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System Design Effects on Social Presence
and Telepresence in Virtual Communities

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SYSTEM DESIGN EFFECTS ON SOCIAL PRESENCE AND TELEPRESENCE IN VIRTUAL COMMUNITIES

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Abstract

The influence of presence on users attitudes and behavior is widely reported in the literature. However, we still lack a good understanding of the effects of system design on the formation of a sense of presence in computer-mediated environments in general and virtual communities in particular. In this research, we address this void. More specifically, we examine the relationship between important system design characteristics and perceived presence. We adopt a multidimensional conceptualization of presence, distinguishing between telepresence and social presence. Deviating from the virtual reality literature, we apply new frameworks for the conceptualization of the main determinants of presence (i.e., interactivity and vividness) that are more relevant to the virtual community context. An empirical study involving 149 members of a virtual community specializing in health issues provided strong support for our model. Vividness and interactivity are found to be significant determinants of both telepresence and social presence. While the role of vividness is more important for social presence, that of interactivity is more important for telepresence. All interactivity dimensions (i.e., active control, communication, and synchronicity) are found to be significant for telepresence. For social presence, however, synchronicity does not seem to be as important as the other interactivity dimensions. The theoretical and practical implications of these results are discussed.

Keywords: Interactivity, vividness, presence, telepresence, social presence, and virtual communities

Introduction

The core of humans' desire to use media is to break the limits of body and the sensory channels, thus the concept of presence has become one of the focuses in evolution of all media (Biocca et al. 1995). Although there is currently no clear consensus on how to define sense of presence, most researchers agree that presence describes a subjective perception of mediated interaction (Lombard and Ditton 1997; Stanney and Salvendy 1998). In the case of computer-mediated environments, most prior research focused on virtual reality applications, which are built specifically for the purpose of creating experiences with a high sense of presence (Davies 1995). Presence, in its different forms (i.e., telepresence, social presence), has been recognized as a significant factor in explaining user behavior and performance in virtual environments. Venkatesh and Johnson (2002), for example, report positive effects of telepresence and social richness (an important indicator of presence) on motivation, subsequently leading to increased systems usage. An enhanced sense of presence is central to the use, and, therefore, the effectiveness and profitability of new technologies (Draper et al. 1998; Lombard and Ditton 1997; Nash et al. 2000). Recent studies specifically examine the role of presence in Web-based applications. Telepresence is shown to be an important predictor of online consumers flow experience, contributing to increased participation, exploration, and positive attitude in navigating a website and resulting in enhanced learning (Li et al. 2002; Novak et al. 2000). Social presence, another dimension of presence, is reported to be a significant antecedent of perceived use of e-mail systems (Karahanna and Straub 1999).

Despite the importance of presence for user behavior and performance, we still lack a good understanding of the formation of sense of presence (Regenbrecht et al. 1998; Stanney and Salvendy 1998) in general and the role of system design in particular.

The purpose of this research is to address this void. More specifically, we examine the relationship between important system design characteristics and perceived presence. This study makes important theoretical and practical contributions. On the theoretical side, we draw upon a number of theories to develop a model explaining the effects of system characteristics on social presence and telepresence. We empirically test the model in the context of virtual communities. On the practical side, we identify important system features for presence formation and assess their relative importance, providing guidelines for system designers.

This paper is structured as follows. We first introduce a typology of presence, followed by a discussion of the relationship between system characteristics and presence. We then present the theoretical development and justify our research model. This is followed by a description of the empirical study and an interpretation of its results. We conclude the paper with a discussion of the implications, limitations, and future research directions.

Typology of Presence

The research on presence proliferates in many fields, such as computer science, psychology, virtual reality, and communication. However, the lack of a unified understanding and conceptualization makes it hard to successfully communicate among researchers from different disciplines (Lee 2004). For example, the conceptualization of “telepresence” in Steuer (1992) is similar to that of the broader construct of “presence” in Li et al. (2002). It is, therefore, necessary to define a topology of presence. This paper regards presence as an overarching concept (Lee 2004; Lombard and Ditton 1997), which is broadly defined as “the perceptual illusion of non-mediation” (Lombard and Ditton 1997). More specific conceptualizations can be derived from this overarching concept of presence. Lombard and Ditton (1997) identified six different types of virtual experience, highlighting the multidimensionality of presence. Ijsselsteijn et al. (2000) later collapsed these six types into two categories: physical and social presence. Physical presence refers to the sense of being located somewhere, while social presence relates to the feeling of being together. For mediated environments (e.g., TV, computer-based), the more specific term of telepresence is used for physical presence. Indeed, several researchers (Biocca et al. 2003; Heeter 1992) present presence as consisting of two interrelated dimensions: telepresence and social presence. Telepresence, also known as spatial presence or physical presence, describes the illusion of being physically present in the setting simulated by the medium (Lombard and Ditton 1997; Slater et al. 1994; Venkatesh and Johnson 2002). Social presence captures the sense of “being together with another” including primitive responses to social cues, simulations of ‘other’s minds’ and automatically generated models of the intentionality of others (Biocca et al. 2003).

Telepresence refers to a projection of human consciousness into a computer-mediated environment. It is defined as a mental state in which a user feels physically present within the computer-mediated environment (Draper et al. 1998; Kim and Biocca 1997; Sheriden 1992). Kim and Biocca (1997) show that telepresence experienced by TV viewers is associated with *arrival* and *departure* feelings. *Arrival* refers to the sensation of being in the virtual environment created by the medium, while *departure* describes the feeling of not being in the physical world.

Social presence is the degree to which the medium facilitates awareness of the other social actors and interpersonal relationships during the interaction (Fulk et al. 1990). It can also be defined as “the degree to which participants are able to project themselves affectively within the medium” (Garrison 1997). Earlier studies focused on socio-psychological constructs describing the extent of social presence felt by users, for instance, intimacy and immediacy (Biocca et al. 2003). The use of media with high social presence makes for greater intimacy (Short et al. 1976). Social presence is also a correlate of immediacy, a measure of psychological distance that a communicator puts between himself and the object of his communication and his addressee (Mehrabian and Russell 1974; Short et al. 1976). Some IS researchers used the socio-psychological perspective to argue that computer-mediated communication lacks non-verbal cues, therefore reducing intimacy and immediacy, and resulting in low social presence (Sia et al. 2002). However, the social information processing theory of mediated communication (Walther and Tidwell 1995) contends that, despite fewer cues, participants are still able to build interpersonal impressions, build mental models of their colleagues, and develop relationships marked by affective exchange, through the adaptation of their language behavior to fulfill the functions of missing nonverbal cues. Indeed, Internet users have developed a variety of paralanguages substituting or enriching the non-verbal cues (e.g., :) represents a smile). In addition, online relationships are developed similar to face-to-face situations, sometimes becoming more socially oriented (Walther 1993).

Although distinct, the constructs of telepresence and social presence are not mutually exclusive. In fact, the social cyberspace created by the Internet can induce both the feeling of social presence and that of telepresence. Venkatesh and Johnson (2002) found both types of presence to simultaneously exert significant effects on user motivation.

System Effects on Presence

Presence, as a subjective perception of the virtual environment, depends upon the objective nature of media, i.e., the technological characteristics (Short et al. 1976). Although the determinants of presence include task, individual, and system characteristics, the literature covers predominantly the system effects (Ijsselstein et al. 2000; Lombard and Ditton 1997; Nash et al. 2000). A possible explanation of the literature’s focus on technological characteristics of media is that system factors are controlled by designers, while other factors are accepted as given. Lombard and Ditton (1997) and Nash et al. (2000) provide comprehensive reviews of technological features influencing presence. Most prior studies adhere to Steuer’s (1992) conceptualization of these technological features into two constructs: interactivity and vividness. Interactivity is defined in terms of three dimensions: speed (update rate of the controls and displays), mapping (ability of a system to map its controls to changes in the mediated environment in a natural and predictable manner), and range (number of attributes of the mediated environment that can be manipulated, and the amount of variation possible within each attribute). Vividness, on the other hand, is defined in terms of sensory breadth (number of sensory dimensions simultaneously presented) and sensory depth (resolutions within each perceptual channel). Using this framework, several studies empirically investigated the effects of system characteristics on presence. Coyle and Thorson (2001), for example, conducted an experiment to investigate the effects of interactivity and vividness of marketing websites on telepresence. In their experiment, vividness is manipulated by adding audio or animation to the websites, while interactivity is manipulated by providing choice availability and mapping functions. Their empirical results show significant positive effects of these added website features on the development of a sense of telepresence. In another study, Li et al. (2002) use Steuer’s framework to compare 3-D and 2-D online product catalogs, stipulating 3-D websites to be stronger in both interactivity and vividness. Their results show that 3-D websites can elicit a higher level of telepresence.

Most prior studies investigated the effects of interactivity and vividness on telepresence in particular or presence in general without distinguishing between telepresence and social presence. Such a distinction, however, is very important, given that telepresence and social presence may affect the user attitude and behavior differently. Furthermore, Steuer’s framework, which was originally developed in the context of virtual reality, may not be directly applicable to web-based interactions. In virtual communities, most interactions are among users rather than between the users and a simulated world. Therefore, a different conceptualization of interactivity is required.

Theoretical Development

To develop a better understanding of the relationship between system characteristics and presence in the context of web-based interactions in general and virtual communities in particular, we distinguish between social presence and telepresence. Furthermore, we also adapt a more relevant framework for the operationalization of the interactivity and vividness constructs. In our research model (Figure 1), we conceptualize social presence and telepresence as separate constructs. We argue that they are distinct feelings that can be experienced with the same Web-based application. In fact, in the context of virtual community, the users may experience a higher level of social presence than telepresence. Our research model also identifies three dimensions of interactivity: active control, communication, and synchronicity. As for vividness, we opt for a holistic perspective, arguing that members of a virtual community are not as sensitive in distinguishing between sensory width and depth as the users of virtual reality. In the following sections, we define the interactivity and vividness constructs, present their conceptualization, and discuss their effects on social presence and telepresence.

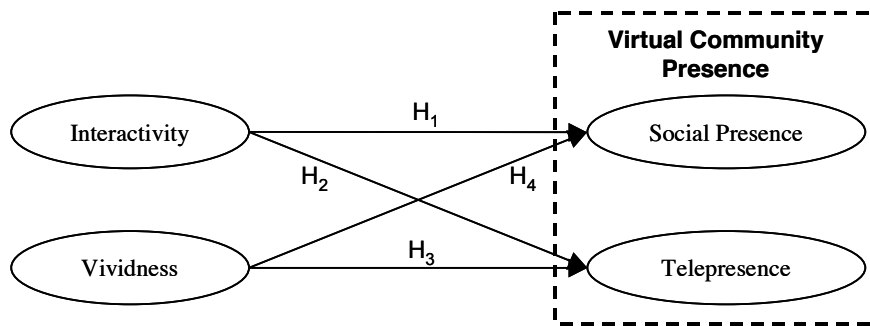


Figure 1. Theoretical Model

Interactivity

Interactivity is defined as the degree to which “users can participate in modifying the form and content of a mediated environment in real time” (Steuer 1992). The role of interactivity in the formation of a sense of presence has been primarily investigated in the context of virtual reality. The literature implicitly assumes or explicitly claims interactivity to be an important determinant of telepresence in virtual reality (Lombard and Ditton 1997). The positive relationship between interactivity and telepresence has also been verified in the context of Web-based applications such as Internet advertising (Coyle and Thorson 2001; Li et al. 2002). Furthermore, interactivity is believed to have a positive relationship with social presence (Williams and Rice 1983). Several studies provided empirical evidence for such a relationship. For example, Garramone et al. (1986) demonstrate that the degree of social presence felt with a bulletin board system is higher for more interactive users. Fortin and Dholakia (2003) empirically demonstrate that more interactive Internet ads evoke a greater sense of social presence. Based on the evidence presented earlier, we hypothesize that

H₁: Interactivity is positively related with social presence in virtual communities.

H₂: Interactivity is positively related with telepresence in virtual communities.

Steuer’s (1992) multidimensional conceptualization of interactivity (speed, range, and mapping) was originally developed for virtual reality. Such conceptualization emphasizes user-machine interaction and does not account for the interaction among users (Liu and Shrum 2002). It is, therefore, not appropriate for virtual communities, where the system not only operates as a social actor by itself, but also provides a social place for users to interact with each other (Biocca et al. 2003). We adopt a different conceptualization of interactivity that was developed by Liu and Shrum (2002) in the context of Internet advertising, identifying three dimensions: active control, communication, and synchronicity. Compared to the dimensions of Steuer, active control overlaps with range and mapping, while synchronicity is similar to speed. The new conceptualization adds a new dimension, communication, which we believe to be important for the virtual community context.

Active control is characterized by voluntary and instrumental action that directly influences the user’s experience. An interactive website enables participants to determine the material they examine and the pace with which they want to proceed (Kettanurak et al. 2001). Witmer and Singer (1998) suggest that the more control virtual reality users have over their actions, the higher the ensuing sense of presence in general. Welch et al. (1996) also demonstrate that the sense of telepresence is higher for virtual reality users who are in control of their own actions as compared to passive observers. Although there is a lack of research about the effects of active control on social presence, there is ample evidence on the relationship between social presence and interactivity in general and the relationship between active control specifically and other constructs related to social presence. Active control is reported to contribute to a sense of community (Ha and James 1998), increased sociability (Rafaeli and Sudweeks 1997), and feeling of connectedness (Bhatt 2004). Accordingly, we hypothesize that

H_{1a}: Active control is positively related with social presence in virtual communities.

H_{2a}: Active control is positively related with telepresence in virtual communities.

Communication refers to the ability for reciprocal message exchange (Ha and James 1998), including the degree of message relevance (Rafaeli 1989) and response contingency (Alba et al. 1997). In some literature, communication is also referred to as mutual discourse (Burgoon et al. 2000; Williams et al. 1988). With communication, a wide range of sensory information is conveyed from and to the mediated environment (Barfield and Weghorst 1993), facilitating seamless interaction and consequently enhancing the sense of telepresence (Nash et al. 2000). Compared with its effects on telepresence, the relationship of communication with social presence is more direct and salient. Communication compensates for the lack of non-verbal and temporal cues in virtual communities. In fact, Tidwell and Walther (2002) show that communication facilitates users to engage in selective self-representation and partner idealization, enacting exchanges more intimate than those of face-to-face counterparts. Based on the arguments presented earlier, we hypothesize that

H_{1b}: Communication is positively related with social presence in virtual communities.

H_{2b}: Communication is positively related with telepresence in virtual communities.

Synchronicity or speed of interaction refers to whether the communication takes place in real time (synchronous) or is delayed (asynchronous). Steuer claims that immediacy of response enables the mediated environment to enhance the sense of presence.

The virtual reality literature widely acknowledges the important role of speed in generating telepresence, and demonstrates that response latency as well as delay of virtual feedback degrades the sense of telepresence (Welch et al. 1996). Synchronicity also contributes to social presence through the enhancement of perceived immediacy. Immediacy of feedback has a positive effect on media richness and the enhanced richness in turn evokes more social presence (Trevino et al. 1987). In fact, Tu (2000) demonstrates that when an immediate response is expected but is not received the sense of social presence decreases.

H_{1c}: Synchronicity is positively related with social presence in virtual communities.

H_{2c}: Synchronicity is positively related with telepresence in virtual communities.

Vividness

Vividness refers to the representational richness of a mediated environment. Steuer conceptualizes vividness as a two-dimensional construct consisting of sensory width and sensory depth. Sensory width relates to the number of sensory dimensions simultaneously presented, and sensory depth describes the resolution within each of these perceptual channels. Such conceptualization is developed for virtual reality systems where sensory stimulations are rich and diversified. For virtual communities, however, the simultaneous use of multiple sensory channels is limited. Furthermore, users tend to form a general impression rather than focus on specific facets of sensory stimulations (Anderson and Bower 1980; Nisbett and Ross 1980). Therefore, even though sensory depth and sensory width can be distinguished conceptually, practically such a distinction is blurred for users. We consequently conceptualize vividness as a unidimensional construct. Recent operationalization of vividness in the IS literature also favored a unidimensional approach (e.g., Jiang and Benbasat 2003).

Vividness is often cited as an important determinant of presence (Lombard and Ditton 1997). The virtual reality studies focused on the effects of vividness on telepresence, demonstrating that the more vivid the stimulation provided by the medium, the greater is the resulting sense of telepresence (Lombard and Ditton 1997; Steuer 1992). Consistently, Bhatt (2004) shows that the vividness of a website enhances the user's engagement, an important indicator of telepresence. As for the marketing literature, several studies provide empirical evidence for a positive relationship between vividness and telepresence. For example, Coyle and Thorson (2001) reveal that media providing both audio and visual stimuli induce a greater sense of telepresence than those with audio only (or visual only). Li et al. (2002) also demonstrate that 3-D advertising elicits more telepresence than 2-D advertising. Therefore, we accordingly hypothesize that

H₃: Vividness is positively related with telepresence in virtual communities.

As for social presence, the effects of vividness are twofold. First, by providing sensory information about facial expression, posture, dress, and other non-verbal cues, vividness strengthens the intimacy and immediacy between communicators, consequently evoking the sense of social presence (Short et al. 1976). Second, by presenting consistent and accurate stimulations, vividness facilitates the development of trust toward the website and other participants, making the interactions less artificial and more social (Lombard and Ditton 1997; Stein and Meredith 1993). Consistently, we hypothesize that

H₄: Vividness is positively related with social presence in virtual communities.

In our research model, we did not include any relationship between telepresence and social presence, as there is no theoretical justification of such a relationship. Furthermore, most studies that considered telepresence and social presence did not hypothesize a relationship between the two constructs. One of very few exceptions is Choi et al. (2001). Although their empirical results show a significant positive effect of telepresence on social presence, the relationship is not theoretically justified. Like Slater et al. (2000), we consider telepresence and social presence as orthogonal. Any possible relationship between the two constructs is mainly due to the underlying common factors.

Methodology

To test our research model, we conducted a Web-based survey with the members of a virtual community specializing in health issues. The community counts over 30,000 registered members, with an average participation rate of 200 users per day generating about 2,000 contributions. The members are heterogeneous in demographics and interests (over 20 different themes). The community is supported by a knowledge portal providing a wealth of information on various health-related topics and a variety

Table 1. Demographics of Respondents

Demographics		Percent
Gender	Male	70.5
	Female	29.5
Education	High school certificate	20.2
	Undergraduate Degree	55.0
	Postgraduate/higher degree	24.8
Familiarity with Internet	Less than one year	5.0
	1-2 years	9.0
	3-4 years	49.0
	More than 4 years	37.0
Frequency of Login	At least once a month	2.6
	At least once a week	47.0
	At least once a day	50.4
Familiarity with the Virtual Community	Not at all (new users)	1.3
	A little	26.2
	Familiar	45.0
	Very familiar	27.5

of online discussion forums. The content of the portal is mainly contributed by the members. The main functions of the system include browsing, searching, exchanging multimedia files, synchronous and asynchronous discussion forums, and voting. Members can attach animated icons (e.g., facial expressions) to better express their feelings, as well as audio and video to enrich their exchanges.

We obtained the permission of the management of the virtual community to post a link to our online questionnaire for three days, promising to share the results of the survey with them. A total of 149 participants completed the survey. The demographics of these respondents are shown in Table 1.

Measurement

We relied on validated reflective measures for vividness, social presence and telepresence, and on formative measures for interactivity. With reflective items, the underlying latent construct causes the observed variation in the measures (Bollen 1989), implying the covariation of items and assuming the direction of causality to be from the latent variable to its measures. The items are congeneric indicators tapping into a latent first-order factor. In contrast, formative measurement assumes causality flowing from the measures to the latent construct, where the indicators jointly determine the conceptual and empirical meaning of the construct (Bollen 1989). The items form the emergent first-order factor. The use of formative measurement items for interactivity enables the assessment of the significance and relative importance of the three interactivity dimensions: active control, communication and synchronicity.

We used a semantic differential scale in the form of a slider to record the respondents’ answers. The slider is a graphical scale with anchors at both ends (e.g., very abstract—very concrete). With a resolution ranging from 1 to 100, the slider provides 100 scale steps. According to numerous psychometric studies, the reliability of individual rating scales is a monotonically increasing function of the number of steps (Nunnally 1978). Graphical scales are reported to be superior to numeric scales since people usually think of quantities as represented by degrees of physical extensions (e.g., the yardstick). Graphical scales also convey the idea of a rating continuum and lessen clerical errors in making ratings (Nunnally 1978).

For vividness, we used the visual vividness imagery questionnaire developed by Marks (1973). It is a widely used instrument with high reliability and validity (Campos et al. 2002), involving seven bipolar items such as abstract—concrete and confusing—clear.

For social presence, we adapted the instrument developed by Short et al. (1976) and validated by several studies (Biocca et al. 2003; Venkatesh and Johnson 2002). The instrument consists of bipolar items such as social—unsocial, sensitive—insensitive, and warm—cold. As for the measurement of telepresence, we adapted the arrival and departure instrument developed by Kim and Biocca (1997) and validated by several studies (Coyle and Thorson 2001; Novak et al. 2000; Venkatesh and Johnson 2002). A sample item is rating on a scale ranging from never happens to always happens the statement, “While I was in this website, my body was in the room, but my mind was inside the world created by the website. As for interactivity, the formative measurement includes three items representing the three dimensions of this construct (i.e., active control, communication, and synchronicity). These items were adapted from instruments developed by Liu (2003) and McMillan and Huang (2002).

Data Analysis

The analysis of the data was done in a holistic manner using partial least squares procedure (PLS) because it allows for the simultaneous usage of reflective and formative measurements and is able to model latent constructs under conditions of non-normality and small to medium sample sizes (Chin et al. 2003). We conducted tests of significance for all paths using the bootstrap resampling procedure (Cotteman and Senn 1992) and the standard approach for evaluation that requires path loadings from construct to measures to exceed 0.70. For checking internal consistency, we relied on composite reliability measures (ρ) as suggested by Chin (1998) and on the average variance extracted (AVE) as suggested by Fornell and Larcker (1987). We tested the discriminant validity by comparing the square root of the AVE for a particular construct to its correlations with the other constructs (Fornell and Larcker 1987) and by examining cross-loadings of the constructs.

Results and Discussion

We performed several tests on the measurement model to examine its validity and reliability. Table 2 presents the loadings of the reflective measures to their respective constructs along with composite reliability scores, standard errors, and t-statistics. It also includes the weights of the formative items, which will be discussed further in the interpretation of the structural model. All reflective items are significant at the 99 percent level with high loadings (all above 0.70 and most above 0.80), therefore demonstrating convergent validity. The only relatively low loading is that of item 3 of social presence. However, it still passes the minimum threshold of 0.5 recommended by Fornell and Larcker (1987). The composite reliability scores (ρ) of all latent constructs are higher than the recommended value of 0.80 (Nunnally 1978), demonstrating internal consistency.

Table 3 presents the discriminant validity statistics. The square roots of the AVE scores (diagonal elements of Table 3) are all higher than the correlations among the constructs, demonstrating discriminant validity. Furthermore, all items loaded higher on their respective constructs than on others, providing additional support for discriminant validity.

Figure 2 presents the results of the PLS analysis of the structural model, including the overall explanatory power (R^2) and path coefficients (for relationships between latent variables). The model explains 42.4 percent of the variance of social presence and 29.8 percent of the variance of telepresence. A plausible explanation of this difference in explanatory power is that virtual communities are designed with the purpose of extending social interaction to the virtual world. Therefore, the system design features of virtual communities may favor social presence over telepresence. These results provide strong support for our argument of distinguishing between telepresence and social presence. Prior research investigating the relationship between system features and presence mainly focused on telepresence, as this particular conceptualization of presence is perhaps more salient for virtual reality. For other types of applications in general and virtual communities in particular, the conceptualization of presence should include social presence as well.

All path coefficients of interactivity and vividness are significant at the 99 percent level, providing strong support for the research model and verifying the hypothesized positive effects of interactivity and vividness on both social presence (H_1, H_3) and telepresence (H_2, H_4). Vividness (.467) is found to be relatively more important than interactivity (.235) in the formation of a sense of social presence. A possible interpretation of this result is that social presence is more dependent on the representational richness of the mediated environment, for example, ability to transmit social cues and resolve equivocality (Rice 1992). As for telepresence, interactivity (.352) seems to be slightly more important than vividness (.290). This finding is different from the results reported in prior studies (Lombard and Ditton 1997), which indicate the primacy of vividness in eliciting telepresence in virtual reality. A possible explanation is that the vividness features of virtual communities focus on stimulating the senses that facilitate the awareness of social actors rather than those senses that evoke the illusion of stepping into a simulated world. The primacy of vividness is, therefore, verified for social presence but not for telepresence.

Table2. Measurement Model

Construct	Items	Loadings	Weights	Std. Error	T-Statistics
Social Presence $\rho = 0.818$	Item1	0.8969		0.0209	42.9518
	Item2	0.8581		0.0440	19.4937
	Item3	0.5365		0.1298	4.1323
Telepresence $\rho = 0.825$	Item1	0.8712		0.0301	28.9858
	Item2	0.7658		0.0625	12.2557
	Item3	0.7015		0.0815	8.6059
Vividness $\rho = 0.944$	Item1	0.8312		0.0339	24.5532
	Item2	0.8828		0.0283	31.2192
	Item3	0.8032		0.0546	14.7212
	Item4	0.8142		0.0572	14.2289
	Item5	0.7436		0.0630	11.7962
	Item6	0.8867		0.0270	32.7932
	Item7	0.9124		0.0177	51.5473
Formative Measures for Interactivity	Active Control		0.4995	0.2371	2.1070
	Communication		0.5880	0.1902	2.7727
	Synchronicity		0.3766	0.2371	2.1070

Table3. Correlations between Latent Constructs
(Diagonal Elements are Square Roots of the AVE)

	Dependent Variable: Social Presence		
	SP	TP	VI
Social Presence (SP)	0.78		
Telepresence (TP)	0.38	0.78	
Vividness (VI)	0.60	0.42	0.84

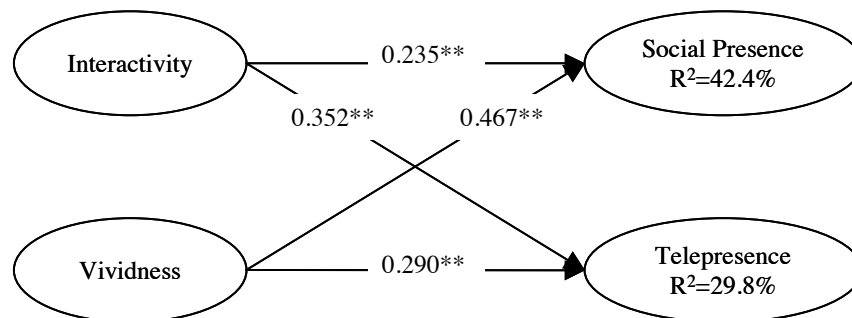


Figure 2. Structural Model

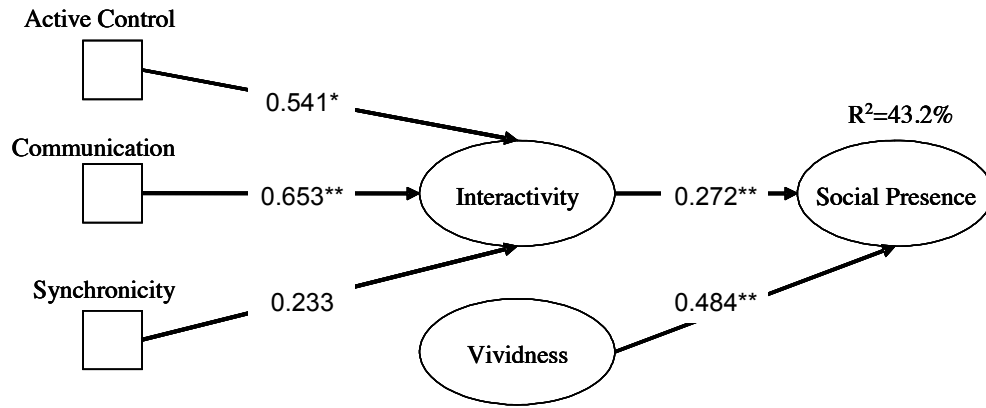


Figure 3. Structural Model for Social Presence

Although we did not hypothesize a relationship between telepresence and social presence, we nevertheless tested for it. We did not find any significant causal relationship. These results support our earlier argument that telepresence and social presence are orthogonal and any possible relationship between the two constructs is mainly due to the underlying common factors. Having tested the model in a holistic manner, we run additional analyses for social presence and telepresence separately in order to have a more accurate interpretation of the weights of the formative items measuring interactivity. The results are reported in Figure 3 for social presence and Figure 4 for telepresence.

An analysis of the weights of the formative items of interactivity reveals that the magnitude and significance of the effects of each interactivity dimension varies for different types of presence. The communication dimension of interactivity is found to be significant in evoking both types of presence, with a weight of 0.653 for social presence and 0.518 for telepresence, verifying hypotheses H_{1b} and H_{2b} . This finding emphasizes the role of communication features in the development of telepresence and social presence in virtual communities. Through communication, users become aware of other social actors (Rheingold 1993) and build virtual relationships with the system and with other users (Hagel and Armstrong 1997). Active control is also found to be significant for social presence with a weight of 0.541 and for telepresence with a weight of 0.44, confirming hypotheses H_{1a} and H_{2a} . Users with greater control over their actions tend to be more immersed in the mediated experience and therefore develop a stronger sense of telepresence. Furthermore, greater user control reduces communication barriers and encourages active and effective participation, therefore facilitating the projection of oneself and the awareness of other social actors. Different from active control and communication, synchronicity is significant for telepresence only, confirming hypothesis H_{2c} but not H_{1c} . With a significant weight of 0.512, synchronicity has a positive effect on telepresence, implying that the user is more likely to be immersed in the virtual community (having the illusion of being there) with speedy feedback and synchronous interactions. The lack of significance of the effect of synchronicity on social presence suggests that the immediacy resulting from speedy interactions does not add sufficient media richness to significantly enhance interpersonal relationships. The synchronicity of interactions does not seem to contribute significantly to form a sense of social presence, but is essential for telepresence.

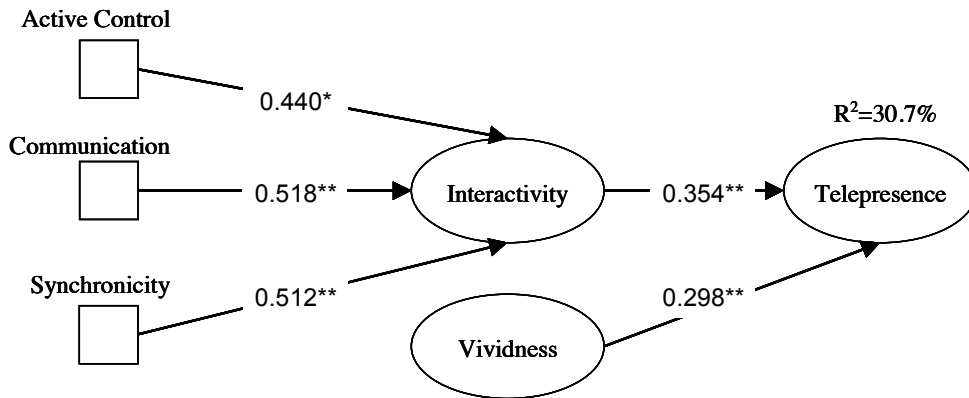


Figure 4. Structural Model for Telepresence

Conclusion

Prior research on the relationship between system characteristics and presence investigated specific system features in isolation and seldom distinguished between different types of presence. Furthermore, most of these studies were conducted in the virtual reality environment, providing little evidence of the generalizability of the results to other contexts. In this research, we develop a more comprehensive model for explaining the relationships between system characteristics and presence and empirically validate the model in the virtual community context. We distinguish between two different types of presence: telepresence and social presence. Such a distinction is very important, given that telepresence and social presence may affect the user's attitude and behavior differently. Furthermore, we also adapt a more relevant framework for the conceptualization of the main determinants of presence (i.e., interactivity and vividness). Deviating from the virtual reality literature, we identify three dimensions of interactivity (active control, communication, and synchronicity), attesting their better fit to the virtual community context. As for vividness, we opt for a holistic perspective, arguing that members of a virtual community are not as sensitive in distinguishing between sensory width and depth as the users of virtual reality.

The results of our study present significant theoretical and practical contributions. They confirm the multidimensionality of users' sense of presence. They also provide evidence for the change in significance and relative importance of the effects of system characteristics depending on the type of presence under consideration. Vividness and interactivity are found to be significant determinants of both telepresence and social presence. However, while the role of vividness is more important for social presence, that of interactivity is more important for telepresence. From a theoretical point of view, these results highlight the importance of the conceptual distinction between telepresence and social presence and the necessity of the simultaneous consideration of these two types of presence. As for the practical implication for system designers, the results provide a clearer guideline regarding which particular type of features (vividness vs interactivity features) to emphasize depending on their prioritization of the different types of presence. All interactivity dimensions (active control, communication, and synchronicity) are found to be significant for telepresence. For social presence, however, synchronicity does not seem to be as important as the other interactivity dimensions. These results support the theoretical distinction between different interactivity dimensions. They also have practical implications. A consequent guideline for system designers is that the immediacy of interactions is not as critical as their richness for evoking a sense of social presence. The results also shed some light on the consequences of critical mass or lack of it. Virtual communities provide for both synchronous and asynchronous interactions. Synchronous interactions, however, require a critical mass (sufficient number of simultaneous users). The lack of critical mass reduces synchronicity, hampering the formation of telepresence, but does not affect much social presence, as synchronicity does not prove vital for social presence.

In the context of virtual communities, our model has a better explanatory power for social presence than for telepresence. A possible explanation is that virtual communities are designed with the purpose of extending social interactions to the computer-mediated environment. In such a case, the system design may inherently favor social presence over telepresence. In future research, the model should be tested in different contexts where social presence is not necessarily dominant. This would provide a better understanding of the model's generalizability. Furthermore, the effects of system characteristics on presence may vary from individual to individual depending on personality traits. Therefore, future research may investigate the interaction between user characteristics and system characteristics. Finally, prior research examined the effects of presence on the user's attitude and behavior. Our study provides a better understanding of the effects of system characteristics on presence. Future research should provide a more integrative perspective through the examination of the relationships between system characteristics and the user's attitudes and behavior, as mediated by telepresence and social presence.

References

- Alba, J., Lynch, J., Weitz, B., Janiszewski, C., Lutz, R., Sawyer, A., and Wood, S. "Interactive Home Shopping: Consumer, Retailer, and Manufacturer Incentive to Participate in Electronic Marketplaces," *Journal of Marketing* (61:3), 1997, pp. 38-53.
- Anderson, J., and Bower, G. *Human Associative Memory*, V. H. Winston, Washington, DC, 1980.
- Barfield, W., and Weghorst, S. "The Sense of Presence Within Virtual Environments: A Conceptual Framework," in *Human Computer Interaction: Software and Hardware Interfaces*, G. Salvendy and M. D. Smith (Eds.), Elsevier, Amsterdam, 1993, pp. 699-704.
- Bhatt, G. "Bringing Virtual Reality for Commercial Web Sites," *International Journal of Human-Computer Studies* (60), 2004, pp. 1-15.
- Biocca, F., Harms, C., and Burgoon, J. K. "Toward a More Robust Theory and Measure of Social Presence: Review and Suggested Criteria," *Presence* (12:5), 2003, pp. 456-480.

- Biocca, F., Kim, T., and Levy, M. R. "The Vision of Virtual Reality," in *Communication in the Age of Virtual Reality*, F. Biocca and M. R. Levy (Eds.), Lawrence Erlbaum Associates Inc., Hillsdale, NJ, 1995, pp. 3-14.
- Bollen, K. *Structural Equations with Latent Variables*, Wiley, New York, 1989.
- Burgoon, J. K., Bonito, J. A., Bengtsson, B., Ramirez, J. A., Dunbar, N. E., and Miczo, N. "Testing the Interactivity Model: Communication Processes, Partner Assessments, and the Quality of Collaborative Work," *Journal of Management Information Systems* (16:3), 2000, pp. 33-56.
- Campos, A., Gonzalez, M. A., and Amor, A. "The Spanish Version of the Vividness of Visual Imagery Questionnaire: Factor Structure and Internal Consistency Reliability," *Psychological Reports* (90:2), 2002, pp. 503-506.
- Chin, W. W. "The Partial Least Squares Approach for Structural Equation Modeling," in *Modern Methods for Business Research*, G. A. Marcoulides (Ed.), Lawrence Erlbaum, Mahwah, NJ, 1998, pp. 295-336.
- Chin, W. W., Marcolin, B. L., and Newsted, P. R. "A Partial Least Squares Latent Variable Modeling Approach for Measuring Interaction Effects: Results from a Monte Carlo Simulation Study and an Electronic-Mail Emotion/Adoption Study," *Information Systems Research* (14:2), 2003, pp. 189-217.
- Choi, Y. K., Miracle, G.E., and Biocca, F. "The Effects of Anthropomorphic Agents on Advertising Effectiveness and the Mediating Role of Presence," *Journal of Interactive Advertising* (2:1), 2001 (available online at <http://www.jiad.org/vol2/no1/choi/>).
- Cotteman, W., and Senn, J. *Challenges and Strategies for Research in Systems Development*, Wiley, Chichester, England, 1992.
- Coyle, J. R., and Thorson, E. "The Effects of Progressive Levels of Interactivity and Vividness in Web Marketing Sites," *Journal of Advertising* (30:3), 2001, pp. 65-77.
- Davies, C. "Osmose Notes on 'Being' in Immersive Virtual Space," paper presented at of the Sixth International Symposium on Electronic Arts, Montreal, Canada, 1995.
- Draper, J. V., Kaber, D. B., and Usher, J. M. "Telepresence," *Human Factors* (40:3), 1998, pp. 354-375.
- Fornell, C., and Larcker, D. "A Second Generation of Multivariate Analysis: Classification of Methods and Implications for Marketing Research," in *Review of Marketing*, M. J. Houston (Ed.), American Marketing Association, Chicago, 1987, pp. 407-450.
- Fortin, D. R., and Dholakia, R. R. "Interactivity and Vividness Effects on Social Presence and Involvement with a Web-based Advertisement," *Journal of Business Research*, 2003 (forthcoming) (available online through www.sciencedirect.com).
- Fulk, J., Schemitz, J., and Steinfield, C. "A Social Influence Model of Technology Use," in *Organizations and Communication Technology*, J. Fulk and C. Steinfeld (Eds.), Sage, Newbury Park, CA, 1990, pp. 117-142.
- Garramone, G. M., Harris, A. C., and Anderson, R. "Uses of Political Computer Bulletin Boards," *Journal of Broadcasting & Electronic Media* (30:3), 1986, pp. 325-339.
- Garrison, D. R. "Computer Conferencing and Distance Education: Cognitive and Social Presence Issues," in *The New Learning Environment: A Global Perspective, Proceedings of the International Council for Distance Education World Conference*, S. Virkus (Ed.), Pennsylvania State University, Pittsburgh, PA, 1997.
- Ha, L., and James, E. L. "Interactivity Reexamined: A Baseline Analysis of Early Business Web Sites," *Journal of Broadcasting & Electronic Media* (42:4), 1998, pp. 457-474.
- Hagel III, J., and Armstrong, A. *Net Gains: Expanding Markets Through Virtual Communities*, Harvard Business School Press, Cambridge, MA, 1997.
- Heeter, C. "Being There: The Subjective Experience of Presence," *Presence* (1:2), 1992, pp. 262-271.
- Ijsselstein, W. A., de Ridder, H., Freeman, J., and Avons, S. E. "Presence: Concept, Determinants and Measurement," in *Proceedings of the SPIE: Human Vision and Electronic Imaging V*, International Society for Optical Engineering, San Jose, CA, 2000, pp. 3959-3976.
- Jiang, Z., and Benbasat, I. "The Effects of Interactivity and Vividness of Functional Control in Changing Web Consumers' Attitudes," in *Proceedings of the Twenty-Fourth International Conference on Information Systems*, S. T. March, A. Massey, and J. I. DeGross (Eds.), Seattle, WA, 2003, pp. 960-967.
- Karahanna, E., and Straub, D. W. "The Psychological Origins of Perceived Usefulness and Ease-of-Use," *Information & Management* (35:4), 1999, pp. 237-250.
- Kettanurak, V., Ramamurthy, K., and Haseman, W. D. "User Attitude as a Mediator of Learning Performance Improvement in an Interactive Multimedia Environment: An Empirical Investigation of the Degree of Interactivity and Learning Styles," *International Journal of Human-Computer Studies* (54:4), 2001, pp. 541-583.
- Kim, T., and Biocca, F. "Telepresence via Television: Two Dimensions of Telepresence may Have Different Connections to Memory and Persuasion," *Journal of Computer Mediated Communication* (3:2), 1997.
- Lee, K. M. "Presence, Explicated," *Communication Theory* (14:1), 2004, pp. 27-50.
- Li, H., Daugherty, T., and Biocca, F. "Impact of 3-D Advertising on Product Knowledge, Brand Attitude, and Purchase Intention: The Mediating Role of Presence," *Journal of Advertising* (31:3), 2002, pp. 43-57.
- Liu, Y. "Developing a Scale to Measure the Interactivity of Websites," *Journal of Advertising Research* (43:2), June 2003, pp. 207-216.
- Liu, Y., and Shrum, L. J. "What Is Interactivity and Is it Always Such a Good Thing? Implications of Definition, Person, and Situation for the Influence of Interactivity on Advertising Effectiveness," *Journal of Advertising* (31:4), 2002, pp. 53-64.

- Lombard, M., and Ditton, T. "At the Heart of It All: The Concept of Presence," *Journal of Computer Mediated Communication* (3:2), 1997.
- Marks, D. F. "Visual Imagery Differences in the Recall of Pictures," *British Journal of Psychology* (64:1), 1973, pp. 17-24.
- McMillan, S. J., and Huang, J. S. "Measures of Perceived Interactivity: An Exploration of the Role of Direction of Communication, User Control, and Time in Shaping Perceptions of Interactivity," *Journal of Advertising* (31:3), 2002, pp. 29-42.
- Mehrabian, A., and Russell, J. A. *An Approach to Environmental Psychology*, MIT Press, Cambridge, MA, 1974.
- Nash, E. B., Edwards, G. W., Thompson, J. A., and Barfield, W. "A Review of Presence and Performance in Virtual Environments," *International Journal of Human-Computer Studies* (12:1), 2000, pp. 1-41.
- Nisbett, R., and Ross, L. *Human Inference: Strategies and Shortcomings of Social Judgment*, Prentice-Hall, Inc., Englewood Cliffs, NJ, 1980.
- Novak, T. P., Hoffman, D. L., and Yung, Y. "Measuring the Customer Experience in Online Environments: A Structural Modeling Approach," *Marketing Science* (19:1), 2000, pp. 22-42.
- Nunnally, J. C. *Psychometric Theory*, McGraw Hill, New York, 1978.
- Rafaeli, S. "Interactivity: From New Media to Communication," in *Advancing Communication Science: Merging Mass and Interpersonal Processes*, R. P. Hawkins, J. M. Wieman, and S. Pingree (Eds.), Sage Publications, Newbury Park, CA, 1989, pp. 110-134.
- Rafaeli, S., and Sudweeks, F. "Networked Interactivity," *Journal of Computer-Mediated Communication* (2:4), 1997 (available online at <http://www.ascusc.org/jcmc/vol2/issue4>).
- Regenbrecht, H. T., Schubert, T. W., and Friedmann, F. "Measuring the Sense of Presence and its Relations to Fear of Heights in Virtual Environments," *International Journal of Human-Computer Studies* (10:3), 1998, pp. 233-249.
- Rheingold, H. *The Virtual Community: Homesteading on the Electronic Frontier*, Addison Wesley, Reading, MA, 1993.
- Rice, R. E. "Task Analyzability, Use of New Media, and Effectiveness: A Multi-site Exploration of Media Richness," *Organization Science* (3:4), 1992, pp. 475-500.
- Sheriden, T. B. "Musings on Telepresence and Virtual Presence," *Presence* (1:1), 1992, pp. 120-126.
- Short, J., Williams, E., and Christie, B. *The Social Psychology of Telecommunications*, Wiley, London, 1976.
- Sia, C. L., Tan, B. C. Y., and Wei, K. K. "Group Polarization and Computer-Mediated Communication: Effects of Communication Cues, Social Presence, and Anonymity," *Information Systems Research* (13:1), 2002, pp. 70-90.
- Slater, M., Sadagic, A., Usoh, M., and Schroeder, R. "Small-Group Behavior in a Virtual and Real Environment: A Comparative Study," *Presence* (9:1), 2000, pp. 37-51.
- Slater, M., Usoh, M., and Steed, A. "Depth of Presence in Virtual Environment," *Presence* (3:2), 1994, pp. 130-144.
- Stanney, K., and Salvendy, G. "Aftereffects and Sense of Presence in Virtual Environments: Formulation of a Research and Development Agenda," *International Journal of Human-Computer Studies* (10:2), 1998, pp. 135-187.
- Stein, B. E., and Meredith, M. A. *The Merging of Senses*, MIT Press, Cambridge, MA, 1993.
- Steuer, J. "Defining Virtual Reality: Dimensions Determining Telepresence," *Journal of Communication* (42:4), 1992, pp. 73-93.
- Tidwell, L. C., and Walther, J. B. "Computer-Mediated Communication Effects on Disclosure, Impressions, and Interpersonal Evaluations: Getting to Know One Another a Bit at a Time," *Human Communication Research* (28:3), 2002, pp. 317-348.
- Trevino, L. K., Lengel, R., and Daft, R. L. "Media Symbolism, Media Richness, and Media Choice in Organization: A Symbolic Interactionist Perspective," *Communication Research* (14:5), 1987, pp. 553-574.
- Tu, C. H. "On-line Learning Migration: from Social Learning Theory to Social Presence Theory in a CMC Environment," *Journal of Network and Computer Applications* (23), 2000, pp. 27-37.
- Venkatesh, V., and Johnson, P. "Telecommuting Technology Implementations: A Within- and Between- Subjects Longitudinal Field Study," *Personnel Psychology* (55:3), 2002, pp. 661-687.
- Walther, J. B. "Impression Development in Computer Mediated Interaction," *Western Journal of Communication* (57), 1993, pp. 381-398.
- Walther, J. B., and Tidwell, L. C. "Nonverbal Cues in Computer-Mediated Communication, and the Effect of Chronemics on Relational Communication," *Journal of Organizational Computing* (5), 1995, pp. 355-378.
- Welch, R. B., Blackmon, T. T., Liu, A., Meller, B. A., and Stark, L. W. "The Effects of Pictorial Realism, Delay of Visual Feedback, and Observer Interactivity on the Subjective Sense of Presence," *Presence* (5:3), 1996, pp. 263-273.
- Williams, F., and Rice, R. E. "Communication Research and the New Media Technologies," in *Communication Yearbook 7*, R. N. Bostrom (Ed.), Sage Publications, Beverly Hills, CA, 1983, pp. 200-224.
- Williams, F., Rice, R. E., and Rogers, E. M. *Research Methods and the New Media*, Free Press, New York, 1988.
- Witmer, B. G., and Singer, M. J. "Measuring Presence in Virtual Environments: A Presence Questionnaire," *Presence* (7:3), 1998, pp. 225-240.