# Influence of Sense of Presence on Intention to Participate in a Virtual Community

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## Abstract

*This research addresses the question of the design of advanced interfaces (e.g., 3D) to encourage participation in virtual communities and support social interaction. While prior studies have examined diverse factors to affect members' intention to participate in virtual communities, they have relatively underestimated a technological influence on members' intention to participate. Considering current virtual communities have been armed with advanced interfaces, it is vital to investigate a technological influence on members' behavioral intention. This paper investigates members' intention to participate in virtual communities by testing a research model consisting of two types of presence (telepresence and social presence) and their antecedents. The research model was empirically tested with data from 207 members of Second Life which is an emerging virtual community equipped with an advanced 3D interface. The results showed our model can be a good framework in understanding members' intention to participate in virtual communities.*

## 1. Introduction

Virtual communities (VCs), indicating cyberspaces in which the Web users interact and form personal relationships with human feelings [45], not only allow people to extend social relationships, but they have also diverse benefits, such as facilitating knowledge sharing, enabling peer-to-peer transactions, and playing a role of marketing channels in business to consumer (B2C) e-commerce [1]. Owing to these numerous merits, VCs have exponentially increased so that approximately one fifth of the Internet users have at least one VC in which they maintain a regular online contact with other users [21]. Despite the quantitative growth, many VCs have disappeared or have been characterized as 'gloomy landscapes' because of poor member participation. According to prior studies, only 10 percent of members of one popular peer-to-peer sharing VC provided 87 percent of all content [2], and 4 percent of members of a open-source development VC produced 88 percent of new codes and 66 percent of code fixes [41]. These findings show the reality of a lacking participation of VC members though their participation is an essential factor in the ongoing life of VCs. As a result, a number of researchers have concentrated on understanding the factors that affect members' participation in VCs. Recently, the topic of VC members' participation has attracted even more attention by researchers and practitioners, because user-created content (UCC) is regarded as the next 'killer application' on the Web, and Web 2.0, which stresses Web users' participation and employing a wiki, is on the verge of being substituted for the traditional Web. Accordingly, the question of *which factors affect members' intention to participate in VCs* continues to be a high priority for research.

In answering this question, researchers have examined various factors from the social perspective. Some researchers have employed *sense of VC*, defined as the member's feeling about belonging to a VC [29], and empirically demonstrated its influence on VC members' behavioral intention to participate [55]. Other researchers have used several social factors, such as trust, leader's enthusiasm, offline interaction, uniqueness of contribution and managerial strategies, as direct antecedents of members' intention to participate or indirect ones mediated by sense of VC [30, 45, 55]. Studies on VC members' participation have focused primarily on social, or non-technological, factors, and this represents a major limitation of prior research. Given that technologies are one of the primary components of a VC together with the people, purpose and policies [44], technological factors such as qualities of the user interface are also assumed to help encourage VC members' participation [18]. Nevertheless, prior studies have underestimated the influence of technological factors on members' participation in VCs, resulting in the lack of a comprehensive perspective on VC members' participation. In particular, the influence of

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technological factors may be even more prominent in up-to-date VCs armed with advanced interfaces (e.g., 3D). In order to compensate for this missing dimension in prior studies, recent studies have proposed new frameworks that include technological influences on VC members' intention to participate, especially *telepresence* and *social presence* [25, 56].

Telepresence and social presence have been known as significant factors in understanding users' behavioral intention in virtual reality applications and the web environment [5, 40, 52]. Telepresence is shortly defined as the sense of *being there* [5], and it has been treated as a technology-based concept in virtual reality and communication literature. Social presence is defined as the sense of *being together with someone* [48], and it is based on characteristics of a communication medium and human interaction. In 1976, Short et al. [48] coined social presence as the perception based on technological features of a communication medium (i.e., a medium's capability to facilitate user communication); however, since then, social presence has been extended to the perception deriving from interactions with other members in VCs [25, 56]. A key advantage, then, of a framework consisting of telepresence and social presence is to encompass a social perspective in addition to a technological perspective in exploring VC members' participation.

Despite the potential of telepresence and social presence to explain VC members' behavioral intention to participate, there is little literature exploiting them [25]. Furthermore, there is little work investigating antecedents of telepresence and social presence in the context of VCs, except for Khalifa and Shen [25]. In order to begin to address this gap, we conducted an empirical study to investigate members' intention to participate in a VC equipped with an advanced 3D interface (*Second Life*), employing telepresence, social presence and their antecedents in the research model.

In the next section, we begin the paper by reviewing the literature on VC members' participation and the two types of presence (telepresence and social presence).

## 2. Theoretical background

### 2.1. Literature on VC members' participation

Owing to the importance of members' participation, many researchers have dealt with the issue of what spurs individuals to participate in VCs. Several guidelines for promoting VC members' participation have been suggested: for example, cultivating opinion leaders, creating offline interaction, offering unique content and utilizing user-friendly interface [54]. Koh and Kim [29] contend that leaders' enthusiasm, offline interaction and enjoyability affect members' sense of VC which is assumed to have a significant influence on members' intention to participate, and Yoo et al. [55] empirically demonstrated the influence of sense of VC on members' participation in VCs. Trust is regarded as an important factor in generating sense of VC [7]; on the other hand, trust also has a direct influence on a member's behavioral intention (desire to give information) [46]. Also, the antecedents of sense of VC, such as leader's enthusiasm, offline interaction and managerial strategies (e.g., how to define the purpose of a VC and build rules), have been used as the direct antecedents of members' intention to participate, not mediated by sense of VC [30, 55].

Prior factors are all social or non-technological factors. Though we totally agree with an essential role of social factors in exploring VC members' participation, we contend that technological factors also significantly affect members' participation. Despite the lack of empirical studies, the influence of technological factors on members' participation has been often mentioned in discussions of the topic. Godwin [18] states that software can promote discussions among VC members, and Kim [26] points out that user-friendly interfaces and reliable systems can support members' participation by facilitating their access. Preece [44] also maintains that computer systems assist social interactions and facilitate a sense of togetherness in VCs. More recently, a few studies have attempted to consider a technological influence on VC members' intention to participate, depending on sense of presence [25, 56]. Depending on their initial theoretical framework, we build a research model consisting of both telepresence and social presence to explain members' intention to participate in a VC. The following section introduces these two concepts.

### 2.2. Sense of presence

Presence has been used in diverse forms such as telepresence [39], virtual presence [47], social presence [48] or para-social presence [31]. In spite of its various forms, two types of presence are typically pronounced: *telepresence* and *social presence* [6, 32].

**2.2.1. Telepresence:** Telepresence refers to the awareness of being physically located somewhere, or *being there* [5] in the mediated environment. For example, when one watches a science fiction movie or explores a prehistory battlefield in "Dungeons and Dragons", one may feel a 'realistic' artificial

situation as if one exists there. It is commonly regarded that telepresence is affected mainly by two determinants: *interactivity* and *vividness* [50].

As defined by Steuer [50], interactivity is defined as "the extent to which users can participate in modifying the form and content of a mediated environment in real time" [50, p. 84]. Interactivity has three dimensions: *speed*, referring to "the rate at which input can be assimilated into the mediated environment" [p. 85]; *range*, referring to "the number of possibilities for action at any given time" [p. 85], and *mapping*, referring to "the ability of a system to map its controls to changes in the mediated environment in a natural and predictable manner" [p. 85]. Khalifa and Shen [25] modified Steuer's two determinants to fit them to virtual communities. Accommodating Liu and Shrum's [36] work, they identify three dimension of interactivity: *active control* as the ability for voluntary and instrumental action that directly affects the user's experience; *communication* as the ability for reciprocal meaning exchange; and *synchronicity* as whether the communication takes place in real time. They stress communication because it is an important factor in e-commerce, especially VCs where interactions among members are dominant.

Vividness is described "the representational richness of a mediated environment" [50, p. 81]. Vividness has two dimensions: *sensory breadth*, referring to "the number of sensory dimensions simultaneously presented" [p. 81], and *sensory depth*, referring to "the resolution within each of these perceptual channels" [p. 81]. Some researchers regard vividness as a uni-dimensional concept rather than a two dimensional one because the distinction between sensory breadth and depth is not clear for users and users are inclined to form a general impression on sensory stimulations, although sensory breadth and depth can be conceptually distinguished [8, 22, 25].

It has been demonstrated that telepresence significantly affects users' behaviors or attitudes in the Web context. Novak et al. [42] contend that telepresence is one of determinants of flow, referring to an optimal state of experience, on the Web, and Coly and Thorson [11] empirically show that telepresence positively affects consumers' attitude on commercial websites.

**2.2.2. Social presence:** In comparing the influence of different types of communication media on social interactions, Short et al. [48] maintain that each medium has a different degree of social presence which significantly affects social interactions. Short et al. defined social presence as the degree to which a medium allows a user to build personal connection with others. In other words, social presence is regarded as the capability of a medium to convey a number of socio-emotional cues [48], or the capability of a medium to facilitate awareness of the others' existence [15]. For instance, users may feel a higher social presence in a VC allowing a synchronous chatting and BBS (Bulletin Board System) than a VC offering only BBS.

However, if two VCs have the same interface for communications such as BBS, do users have the same degree of social presence in both VCs? The above conceptualization from the technological point cannot completely explain a situation in which human interactions are prominent. Given that social presence involves individual perception, this perception may be significantly affected by human-to-human interactions in addition to a communicational environment provided by a medium. In short, social presence stands on human-to-human interactions in VCs as well as technological attributes of a medium. In VC literature, some researchers have employed social presence as a construct to evaluate human interactions [25, 56].

Social presence has often appeared in e-commerce research. Karahanna and Straub [24] adopted social presence to examine the origin of perceived usefulness and perceived ease of use in email systems, and Kumar and Benbasat [31] employed para-social presence focusing on an interpersonal relationship and argued that it positively affects perceived usefulness. They also claim that para-social presence positively affects trust. Fortin and Dholakia [14] explained online consumers' attitude or intention by social presence. Spencer [49] contends that social presence has a significant influence on swift trust in online learning, and Pavlou et al. [43] argued that social presence positively affects trust in online sellers.

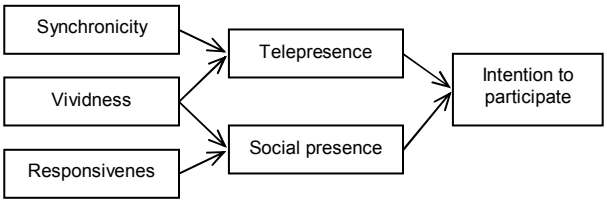


**Figure 1. The Research model**

## 3. Research model

In order to consider both technological factors and social factors, we built a research model consisting of telepresence, social presence, behavioral intention and three antecedents of presence - synchronicity, vividness and responsiveness (see Figure 1).

We employ synchronicity as an antecedent of telepresence, responsiveness as an antecedent of social presence, and vividness as an antecedent of both. Because our target VC provides an advanced 3D interface which requires a high-capacity computer and a broadband connection, delayed responses and even crashes often happen in this VC. Accordingly, it is expected that synchronicity has an influence on generating members' telepresence. Previous studies have used communication as an antecedent of telepresence in websites, together with synchronicity and vividness. However, in prior studies, communication is used mainly to catch interactions between the website (or operators) and customers; thus, it is not easily applied in VCs. In VCs, communications among members are more dominant rather than ones between the website (or operators) and members, and so, we use *responsiveness* instead of communication in order to focus on user-to-user communication.

Synchronicity is one of determinants of interactivity which is in turn assumed to affect telepresence. It refers to the degree to which a system offers communication speed. Some researchers broadly define synchronicity as a factor which covers both feedback from a system and feedback from human actors in VCs [25, 51]. Based on this broader conceptualization, Khalifa and Shen [25] claim that synchronicity is an antecedent of telepresence and social presence. It is, however, desirable to distinguish between feedback from a system and those from human actors (responsiveness in our study), because they may affect different types of presence; that is, feedback from a system may be more bound up with telepresence, and feedback from human actors may be more tied up with social presence. Thus, we differentiate synchronicity from responsiveness which is defined as the degree to which a user perceives the amount of responses and the speed of responses from other users. Steuer [50] asserts that immediate responses from a system strengthen telepresence, and virtual reality literature has extensively supported a significant influence of synchronicity on telepresence [53]. Also, Ridings et al. [46] demonstrate that rich and rapid responses from others raise VC members' trust which enhances the perception of human connection, and Tu [51] claims that the lack of responses reduces social presence when an immediate response is expected. Relying on prior research, we hypothesize:

H1: Synchronicity positively affects telepresence in virtual communities.

H2: Responsiveness positively affects social presence in virtual communities.

Steuer [50, p.81] defines vividness as "the representational richness of a mediated environment." Although Steuer mentions that vividness consists of breadth and depth, Khalifa and Shen [25] insist that the distinction between sensory breadth and depth is unclear and users have a general impression on sensory stimulations. Following their argument, we regard vividness as a uni-dimensional construct. Virtual reality literature has shown that vividness has a significant role in generating telepresence [37]. Its role has been also applied in the Web context. Coyle and Thorson [11] demonstrate that customers perceive greater telepresence in a vivid website supported by visual and audio stimuli than one equipped only with visual or audio stimulus. Li et al. [34] also show that by appealing to multiple senses, 3D advertising generates greater telepresence than 2D advertising. Khalifa and Shen [25] reveal that the influence of vividness on telepresence is significant in the VC context. Thus, we hypothesize:

H3: Vividness positively affects telepresence in virtual communities.

Social presence can be enhanced by a visible manifestation of the communication partner depending on non-verbal cues, such as facial expression, gesture and clothes [48]. In fact, these non-verbal cues are not easily applied in a virtual environment; however, recently many VCs utilize non-verbal cues of members in enhancing social presence, such as enabling members to upload their digital photos and have a personal avatar referring to pictures, drawings, or icons to represent oneself in cyberspace [33]. Counts and Fellheimer [10] demonstrate that digital photos reinforce social presence in photo blogs, and Bente et al. [3] and Kang [23] contend that avatars significantly affect social presence in mediated environment. Thus, we hypothesize:

H4: Vividness positively affects social presence in virtual communities.

Telepresence and social presence have been widely used in understanding humans' attitude or performance in the various Web contexts. Hoffman and Novak [20] maintain that telepresence affects web users' attitude or performance, mediated by psychological flow, and Li et al. [34] show that the greater telepresence customers experience the more favorable attitude toward online advertisement they have. Gefen and Straub [17] and Pavlou et al. [43] found that social presence affects customers' trust in

online stores, and Miranda and Saunders [40] demonstrated that a high social presence environment promotes information sharing. In VCs, high telepresence may induce users' absorption which subsequently encourages their participation [1]. Considering that social interaction among users is the foundation in VCs, we can easily assume that high social presence provokes users' participation. Khalifa and Shen [25] empirically demonstrated that telepresence and social presence have a positive influence on users' intention to participate in a VC. Thus, we hypothesize:

H5: Telepresence positively affects users' intention to participate in virtual communities.

H6: Social presence positively affects users' intention to participate in virtual communities.

## 4. Methodology

### 4.1. Target VC and samples

The target VC for the study is *Second Life* (www.secondlife.com) which is a VC equipped with an advanced 3D interface and is similar to role-playing games. The number of its registered members is over seven million as of May 2007. In *Second Life*, a member has a personal avatar representing oneself. A member can elaborate a personal avatar's face, hair, and body and put it into clothes. Also, a member can create 3D objects (e.g., chair, building, waterfall) using basic prims (e.g., squares, triangles, cubes) and chunks of code called script; and perform virtual tasks with them or sell them to other members. Controlling a personal avatar, members can enjoy synchronous chatting at the park or on the beach, dancing at night club, or taking a class in *Second Life*.

We tested the research model with 207 users of *Second Life*. Over the course of two weeks, we solicited users to participate in our web-based survey in various places of *Second Life*. We introduced the survey to logged-in members of *Second Life*, and participants clicked the box which our avatars were holding and was connected to the website for the survey. Participants left their *Second Life* ID on the questionnaire for a reward. We rewarded each participant with 200 *Linden dollars* [2] which is approximately one dollar. We could confirm that we got only one response per participant by checking their ID. The subjects are heterogeneous in demographics (see Table 1).

**Table 1. Demographics of participants**

| | | Frequency | Percent |
|---|---|---|---|
| Gender | Male | 109 | 52.7 |
| | Female | 94 | 45.4 |
| | No answer | 4 | 1.9 |
| Age | 18-24 | 48 | 23.2 |
| | 25-34 | 52 | 25.1 |
| | 35-44 | 64 | 30.9 |
| | 45-54 | 26 | 12.6 |
| | 55-64 | 15 | 7.2 |
| | 65 or older | 1 | 0.5 |
| | No answer | 1 | 0.5 |
| Logging time (hours per week) | 4 or less than 4 | 35 | 16.9 |
| | 5 to 9 | 43 | 20.8 |
| | 10 to 19 | 45 | 21.7 |
| | 20 to 29 | 38 | 18.4 |
| | 30 or more than 30 | 43 | 20.8 |
| | No answer | 3 | 1.4 |

### 4.2. Measurement and pilot test

All measurement items for our constructs were based on previously validated instruments. The items were answered on a seven-point Likert scale (1= strongly disagree to 7= strongly agree) except for vividness. In order to measure telepresence, we employed Kim and Biocca's [27] instrument, which has been widely used in measuring telepresence. We depended on Short et al.'s [48] instrument in measuring social presence. This instrument has been also validated in the diverse contexts. Our measurement items of synchronicity are derived from Liu's [35] instrument. We employed the *Vividness of Visual Imaginary Questionnaire* (VVIQ) [38] to measure vividness. The VVIQ is a method to measure the vividness of visual images of people, scenes and situations with a 5-point scale [38]. The images are stimulated by specific descriptions of people and other objects. To adapt the VIVQ to our context, we made descriptions of avatars and other objects, which reminded participants of the images. Participants gave an answer for each description (one question item) on an original 5-point scale (1= No image at all; 2= Vague and dim; 3= Moderately clear and vivid; 4= Clear and reasonably vivid; 5= Perfectly clear and as vivid as normal vision). The measurement items for responsiveness came from Ridings et al.'s [46] instrument which was validated

[1] In VCs, a member's participation may include various behavioral modes such as posting an informative essay on a broad, answering others' question, transaction with others, or simply logging in a VC. Among them, we operationalized participation as *logging in a VC* in this paper, because it is the most fundamental behavior of participation.

[2] Transactions in Linden dollars are common in *Second Life*.

in the VC context. The items for intention to participate came from Bhattacherjee [4].

In our pilot study, we conducted a principal components factor analysis (PCA) and inspected Cronbach's alpha values with 98 samples. The results of the factor analysis specified six factors whose loadings ranged from .65 to .86 except for one item of responsiveness (.51). Cronbach's alpha values of constructs ranged .75 (vividness) to .95 (intention), and all values exceeded the cutoff (.70) [19]. Based on the results of the pilot study, we confirmed discriminant validity and convergent validity; thus we decided to use all constructs in our actual survey. Our measurement items are shown in Table 2.

**Table 2. Measurement items**

| *Construct (Cronbachs' alpha)* | *Item (Factor loading)* |
|---|---|
| Telepresence (.88) | • TP1: I forgot about my immediate surroundings when I am on Second Life (.88)<br>• TP2: Surfing Second Life often made me forget where I am (.82).<br>• TP3 After surfing S Second Life, I felt like I came back to the "real world" after a journey (.86).<br>• TP4: Using Second Life created a new world for me, and this world suddenly disappeared when I stop using it (.77). |
| Social presence (.90) | During surfing Second Life, the interaction with the other users was:<br>• SP1: Personal (.77)<br>• SP2: Warm (.75)<br>• SP3: Close (.84)<br>• SP4: Humanizing (.80) |
| Synchronicity (.82) | • Syn1: Second Life processed my input very quickly (.86).<br>• Syn2: I was able to obtain information to my input without any delay on Second Life (.85).<br>• Syn3: Second Life was very slow in processing to my inputs (.77)*. |
| Responsiveness (.80) | • Res1: Second Life users were very responsive in interaction with me (.75).<br>• Res2: I could get quick responses from the other users on Second Life (.74).<br>• Res3: I could get a lot of responses in interaction with the other users on Second Life (.68). |
| Vividness (.86) | Please call avatars and constructions (e.g. roads, buildings, scenery, etc.) in Second Life to mind:<br>• Viv1: Avatars: The exact contour of face, head, shoulders and body (.79).<br>• Viv2: Avatars: Characteristic poses of head, attitudes of body (.80).<br>• Viv3: Constructions: The overall appearance of constructions (.80).<br>• Viv4: Constructions: The colors, shapes and det ails of buildings (.79). |
| Intention to participate (.96) | • Int1: If I could, I would like to use Second Life in the future (.89).<br>• Int2: I intend to continue using Second Life in the future (.90).<br>• Int3: I expect my use of Second Life to continue in the future (.87). |

* Reverse questions

## 5. Data analysis and results

We used structural equation modeling (SEM) as the data analysis method. SEM has been comprehensively applied in studies on an individual's technology acceptance [16]. We used AMOS 7.0 which is the latest and easily operated software for SEM.

Prior to SEM, an exploratory factor analysis was conducted with SPSS. A Varimax rotated PCA specified six factors which had over 1.0 eigenvalue cutoff criterion. We confirmed discriminant validity because all factor loadings were larger than .70 except for one item of responsiveness (.68) and there were no cross-loaded items. Also, Cronbach's alpha values were examined and they ranged from .80 to .96, making sure convergent validity and reliability of our constructs. The examination of the average variance extracted (AVE) supported the results of our factor analysis and reliability test. To confirm discriminant validity, the AVE of a construct should be greater than the square of the correlation estimates with the other constructs [13]. Also, for convergent validity, the AVE should be greater than .50 [19]. As shown in Table 3, our AVE values satisfied these requirements.

**Table 3. The AVE and the correlation estimates**

| | TP | SP | Syn | Res | Viv | Int |
|---|---|---|---|---|---|---|
| Telepresence | **.80** | | | | | |
| Social presence | .14 | **.81** | | | | |
| Synchronicity | .38 | .00 | **.78** | | | |
| Responsiveness | .00 | .61 | .00 | **.78** | | |
| Vividness | .24 | .23 | .00 | .00 | **.78** | |
| Intention | .36 | .50 | .06 | .26 | .13 | **.94** |

(Diagonal elements represent the square roots of the AVE; off-diagonal elements are the correlation estimates.)

Our model fit indices show that the research model is acceptable, though it does not have excellent values in all fit indices (see Table 4). The $\chi^2$ of 386.82 with 183 degrees of freedom revealed that a $\chi^2$ to degree of freedom ratio was less than the recommended cutoff (< 3.0). AGFI of .82, CFI of .93 and RMSEA of .07 were over their benchmarks; while GFI of .86 was slightly below the .90 cutoff. Though GFI can be increased by reducing the number of items, we used all items for content validity of our constructs. The model explains 49 percent of the variance of social presence, 12 percent of the variance in telepresence, and 30 percent of the variance in behavioral intention.

All paths were significant for a p-value level of .01, indicating that all six hypotheses were supported (see Figure 2). Social presence (.48) has a greater influence on behavioral intention than telepresence (.28). Synchronicity (.22) also

significantly affects telepresence. Vividness has a significant influence on both types of presence, and specifically has a greater influence on social presence (.35) than telepresence. (.28). Responsiveness (.61) greatly affects social presence.

**Table 4. Model fit indices**

| Fit statistics | Recommended | Obtained |
|---|---|---|
| $\chi^2$ | | 386.82 |
| *df* | | 183 |
| $\chi^2$ / *df* | < 3.00* | 2.11 |
| GFI | > .90* | .86 |
| AGFI | > .80* | .82 |
| CFI | > .90* | .93 |
| RMSEA | < .08** | .07 |

(* from [9]; ** from [19])

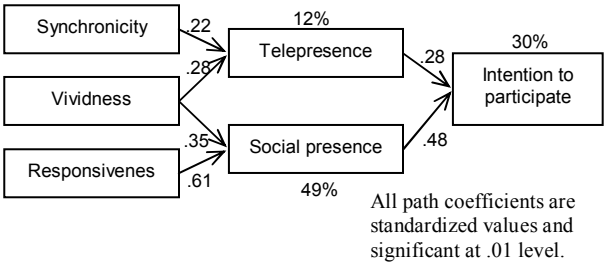


**Figure 2. The structural model**

## 6. Discussion and implications

### 6.1. Key findings

We contend that VC members' participatory intention can be better understood by considering technological features as well as social factors of VCs. For our argument, we employed two types of presence (telepresence and social presence), and confirmed that the research model consisting of both types of presence can provide a good framework to explain members' intention to participate in a VC armed by advanced interfaces. In the results of examining antecedents of both types of presence, we also showed that synchronicity, vividness and responsiveness have explanatory powers as antecedents of telepresence and social presence. In addition to this overall result, this research has several specific findings.

First, though Zhu et al. [56] maintain that neither types of presence have a direct relationship with behavioral intention, our results reveal that both have a direct relationship with users' intention. A plausible explanation of the different results is that using an advanced 3D interface of VCs induces and strengthens the direct connection between telepresence and intention. The direct influence of social presence on intention is more straightforward, because the fundamental purpose of VCs is to extend social relations which are facilitated by manifest social cues (i.e., high-level social presence). Some studies also support telepresence and social presence having a direct influence on behavioral intention.

Second, social presence has a much greater influence on members' intention than telepresence. Again, the main aim of VCs (i.e., the extension of social relations) can be a reason for this result. Additionally, as Khalifa and Shen [25] argue, this result shows that social presence has a unique status distinguished from telepresence in environments where human interactions are dominant such as VCs. On the other hand, the result confirms that *Second Life* is rooted in VCs rather than online games. In fact, *Second Life* is similar with massively multiplayer online games (MMOGs) such as EverQuest, World of Warcraft and Runescape. However, *Second Life* is different from MMOGs in that *Second Life* users do not advance through levels [12]. With their avatar, members wander on the street, meet others, and sometimes buy or sell 3D objects created by members themselves. All behaviors are based on social interactions rather than a 'quest' or 'level-ups' which is a goal of MMOGs users. Accordingly, we can comment that the nature of VCs of *Second Life* makes social presence much more influential on members' intention to participate in the VC.

Third, vividness has a significant influence on telepresence and social presence, and is more influential on social presence than telepresence. Prior literature has demonstrated the role of vividness as a strong antecedent of telepresence. Although few studies have dealt with a connection of vividness and social presence, recently Khalifa and Shen [25] demonstrated the influence of vividness on social presence in a VC. In particular, *Second Life* members can experience the richer representations of the other members as watching human-like avatars which have an aesthetically elaborated appearance and do various human behaviors (e.g., laughing, dancing). Thus, vividness significantly affects social presence, and even produces a greater effect on social presence than telepresence in *Second Life*.

Fourth, responsiveness is crucial in forming social presence in VCs. In previous research, communication, which is a main antecedent of telepresence, has been used mainly to catch interactions between the website (or an operator) and visitors rather than interactions among visitors (members). Because we dealt with VCs where human interactions are prominent and further employed social presence distinguished from telepresence, we excluded communication which is an antecedent of telepresence, and employed

responsiveness as an antecedent of social presence. The results strongly supported our decision.

Finally, the influence of synchronicity on telepresence is significant in VCs, consistent with prior research. Of course, the exploratory power of synchronicity (.22) was rather low, compared to prior studies. Prior studies assume that together with control and communication, synchronicity affects the construct *interactivity* which in turn affects telepresence. In our paper, we did not consider interactivity and made a direct connection between synchronicity and telepresence. Though prior studies shows a little higher influence of synchronicity on interactivity (.51 in [24]), those exploratory powers are not a direct influence on telepresence. Therefore, we could not directly compare our result to results of prior studies concerning synchronicity.

### 6.2. Contributions

Bring to mind Rheingold's [45] early definition of virtual communities (VCs): "social aggregations that emerge from the Net when enough people carry on those pubic discussions long enough, with sufficient human feeling, to form webs of personal relationships in cyberspace". Also, consider IBM CEO Sam Palmisano's recent remark: the 3D Internet will be the future platform of the Web [28]. If researchers and practitioners combine two celebrities' remarks, they can get an insight into future VCs and may come up with the issue: how to develop advanced interfaces to support social interaction among VC members and encourage their participation. We started the issue in this study.

This study contributes both theoretical and managerial implications. The first contribution is that this research took into account technological aspects of VCs. Although researchers recognize the critical role of members' participation in VCs, their approaches have been focused toward social factors. By examining technological aspects, this paper is an initial step in filling a theoretical void of prior works that have underestimated technological influences on VC members' intention to participate. Second, the paper makes a contribution on the generalizability of sense of presence in the Web environment. Though sense of presence has been examined in various Web contexts, few studies employing it deal with VCs which represent a large portion of cyberspace. This study demonstrated that sense of presence is applicable in VCs. Third, the paper offers the refined presence model. Many prior studies have only used telepresence. We, however, employed two types of presence and proved that they have different effects on members' intention. Also, this was the first study to empirically include responsiveness as an antecedent of social presence, and results validated its strong exploratory power. Despite the need for more elaboration, our model is more refined than prior presence models. Lastly, the paper contributes to VC literature in that it treated the newest VC equipped with an advanced 3D interface differently from VCs studied in previous VC literature. The investigation of various types of VCs is imperative in VC literature as much as the examination of relevant theories [29]. We investigated an emerging type of virtual community which is regarded as a form of future VCs.

This research also has managerial implications by identifying systemic features of VCs to stimulate members' participation. The study shows that VC operators can enhance telepresence by a quick processing speed. For example, unnecessary flash usage and overloaded webpages with irrelevant content with members' inputs may cause processing delays which disturb members' immersion in VCs. The study results also lead to the recommendation that VC operators improve vividness to enhance telepresence and social presence. By making clear objects (e.g., a character, icons) or allowing members to add objects (e.g., digital photos, personal avatars) in VCs, VC operators can improve vividness and in turn enhance telepresence and social presence. In particular, an elaborating editing tool of avatars can improve social presence by permitting rich representational cues. Finally, VC operators need to help communications among members (i.e., responsiveness) by providing various means such as synchronous textual or voice chatting.

### 6.3. Limitations and future research

This research did not consider prior social constructs (e.g., managerial strategy) that have been shown to affect users' intention to participate in VCs. Also, the paper examined only three determinants of telepresence and social presence. Future research needs to build a more comprehensive model encompassing potential determinants of sense of presence and social factors in addition to sense of presence. Another limitation is our naïve conceptualization of VC members' participation. We regarded *logging-in a VC* as participation, because it is a prerequisite for other participatory behaviors (e.g. answering other members' questions). However, to conceptualize *VC members' participation* more rigorously, future research is required to consider various participatory behaviors in addition to *logging-in a VC*. We modified Marks' [38] VVIQ to evaluate vividness, and used only four scripts stimulating the images of avatars and objects to minimize the effects of exhaustion, though the

original VVIQ has 16 scripts. It appears that more scripts are needed for exact measurement of vividness. The future research using VVIQ is required to develop abundant scripts for more exact measurement of vividness. Lastly, we did not control variance caused by language. *Second life* is a worldwide VC and the members come from various countries. Thus, our English questionnaire may have a limitation to cover variance caused by language. Future studies dealing with worldwide VCs need to consider this matter. For remedying variance caused by language, researchers may create multi-version questionnaires aiming at different language speakers.

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