be used to increase information sufficiency, thus offsetting the relation between language variety and message certainty.

Personal focus was positively related to message certainty (p.c. = .25, $t = 6.24$, $p < .001$) and message unequivocality (p.c. = .03, $t = 2.80$, $p < .01$), supporting H3 and H4. However, multiple cues were not related to message unequivocality (p.c. = .01, $t = 0.78$, $p > .05$), not supporting H5. The reason may be that multiple communication channels may increase the likelihood that users feel any consistency between information from multiple channels. Any inconsistency would hinder message receivers from assessing the message as straightforward nor easy-to-understand, offsetting the hypothesized relation.

As predicted, message certainty was positively related to message unequivocality (p.c. = .98, $t = 67.53$, $p < .001$) and network convergence (p.c. = .32, $t = 13.62$, $p < .001$), supporting H6 and H7. Moreover, message unequivocality and network convergence further were positively related to interdependence (p.c. = .09 and .79, $t = 5.66$ and 32.53 , $p < .001$), supporting H8 and H9. Network convergence and

interdependence were positively related to commitment to VCs (p.c. = .41 and .24, $t = 10.18$ and 6.12 , $p < .001$), supporting H10 and H11. Figure 2 illustrates the analytical results.

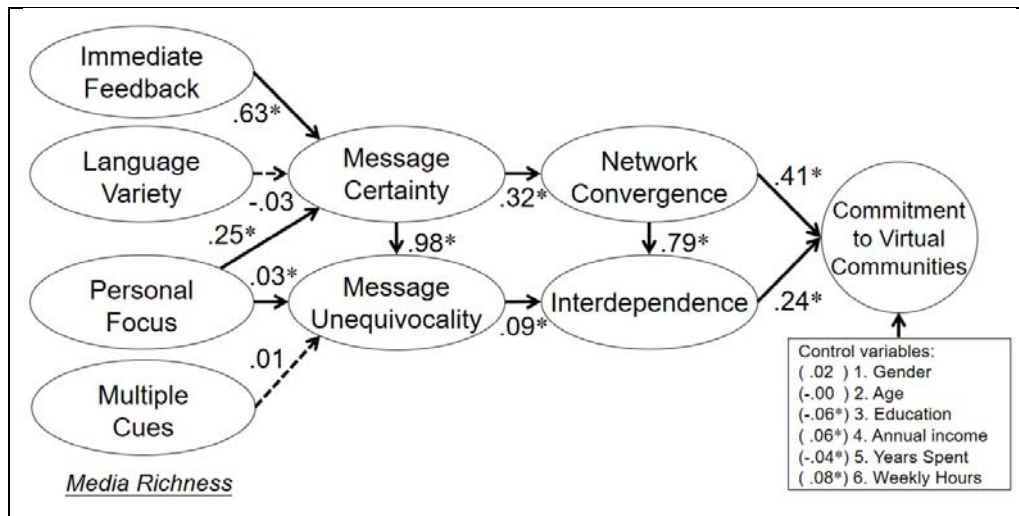


Figure 2. Analytical Results

This study did not find significant impact of gender and age on commitment to VCs (p.c. = .02 and -.00, $t = 1.03$ and -0.18 , $p > .05$). Education and years spent playing the game were negatively related to commitment to VCs (p.c. = -.06 and -.04, $t = -2.85$ and -2.36 , $p < .01$), while annual income and hours spent playing the game were positively related to such commitment (p.c. = .06 and .08, $t = 2.57$ and 4.37 , $p < .01$ and $p < .001$). The impacts of control variables provide a preliminary understanding of the participants, thus offering a base for future studies to explore the underlying reasons.

The structural model also fit the data acceptably, i.e. CFI = .97, IFI = .97, NNFI = .97, RMSEA = .07. The structural model explained 41% of the variance in commitment to VCs (i.e., $R^2 = .41$). This proportion should be regarded as a large effect size, indicating its practical relevance.

We additionally conducted the mediation tests by using the bootstrapping method (Preachers & Hayes 2008). All the 13 potential mediations have significant coefficients (i.e., .01~.54).

We also re-analyzed the model by using the subsamples according to the three most nominated game genres. Most of the test results remain the same for all game genres, indicating their robustness. Message unequivocality was not related to interdependence for massively multiplayer role-playing games. Multiple cues were positively related to message unequivocality for real-time strategy games. Language variety was negatively related to message certainty, while personal focus was not related to message unequivocality for board and card games.

Discussion

Main Findings and Contributions

This study found that immediate feedback and personal focus are two important aspects of media richness for formulating commitment to VCs. Specifically, immediate feedback and personal focus are positively related to message certainty and message unequivocality that are further positively related to network convergence and interdependence, thus contributing to commitment to VCs.

Practically, this study contributes novel insights to IS managers with recommendations to focus on improving immediate feedback and personal focus. Such improvements likely facilitate users' communication, formation of closely connected networks, and thus strengthen their commitment to VCs. Strongly committed users could further reinforce the sustainability of the information systems.

Academically, this study clarifies how aspects of media richness would formulate users' commitment to VCs. Moreover, by consulting the context-specific theorizing process of Hong et al. (2014), we initiated to add the key elements of MRT, i.e., message certainty and message unequivocality. We also

added three novel consequences to the theory, i.e., network convergence, interdependence, and commitment to VC. Such additions should be significant theoretical extensions.

Theoretical Implications

Kim et al. (2018) initiated to examine the impact of sharing members between virtual communities on access to novel knowledge, indicating the strong influences of sharing members. The present study joined the efforts to explore such influences, but is new in examining the impact of sharing members within virtual communities (i.e., network convergence). The present study joins in Kim et al. (2018) to demonstrate the impacts of sharing members in virtual community settings.

Yang et al. (2015) examined the sources of task cohesion (commitment to gaming goals) in gaming teams. Consistent with Yang et al. (2015), the present study examined commitment issues in gaming. However, the present study is unique in examining commitment to the gaming communities and using social networks measures (i.e., network convergence and interdependence) to explain commitment. This uniqueness broadens the commitment issues from the team-level to the community-level.

Faraj et al. (2015) found that structural social capital and sociability are related to being identified as online community leaders. The present study also examines social aspects in online communities. However, the present study suggests network convergence and interdependence as two features of online communities to contribute to commitment to online communities. Therefore, future works could examine the relations among community leadership, network convergence, and interdependence.

Lin and Bhattacharjee (2010) found that perceived enjoyment and social image are important in predicting continuance in hedonic systems, indicating that social aspects are critical for users of hedonic IS. Consistent with that study, the present study also examines social aspects among users of interactive hedonic systems. However, the present study innovates in using network convergence and interdependence to explain how social aspects could impact users' continuance in hedonic systems.

Implications for IS Managers

Our study included elements that apply to a wide spectrum of virtual communities. Specifically, virtual community members need to use communication media to exchange messages, indicating the applicability of the four aspects of media richness and the two message characteristics (i.e., message certainty and unequivocality). Virtual communities provide platforms for members to build friendship or social networks, justifying the usefulness of the two network features (i.e., network convergence and interdependence). Hence, although these features may not be unique features of online gaming communities, our findings should be highly generalizable to most virtual communities, supporting the strong impact of our findings to the virtual community literature.

Immediate feedback was positively related to message certainty, thus indicating the value of enabling immediate feedback. Therefore, IS managers could enhance immediate feedback by suggesting users to use the words "please" and "check" that may as effectively trigger responses. Moreover, IS managers could use platforms of virtual community management, e.g., Community Cloud (Salesforce 2016). Such platforms collect users' information for automatically responding to their questions, enabling prompt delivery of feedbacks, enhancing the perception of immediate feedbacks.

Personal focus was related to message certainty and unequivocality, indicating the importance of personalized messages. Hence, IS managers could design their system functions to redirect users' queries to relevant community discussions or forums, thus generating more personalized solutions, or personalized messages. Such redirection thus could enhance personal focus, and according to our findings, would contribute to users' commitment to VCs.

Message certainty was positively related to network convergence, i.e., sufficient information is important for creating a closely-connected user networks. Hence, IS managers are suggested to offer guidelines, checklist, or templates for their users to provide sufficient information, thus enhancing message sufficiency, or message certainty. Consequently, according to our findings, enhanced message certainty contributes to network convergence, which strengthens users' VC commitment.

Findings of this study suggest the improvements on message characteristics that are observable and manageable, thus practically assisting IS managers to build long-term relationships with members. Substantial relationships can boost sales and contribute to organizational performance with IS.

Research Limitations and Future Research Directions

Our study collected data in online gaming contexts. The survey approach has been known for collecting representative data, strengthening the external validity of the findings. Online games can also be useful platforms to increase business productivity or performance (Goh & Wasko 2012). Moreover, online games have been valid and acceptable IS research contexts (Yang et al. 2015), indicating the adequacy of examining IS issues in online games. Furthermore, online games have been known as enhancing users' hedonic outcomes (Lin & Bhattacharjee 2010) or virtual team performance (Yang et al. 2015). Future works could use our study as a foundation to further examine how IS design features (in media richness) help organizations to enhance user commitment.

Our study uniquely examined the roles of message certainty and unequivocality in building online gaming communities that were typical hedonic contexts (Lin & Bhattacharjee 2010). Message certainty and unequivocality should enhance the information quality, which contributes to users' continual participation in hedonic contexts (e.g., online fan communities) (Kim & Kim 2017), justifying their usefulness in hedonic contexts. However, message certainty and unequivocality may also help avoid conflict and thus improve performance in collaborative contexts, e.g., virtual teams (e.g., Yang et al. 2015). Hence, future works could replicate our study in such contexts.

Our study asked the participants to nominate one game. This approach maximizes the generalizability of our findings to various game genres, thus deemed as acceptable in the recent literature (e.g., Huang et al. 2018a). Moreover, this approach restrains us from focusing on features that are pertaining to a specific game genre. Future studies could choose one popular game genre to explore its features.

Community age enhances the impact of sponsor investments on users' knowledge contributions (Huang et al. 2018b). Future works could include community age as a novel moderator in our model.

Our study initiated to develop the scales for evaluating message certainty and message unequivocality. However, these scales generated scores with a substantially high correlation. Hence, future studies could replicate our study to examine the necessity of revising the scales.

Conclusions

Our research contributes to the IS literature by using the MRT perspective to explain the underlying mechanism through which members form their commitment to VCs. Specifically, we find that message characteristics, i.e., immediate feedback and personal focus, produce certain and unequivocal messages, which further intensifies networked relations and enhances commitment to VCs. Our study is the first in contextualizing the MRT to introduce two novel constructs, i.e., message certainty and message unequivocality. Introduction of these two elements could open a new path for future IS works to examine their roles in the linkages between IS design and use behavior.

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